Introduction to JUNO Distributed Computing

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On behalf of JUNO DCI group

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Based on Xiaomei Zhang slides
Content

- Why need Distributed Computing Infrastructure (DCI)?
- How does DCI work?
- General rule to use DCI
Why need distributed computing?

- JUNO is an international experiment, and resources are provided from several data centers around the world
  - IN2P3, IHEP, JINR, CNAF, SDU……
- How to use resources in these distributed data centers?
- How to access and share data among these distributed data centers?

<table>
<thead>
<tr>
<th>Site</th>
<th>SiteType</th>
<th>MaskStatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRID.IN2P3.fr</td>
<td>GRID</td>
<td>Active</td>
</tr>
<tr>
<td>CLUSTER.SDU.cn</td>
<td>CLUSTER</td>
<td>Active</td>
</tr>
<tr>
<td>CLOUD.IHEP.CLOUD.cn</td>
<td>CLOUD</td>
<td>Active</td>
</tr>
<tr>
<td>GRID.IHEP.cn</td>
<td>GRID</td>
<td>Active</td>
</tr>
<tr>
<td>CLOUD.INFN-PADOVAN...</td>
<td>CLOUD</td>
<td>Active</td>
</tr>
<tr>
<td>GRID.JINR-CONDOR.ru</td>
<td>GRID</td>
<td>Active</td>
</tr>
<tr>
<td>GRID.INFN-CNAF.it</td>
<td>GRID</td>
<td>Active</td>
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</table>
DCI (Distributed Computing Infrastructure) provides solutions

DCI is a system which can integrate heterogeneous resources, hide complexity from users, and provide a simple way for users to use distributed resources with:

- Global “ID” to identify each user
- Unique interface for job submission and data access

This tutorial is going to tell you how to get global “ID” and how to use the interface
DCI vs. local cluster

- Similar procedure
  - Need authentication to tell the system who you are
    - DCI: “ID” (proxy certificate) ; Cluster: Account/password
  - Interface or commands to submit jobs or access data
    - Jobs: JSUB vs. Hep_Sub, Data: DFC vs. local
  - Access JUNO software from CVMFS

- Differences in interface or commands
  - In DCI, jobs are running in remote resources
  - In DCI, data is accessed from remote storage
How does DCI accept you?

- **Global authority and authentication system in DCI**
  - User “ID” (proxy certificate) which consists of “X509 cert info” + “VOMS info”
    - X509 certificate – user identify info
    - VOMS – the experiment (VO) users belong to
  - All the systems and services in DCI can identify “ID” and do translations between “ID” and local accounts
How does DCI run your jobs?

- **JSUB and Production System (ProdSys)**
  - Provide **interface** for physicist user or prod groups to split and submit tasks to DCI

- **DIRAC**
  - **Interware** between jobs and resources
  - Interface with local schedulers in each sites
  - Receive jobs and schedule jobs to proper resources with pilot scheme

- **Resource in sites**
  - Jobs reach and run in work nodes just as local computing do
How do you use data in DCI?

- In distributed computing environment, data is located in different data centers
  - Data can’t be accessed locally
- **Dirac File Catalogue (DFC)**
  - Interface with different SEs
  - Provide a global view and an *interface* to access remote data in a way similar to local data
  - With LFN, data locations are transparent to users
- **SE (Storage Element)**
  - File system where data is stored, with grid protocols for data movements between SEs
  - Same files can have copies in > 1 SE
  - Normally users don’t need to directly visit SE
- **FTS (File Transfer System)**
  - Help massive data replication between SEs
Resources in JUNO distributed computing

- Current total CPU cores ~3000 cores, storage ~3PB
- Resources continue to grow

<table>
<thead>
<tr>
<th>Sites</th>
<th>CPU (cores)</th>
<th>Storage (TB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNAF</td>
<td>400</td>
<td>620</td>
</tr>
<tr>
<td>IN2P3</td>
<td>210</td>
<td>44</td>
</tr>
<tr>
<td>JINR</td>
<td>2000</td>
<td>600</td>
</tr>
<tr>
<td>IHEP</td>
<td>560</td>
<td>2000</td>
</tr>
<tr>
<td>Padovana</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>SDU</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3270</strong></td>
<td><strong>3264</strong></td>
</tr>
</tbody>
</table>
Official and individual usage

- Two user cases with different tools and interface
  - Official production uses ProdSys (Production System)
    - MC production need to share among groups or across different data centers
    - Larger scale, standard pattern, need more storage space
  - Individual usage uses JSUB
    - Individual simulation, reconstruction or analysis
    - Small scale, more flexible, can be customized
- All output is available via DFC
- In some sites such as IHEP, output available in your local cluster might also be directly accessible without DCI credentials
How to prepare DCI environment?

- Before using JSUB or Prod system and accessing DFC, DCI client environment is needed.

- The DCI client is available in IHEP CVMFS (/cvmfs/dcomputing.ihep.ac.cn) *(Recommended)*
  - In login nodes with CVMFS clients installed, you can directly set up DCI environment
    - source /cvmfs/dcomputing.ihep.ac.cn/dirac/IHEPDIRAC/v0r2-dev11/bashrc
- Another way is to install DCI client in your own machine
  - The install script is available to download from this link:
    - [http://dirac-code.ihep.ac.cn/juno/install/installJUNODIRAC.sh](http://dirac-code.ihep.ac.cn/juno/install/installJUNODIRAC.sh)
How to apply official production?

- Official production is taken care by production group or DCI group
  - Need space negotiation and resource priority
- User can apply productions in IHEP Gitlab
  - Create a Gitlab issue (http://code.ihep.ac.cn/vpj/scripts/-/issues)
  - User can provide production requirements, physics parameters, total event size, data centers to share data, etc
  - Any problems, contact production group or distributed computing group

```bash
#!/bin/bash
source /cvmfs/juno.ihep.ac.cn/centos7_amd64_gcc830/Pre-Release/J20v2r0-Pre2/setup.sh
python $TUTORIALROOT/share/tut_detsim.py --no-gdml --evtmax 25 --seed 774 --output Atmo-detsim-l.root --user-output
python $TUTORIALROOT/share/tut_dets2elec.py --input Atmo-detsim-l.root --output Atmo-elecsim-l.root --user-output
python $TUTORIALROOT/share/tut_elec2calib.py --evtmax -1 --input Atmo-elecsim-l.root --output Atmo-calib-l.root
```

The CNAF files are in
/scratch/gpfs_data/juno/junofs/production/public/users/sgiulio/GENIEv3_09_06/gstroot/atmo_numu_nue_LS_0-30GeV_flat_10M.gst.root
Procedure for individual users

- Get Grid Certificate and join JUNO VO
- Set up DCI environment and prepare proxy with cert
- Use JSUB to create and submit jobs to the DCI
- Check job status from JSUB or DIRAC web portal
- Output is available from DFC

This tutorial will focus on how use DCI for a single researcher
Arguments covered

- Prerequisites
  - How to apply X509 cert and join JUNO VOMS membership

- Job submission
  - How to create and submit jobs with JSUB

- Data usage
  - How to deal with data in DCI environment
Contact

- Any problems, please contact us:
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