GSDC: Datacenter for Data-intensive Research

Ahn Sang-Un for KISTI-GSDC
“e-Science Activities in Korea” @ ISGC2021
KISTI
Korea Institute of Science and Technology Information

- Government-funded research institute founded in 1962 for National Information Services and Supercomputing

- National Supercomputing Center
  - Nurion - Cray CS500 system
    - 25.7 PFlops at peak, ranked 11th of Top500 (2018) => 21st (Nov 2020)
  - Neuron - GPU system, 1.24 PFlops
  - KREONet/KREONet2 - National R&E network
GSDC
Global Science experimental Data hub Center

- Government-funded project, started in 2009 to promote Korean fundamental research through providing computing power and data storage

- Datacenter for data-intensive fundamental research

- 17 staff: system administration, experiment support, external-relation, management and planning
Experiments Support

- Heavy-Ion Physics
  WLCG Tier-1 (2014)

- Astrophysics
  LDG Tier-2 (2019)

- Elementary Particle Physics
  WLCG Tier-2 (2018)
  B2G Tier-2 (TBD)

- Medical Science
  ARGO Regional Center

- Neutrino Physics
  RAW Storage

- Structural Biology
  Data Sharing Platform

- WLCG
  Worldwide LHC Computing Grid

- ALICE

- LIGO

- GSDC

- RENO

- Belle II

- PAL
WLCG Tier-1/Tier-2

Tier-1 Operations Summary

~ 3% Contribution to Total(T0+T1+T2+AF) ALICE Computing

Running Jobs

Job Efficiency
-84% on Average

Total wall clock hours for ALICE jobs (1yr)

Full HTCondor-CE Deployment

~10.5M ALICE Jobs Done for the last year

ALICE-CEKSTI_0600-q74p
3.014PB
No RAW data in 2030

ALICE-CEKSTI_0600-q66
1.671PB
2PB

ALICE-CEKSTI_0600-q62
1.75PB
1.5PB

SE Usage
Custodial Disk Storage (Tapeless)

- The first disk-based custodial storage replacing tape for ALICE experiment
- 12 PB of usable space with 12+4 erasure coding for data protection (provided by EOS)

System Architecture

- Total raw capacity = 18,144TB (= 12TB * 84 disks * 18 boxes)
- EOS version = 4.8.25 (released on 2020.11.10)
- EOS components are running on containers (a fork of EOS-Docker project)
  - Ansible playbook available at https://github.com/jeongheon81/gsdc-ess-docker

QRAIN(12+4) Layout

- Data loss rate in a year is $8.6 \times 10^{-9}$, where 5 disks are failed simultaneously, considering 1.17% of AFR in practice. Cf. vendor published AFR is 0.30% (AFR = Annualized Failure Rate)
LIGO Tier-2

- Expanding LIGO Tier-3 service to the Global one, the Tier-2
- Requested by Korean Gravitational Working Group that participating in LIGO and KAGRA
- Integrated in Open Science Grid (OSG) for LDG services
- Test-bed started in 2018 and the Tier-2 in production since September 2019

LVC Computing Resources

1. Providing the entire LVC unified access to dedicated and shared computing resources from internal and external computing centers
   - OSG --> LIGO-Virgo Computing Grid (LVC)
     - Existing Resources:
       - LIGO Data Grid (CIT, LLD, LHO, Cardiff/ARCAA, Gitach, UWM/NaNo)
       - Virgo computing centers (CNAF, IN2P3, Nikhef, Petgraw)
     - New Resources:
       - **New KISTI Tier-2 Site!**
       - New Virgo computing centers (e.g., PIC)
       - XSEDE HPC/HTC (e.g., COMET, Stampede)
       - Louisiana State University (LSU) CPU and GPU clusters
       - Pacific Research Platform (PRP) GPU cluster
       - Other LVC campus/institutional clusters
ICGC ARGO RDPC

- Hosting global cancer genome clinical data ~ 100k samples
- Collaboration with National Cancer Center and Seoul National University Hospital
Pilot Project for Sharing Data from Heterogenous Instruments

- Establishing physical links for data transfer and systems for sharing and analyzing data
- Collective data analyses feasible by using EM data and X-ray data
Unified Data Analysis Platform for Large-scale Facilities & Instruments

- Simplify R&D process from DAQ to Analysis
- Applicable to Korean R&D environment: research group, facility or instruments, datacenter are not in one place
- A transparent layer of computing platform is necessary to make R&D activities fluent and efficient
Big Data Express

- Collaboration with Fermilab (US)
- KISTI-GSDC developed BDE AmoebaNet
- Demonstrated intercontinental fast data transfer in SC
- Plan to implement BDE to support domestic experiments such as PAL-XFEL, KBSI-CryoEM

**BigData Express – High Performance Data Transfer (I)**

<table>
<thead>
<tr>
<th>mdmFTP</th>
<th>FDT</th>
<th>GridFTP</th>
<th>BBCP</th>
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</thead>
<tbody>
<tr>
<td>Large file data transfer (1 x 100G)</td>
<td>74.18</td>
<td>79.89</td>
<td>91.18</td>
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<tr>
<td>Folder data transfer (30 x 10G)</td>
<td>192.19</td>
<td>217</td>
<td>320.17</td>
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<tr>
<td>Folder data transfer (Linux 3.12.21)</td>
<td>10.51</td>
<td>-</td>
<td>1006.02</td>
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</table>

**Time-to-completion (Seconds) – Client/Server mode**

<table>
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<th>BBCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large file data transfer (1 x 100G)</td>
<td>34.976</td>
<td>N/A</td>
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<tr>
<td>Folder data transfer (30 x 10G)</td>
<td>95.61</td>
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<td>Folder data transfer (Linux 3.12.21)</td>
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<td>N/A</td>
<td>-</td>
</tr>
</tbody>
</table>

**Time-to-completion (Seconds) – 3rd party mode**

- mdmFTP is faster than existing data transfer tools, ranging from 8% to 9500%!
- @ESNet 100GE SDN Testbed,
Summary

• GSDC is a dedicated datacenter at KISTI to promote fundamental research in South Korea by providing necessary computing power, storage and services

• Tightly coupled with KISTI Supercomputer infrastructure and KISTI KREONet's reachability

• Expanding its contribution to global research communities

• More focus on improving R&D capability with advancing data sharing platform in line with the Government promotion