GRID Processing and Analysis of ALICE data at distributed Russian Tier2 centre – RDIG.

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Abstract. The major subject of this paper is the presentation of the distributed computing status report for the ALICE experiment at Russian sites just before the data taking at the Large Hadron Collider in CERN. We present the usage of the ALICE application software, AliEn[1], at the top of the modern EGEE middleware called gLite for the simulation and data analysis in the experiment at the Russian Tier2 in accordance with the ALICE computing model [2]. We outline the results of CPU and disk space usage at RDIG sites for the data simulation and analysis of first LHC data from the exposition of ALICE detector.

1. Introduction
The readiness of Tier-2s to the processing and analysis of LHC data in present days is a subject of worry and control from LHC experiment managements. According to ALICE computing model [1], main tasks of Tier-2 activity are production of simulated data and analysis as simulated as experimental data. Russian sites combined together into distributed Tier-2 RDIG (Russian Intensive Data GRID)[3] were and are participating in the ALICE GRID activity starting from 2004 year. The ALICE GRID activity is based at AliEn with usage of LCG(EGEE) middleware called gLite for the simulation and data analysis in the experiment at the Russian Tier2 in accordance with the ALICE computing model [2]. We outline the results of CPU and disk space usage at RDIG sites for the data simulation and analysis of first LHC data from the exposition of ALICE detector.
community. There will be presented examples of this facility application for analysis of simulated and reconstructed ALICE data for the first LHC physics. The results of Russian computing for ALICE have been presented at few international conferences [6].

2. Structure and management of ALICE RDIG computing

9 computer resources sites are supporting ALICE activity in Russia. At the picture 1 one can see the Google map with presentation of these nine sites at it. The summary computing resources today at these sites pledged for ALICE experiment at LHC is equal 520 TB of disk space and CPU~2030 in kSi2k units. There is presented in Table 1 the share of these resources between sites.

| Site    | CPU (kSi2k) | Disk (TB) |
|---------|-------------|-----------|
| IHEP    | 140         | 40        |
| INR     | 97          | 30        |
| ITEP    | 90          | 20        |
| JINR    | 550         | 120       |
| MEPhI   | 212         | 30        |
| PNPI    | 115         | 40        |
| RRC-KI  | 600         | 220       |
| SINP    | 104         | 0         |
| SPbSU   | 122         | 20        |
| Summ    | 2030        | 520       |

The management of ALICE Data Challenges at these sites to use effectively given resources was and is obligation of the initiative group. Schema of this group functionality is presented at figure 2.

3. Participation in ALICE production in 2008-2009

All nine RDIG sites were and are participating in the mass production rounds of ALICE in 2008-2009. These rounds are large and realistic productions using real data recorded by cosmic rays with putting all grid elements and services together and simulating what the experiments will face in real conditions. The full exercise also stressed the service, support and operation protocols and procedures defined by the grid team towards an efficient data taking approach. There will be presented this participation concerning RDIG part in the whole ALICE production as well as shared of RDIG recourses between four LHC experiments supported by RDIG.
3.1. Contribution to all ALICE production

The contribution of RDIG resources in the ALICE production in 2008-2009 presented in Table 2. One can see in this Table the data concerning occupancy= wall/pledged, efficiency = CPU/wall of CPU resources and contributions of these resources to the whole ALICE resources used in these rounds. There is also presented the contribution of RDIG sites to the number of completed jobs in Table 2.

| Production time | Occupancy wall/pledged | Efficiency CPU/wall | Wall RDIG/all ALICE | Completed jobs RDIG/all ALICE |
|-----------------|------------------------|---------------------|---------------------|-----------------------------|
| June 2008       | 90.03%                 | 77.85%              | 8.85%               | 10.2%                       |
| July 2008       | 102.3%                 | 74.05%              | 7.42%               | 6.3%                        |
| Augs. 2008      | 124.5%                 | 79.19%              | 9.26%               | 7.8%                        |
| Sept. 2008      | 57.33%                 | 77.52%              | 10.1%               | 8.4%                        |
| March 2009      | 78.21%                 | 85.69%              | 13.6%               | 9.8%                        |
| April 2008      | 89.28%                 | 86.06%              | 6.3%                | 5.4%                        |
| May 2008        | 81.53%                 | 80.18%              | 5.5%                | 3.8%                        |

It is seeing from Table 2 that contribution of distributed Russian Tier2 (RDIG) resources to ALICE production is around 5-10%% from whole resources of this experiment with rather high CPU efficiency ~70-80%%.

3.2. Share RDIG resources between fore LHC experiments

Share of RDIG resources between four LHC experiment in period from June 2008 to May 2009 presents in normalized CPU monthly data at figure 3. One can find also at figure 4 the contribution of resources used by ALICE into sum of RDIG resources used by all LHC experiments in Russia in this time interval.

![Figure 3 Normalized CPU time (Spectint2000*hour = 1000) per each virtual organization (VO)](image-url)
4. GRID services for ALICE computing at RDIG

The Alice production in 2008 has been processing at the standard CE services of gLite with WMS and DPM, dCache SE services with xrootd interface at RDIG sites. Analysis of ALICE job processing at these middleware services shown rather low efficiency of them. So the usage of pure xrootd and CREAM-CE was found the more adequate for ALICE jobs. ALICE is interested in the deployment of the CREAM-CE service at all sites which provide support to the experiment. Experiment expresses a deprecation of the WMS use in benefit of the direct CREAM-CE submission, i.e. WMS submission mode to CREAM-CE not required. In accordance of these new requirements to middleware there has been started installation of pure xrootd and CREAM-CE at RDIG sites. The present status of GRID middleware at RDIG sites supported ALICE presented at Table 3.

Table 3. GRID services at RDIG sites for ALICE

| Service  | Sites                  |
|----------|------------------------|
| gLite CE | Single CE cluster      |
|          | INR(Troitsk), MEPhI, PNPI, RRC-KI, SPbSU |
|          | Few CE clusters        |
|          | IHEP, ITEP, JINR, SINP |
| CREAM-CE |                        |
|          | DPM&xrootd             |
|          | IHEP, SPbSU            |
|          | Pure xrootd            |
|          | INR (Troitsk), PNPI, RRC-KI |
|          | IHEP, ITEP, JINR, MEPhI, SPbSU |

Total disks space what will be able for ALICE in 2009 is 520TB, which is shared between 8 RDIG sites in accordance with pledged resources. Till today there has been installed pure xrootd at 5 sites: IHEP, ITEP, JINR, MEPhI and SPbSU. Today ~168TB are in production. CREAM-CE has been installed at two sites (IHEP, SPbSU) with special additional VO boxes for it. CREAM-CE at IHEP is in a stable production. CREAM-CE at SPbSU is still under test. For the time being, ALICE is the only LHC experiment performing stress and real tests to the CREAM-CE.

5. Facility for the GRID analysis

Distributed analysis facility has to provide real-time access to distributed data-storage and CPU resources and provide immediate response for analysis jobs (few minutes): in contrast to batch jobs. There are specific requirements to such tools:

- Only staged data really interesting. Users could perform data pre-selection with staging and pinning.
When queues are full, jobs can not be spawned when needed. Computing centers do not provide direct access to nodes nor queues. Pull model allows job prioritization on the level of a Virtual Organization.

Synchronized operation of distributed jobs. Results must be merged on the fly with intermediate results observable by the user. These requirements are satisfied by usage of two analysis tools developed in ALICE, alienshell application of AliEn in batch analysis and interactive parallel analysis with help of PROOF. In last case PROOF slaves must be started in advance.

User side: provide ROOT classes for user-grid-PROOF interaction

Last few years ~30 persons from different Russian laboratories, registered as members of VO ALICE are using both analysis tools for analysing of simulated data and RAW data from beam test. They are using actively the PROOF facility in CERN, so called CAF (CERN Analysis Facility) and batch analysis tool. For a example, ~10^7 simulated events have been analysing for test of software functionality, to obtain quantitative estimation for number of physical processes, for the test of sub detector PHOS calibration algorithms.

In order to create more effective conditions for the analysis of simulated and real data there are have been decided to provide PROOF facility at Russia. Today two sites: JINR and SPbSU start installation and test PROOF clusters. First one at JINR

JINR PROOF facility has hardware: m/b Intel 5000P chipset; 2 x quad core Intel Xeon E5440 @ 2.83GHz; 16GB ECC RAM (8x2GB); 250GB SATA-II hdd for OS; 3ware 9650SE-12ML SATA-II RAID with 10 x Maxtor 7Y250 SATA 250GB in h/w RAID6; dual port Intel 80003ES2LAN Gigabit Ethernet Controller on m/b and software: Scientific Linux SL release 4.7; xfs file system on single partion on 3ware raid single volume for pool ~2TB; root 5.22/00 17 December 2008.

SPbSU PROOF facility has 6 worker nodes: CPU2xQuard-Core Intel Xeon E5440@ 2.83GHz; RAM (4x4GB); storage 1.5 TB;

6. Summary

RDIG sites are ready to process ALICE data from first LHC expositions.

7. References

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