A Multi VO Grid Infrastructure at DESY

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Abstract. As a centre for research with particle accelerators and synchrotron light, DESY operates a Grid infrastructure in the context of the EU-project EGEE and the national Grid initiative D-GRID. All computing and storage resources are located in one Grid infrastructure which supports a number of Virtual Organizations of different disciplines, including non-HEP groups such as the Photon Science community. Resource distribution is based on fair share methods without dedicating hardware to user groups. Production quality of the infrastructure is guaranteed by embedding it into the DESY computer centre.

1. The DESY Research Centre

DESY [1] is one of the world-wide leading centres for research with particle accelerators and synchrotron light and member of Helmholtz Association (HGF) [2]. The hadron-electron collider HERA with the experiments H1, HERA-B, HERMES, and ZEUS took data until summer 2007 (see [1]). The data analysis is still on-going. As a major HEP laboratory, DESY participates in the LHC [5] experiments ATLAS and CMS and is a leading partner in the International Linear Collider community (ILC) [10],[11]. DESY operates the National Analysis Facility (NAF) [3] for LHC and ILC. For the field of research with synchrotron light DESY has been operating and is building major facilities such as FLASH [15] , PETRA-III [14], and XFEL [16].

2. Grid at DESY

Even before the start of the global Grid infrastructure project EGEE [7] it had become clear that major computing and storage resources for the future can only be expected in the Grid. Hence DESY's Grid activities started in 2004 with a small installation of Grid services and resources. The main intention at that time was to study the feasibility of large-scale *Monte Carlo* on the Grid for H1 and ZEUS, which had fully relied on distributed computing models until then. Moreover, the upcoming ILC community demanded computing and storage resources, and communities such as the Astroparticle physics collaboration IceCube [12] and the International Lattice Data Grid (ILDG) [13] asked for Grid access. Since 2005 DESY is a member of the German/Switzerland (DECH) federation of EGEE and operates a large Grid infrastructure in the context of the service area (SA1) [4]. DESY is also founding member of the national D-GRID initiative [9]. In its participation in WLCG [8] DESY acts as a German Tier-2 centre for the ATLAS, CMS, and LHCb. DESY has been facing steadily growing computing demands of various e-science communities with very different requirements and use cases as well as computing strategies and traditions. In HEP, collaborative work in a global context is well

[1] for the Grid Team at DESY

Table 1. Virtual Organizations at DESY.

VO	VO Home	Purpose
CALICE	DESY	Calorimeter Tests for ILC
DESY	DESY	local for tests
GHEP	DESY	German catch-all
HERMES	DESY	HERA experiment
HONE	DESY	HERA experiment
ICECUBE	DESY	Astroparticle physics
ILC	DESY	ILC
ILDG	DESY	Lattice QCD
XFEL.EU	DESY	Photon Science
ZEUS	DESY	HERA experiment
BIOMED	IN2P3	Bio-informatics
XRAY.VO.EU-EGEE.ORG	ESRF	Photon Science
ATLAS	WLCG	LHC experiment
CMS	WLCG	LHC experiment
LHCb	WLCG	LHC experiment
DGTEST	D-GRID	test
DTEAM	EGEE	deployment
DECH	DECH	deployment
OPS	EGEE	operations

established since long whereas the synchrotron light experiments are just entering the transition region from purely local to mostly global computing approaches with huge amounts of data. In order to meet the requirements, a robust and scalable computing infrastructure is needed which is based on well-defined open standards and protocols - the Grid.

3. The DESY Grid Infrastructure

3.1. Set-up

In order to make maximal use of installed resources and available manpower while remaining scalable, flexible, and open for new communities, DESY is running *one* Grid infrastructure for *all* supported Virtual Organizations (VO) (see table 1). It is based on the most recent gLite middleware [17] and contains all node types to make it a complete Grid infrastructure with all mandatory services. VO-specific unique core services are VOMRS/VOMS to manage VO members and catalogue services (LFC). Core services with multiple instances are the workload management (WMS), proxy server (PX), and information services (BDII). Resources are provided by computing elements (CE) and Storage Elements (SE). The SEs are based on the DESY/FermiLab developed dCache [18].

3.2. Resources

The DESY Grid resources are located at the two DESY sites in Hamburg and Zeuthen.
Per job slot `2GB` of memory and `15GB` of local disk space are provided (see table 2). DESY operates a tape back-end to the SEs of `2PB`.

Table 2. Grid Resources at DESY as of April 2009.

Site	GIIS	Cores	Hosts	Disk Storage
DESY-HH	`grid-giis.desy.de:2170`	2158	373	700 TB
DESY-ZN	`lcg-giis.ifh.de:2170`	450	99	300 TB

3.3. Usage

The computing resources are installed in batch farms, running OpenPBS/Torque [19] with MAUI [20] as a scheduler. Since resources are funded by different projects according to their objectives, resource usage is steered by the fair share scheduling means of MAUI. Compute nodes are not dedicated to VOs or users. Instead, the scheduler will prioritize queued jobs according to the user's VO membership, roles, and groups, taking into account the VO's resource usage in a certain period (typically some weeks). On the other hand the utilization is maximized if not all VO's submit job. On the SE resource usage is managed by providing explicit storage areas (directories) for the VO's and their groups.

4. Grid Operations at DESY

The operation of a Grid infrastructure in a global context puts new demands to the institution in charge. A new level of quality in providing services must be achieved. The DESY Grid infrastructure is operated as part of the DESY computer centre (CC), using its central facilities for housing, power supply, cooling, and networking. Installation and configuration services for central administration of batch farm behind the CE is provided by using Quattor [23]. For monitoring purposes Ganglia [21] is used. Hardware checks including alarming is done via NAGIOS [22]. Mission critical components are operated on fail-safe hardware with double power supplies and RAID-mirrored hard disks. In addition servers with identical set-up are operated in parallel to be put into operations if necessary (cold stand-by). Recently it was started to exploit virtualization techniques to allow for fast switch-overs in case of hardware failures. In this context it should mentioned that managing many VOs and groups on one Computing Element is conceptually easy compared to data management, since jobs are transient but data is persistent.

5. Perspectives

The set-up of global Grid infrastructure was originally driven by HEP's vast demands for computing for LHC. The Grid idea, invented by I. Foster and K. Kesselmann in the mid nineties, fits well to the concept of global HEP collaborations. It was obvious to build single VOs for each collaboration. In the recent years other e-Science communities have started to evaluate the Grid with respect to their needs. DESY hosts a number of synchrotron light facilities. Petra-III [14] has just recently started operations. The European XFEL project has started civil engineering and is planned to deliver synchrotron light by 2014. Compared to HEP the needed of the photon science community are fundamentally different:

- There is no tradition in big global collaborations in the sense of HEP.
- Most experiments are carried out by a very small number of scientists for short times of the order of hours or days.
- The experimentalists act independently.
- There is no or little sharing of data among scientists and experiments.

- Compared to HEP which is mostly Linux-bound, the variety of user platforms is big and in particular contains non-Unix installations.
- In general, computing is seen as a service and not considered as a integral part of the experiment. Therefore knowledge is often limited
- There is only a *Beginning awareness of scaling problems in computing.*

DESY participates in an EU-project to study the usage of Grids for analysis in photon science which is lead by ESRF Grenoble [6] in the context of the upgrade program of their synchrotron radiation facility. For this purpose a VO XRAY.VO.EU-EGEE.ORG was founded at ESRF and is supported by some sites, including DESY. After setting up the Grid infrastructure, first applications are being tested. DESY founded a VO XFEL.EU to contribute to studies for the computing design of XFEL. It is also planned to support the computing of FLASH and Petra-III on the Grid. In all fields data management capabilities of the Grid is considered to be most useful, whereas computing - except simulation studies - are carried out on dedicated systems.

6. Summary

DESY successfully operates a Grid infrastructure for a number of VOs of various disciplines. Computing resources which are funded by different projects for different use cases are distributed to jobs on a fair share basis rather than dedicating hardware to VOs. The Grid infrastructure is embedded in the DESY Computer Centre to provide a reliable production-grade service to the users. In addition to HEP VOs, photon science projects consider Grid usage. Currently use case and demands are studied to include Grid into their computing models.

Acknowledgments

We would like to thank the DESY Computer Centre for their support in installing and operating the Grid infrastructure. EGEE-III is a project funded by the European Commission with the contract number INFSO-RI-222667.

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