ScotGrid and the LCG
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Abstract
ScotGrid is a distributed Tier-2 computing centre formed as a collaboration between the Universities of Durham, Edinburgh and Glasgow, as part of the UK’s national particle physics grid, GridPP. This paper describes ScotGrid’s current resources by institute and how these were configured to enable participation in the LCG service challenges. The emphasis is placed on the management of storage resources detailing ScotGrid’s role in the successful deployment of Storage Resource Managers (SRMs) at all GridPP Tier-2 sites. We outline future plans for ScotGrid, in particular the optimisation of available resources that is necessary to enhance the quality of service that is provided to Grid users.

Introduction
The UK’s Grid for particle physics (GridPP) [1] started in 2000 with the aim of creating a computing grid that would meet the needs of particle physicists working on the next generation of particle physics experiments (i.e., the LHC). To meet this aim, participating institutions were organised into a set of Tier-2 centres according to their geographical location (see Figure 1). Here, we discuss the setup of ScotGrid with GridPP and the wider LCG project, emphasising its role in deployment, provision and realising of storage resources as well as for a Grid environment.

Storage on the Grid
Due to the large volume of data that the LHC will produce, it is essential for the operation of the LCG that there is both sufficient storage capacity across the Grid and that the infrastructure and management of storage resources is accessible to middleware applications via a common application program interface (API). The storage resource manager (SRM) [2], GridPP is responsible for the deployment of SRMs to interface to all UK Tier-2 centres involved in LCG. ScotGrid plays a key role in this deployment due to the work of personnel in the storage management and data management fields. GridPP has shown to use different middleware products to enable Tier-2 to manage their distributed collection of disk servers under a single namespace, with one method of accessing like space being through the SRM interface:

- dCache - jointly developed by DESY and Fermilab to provide a highly configurable and scalable mechanism for managing a set of disk pools and tertiary storage. The SRM version 1 interface to dCache has been developed by Fermilab, enabling dCache to be used in a distributed Grid environment [4];

- DSM - developed at CERN to provide a suitable interface for managing storage of data on a single node, particularly of Tier-2 data. Provides an SRM via interface to the storage, as well as some SRM v2 functionality [5];

- DPM - developed at CERN to provide a suitable interface for managing storage of disk on a single node, particularly of Tier-2 data. Provides an SRM v2 interface to the storage, as well as some SRM v2 functionality [5].

ScotGrid Resources
Edinburgh’s dCache
Edinburgh provides the second largest Tier-2 disk resource within GridPP, saving 22TB for use by LCG VO’s. The storage is split such that 22TB is managed by dCache and 1TB managed by DSM, both providing SRM v1 interfaces for the VO’s to use. To use a new storage resource manager to control access to the disk is key to Edinburgh being able to set up a knowledge base regarding storage within GridPP. The dCache setup can be seen in Figure 2. A single dCache instance runs on each node in the main dCache service (PNFS database, logging SRM) while the file systems (dCache pools) are bound to a single pool node. Using fibre channel connections, the pool node is attached to a RAID Dual FAST16MB 22TB RAID (level 5)isk array which provides a level of resiliency against common malfunctions, protecting against data loss. An additional 8TB of storage is NFS mounted on the pool node from the University Storage Area Network (SAN).

Figure 1: Federated Tier-2 centres within the GridPP collaboration.

Figure 2: Schematic layout of ScotGrid Tier-2.

Figure 3: dCache setup at Edinburgh. See text for description.

Edinburgh’s DPM
Edinburgh also runs a production level DPM over two nodes, one of which was previously the GridPP RA DPM server for the site, but has now been migrated into our DSM environment. Additional storage is NFS mounted from the SAN onto the nodes running the DSM version 2 DPM namespace, SRM interface. Operating both dCache and DPM servers at production level enables Edinburgh to provide a first class service within GridPP, allowing for testing to be carried out, using at the interaction of the two SRM services.

Figure 4: Glasgow DPM setup.

Glasgow currently provides 300 CPUs for use by LCG VO’s and additional hosts for testing purposes. DPM manages the DSM RAID level 5 storage, spans across two pool nodes, each allowing access to the disk via DSM, a third pool node with 3 Replications is planned for deployment.

Storage Deployment

Figure 5: Status of storage resources at each Tier-2 site within GridPP.

Future Work
The aims of SRM interoperability testing using the SC4 was to allow sites to understand the interaction between the LCG middleware components and their hardware setup, ScotGrid plans to use the SC4 period to set a testbed for studying these interactions, finding bottlenecks and optimising available performance. Questions that will be asked:

- What is the smallest pool filesystem to use with dCache and DSM?

- Which RAID configuration is best for efficiency in reading/writing while also providing a suitable level of redundancy?

- What are the optimal tuning parameters (pool) that can be used for dCache and DSM and optimise the file transfer rate?

- What alternative technologies are available to improve read and write to Tier-2 disk storage?

Using the GridPP RA DPM [9], ScotGrid will be able to demonstrate the results of this testing to other sites, allowing GridPP to optimise their service or Grid users.

Conclusions
The operation of ScotGrid in the fields of data and storage management has allowed us to take a leading role within GridPP for the deployment and testing of LCG middleware products which allow grid-sharing access to storage resources, specifically storage resource managers (SRMs). The use of a testing framework and monitoring has contributed to the successful deployment of an SRM service at the LCG middleware developers for future enhancements. ScotGrid will continue in this role during the lifetime of the GridPP project, one of its aims now being the optimisation of the storage and data management middleware framework that it has helped deploy.

References
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