

## **Storage Resource Management (SRM)**

### **Standard widely used & adopted**

Storage Resource Managers (SRMs) are middleware components whose function is to provide dynamic space allocation and file management on shared storage components on the Grid. They complement Compute Resource Managers in providing storage allocation and dynamic management of files and storage resources for execution of Grid jobs.

The SRM functional specification effort was initiated by the Scientific Data Management Group (SDM) at LBNL and supported by the DOE SciADC middleware program. Because the SDM group is also participating to deploy SRMs in two of the National Collaboratory projects, Earth System Grid and especially Particle Physics Data Grid, SRM has developed into an internationally coordinated effort between several DoE laboratories including LBNL, Fermilab and TJNAF, as well as European institutions including CERN and RAL in the UK. This coordinated effort has resulted in the adaptation of the standard specification, and the development of multiple SRM middleware components that inter-operate. This approach is particularly essential for providing Grid access to complex Mass Storage Systems (MSSs). To date, there are multiple MSSs that provide SRM Grid interfaces, including HPSS (developed by LBNL), Enstore (developed at Fermilab), JASMine (developed at TJNAF), and Castor (developed at CERN). In addition, there are several SRM implementations to disk systems, including disk systems on Solaris and Linux platforms (developed at LBNL), dCache (developed at Fermilab), and J-SRM (developed at TJNAF). An SRM was even developed for a legacy MSS system at NCAR, which enabled it to be accessed from the Grid.

SRMs have been used in production by several facilities including BNL, NERSC, Fermilab, CERN, and JTNAF. Some are being used for access to files or for storing files in remote systems, and some are used for intensive data movement between storage systems. For example, The BNL to NERSC setup using SRMs that access HPSS, takes advantage of robustness features of the SRMs. They use the Berkeley-SRMs to move about 10,000 files per month (about 1 GB each) in an automated fashion. The main benefits are great reduction in the error rates, and great savings of human effort. This arrangement, called a DataMover, is also being used by the Earth Systems Grid to move robustly a large volume of simulation production data from NERSC to NCAR, as well as ORNL to NCAR.

The dream of having multiple, diverse, storage system interoperate was fulfilled by this effort, thanks in great part to goodwill and commitment of the international participants. The SRM standard is now widely adopted by various international efforts, including several HENP experiments, including STAR, ATLAS, and CMS, as well as other efforts, such as NorduGrid. SRMs are also being used by other Grid Collaboratory projects, most notably by the Earth Systems Grid for production use. Although the SRM specification has become a de-facto standard, there is an ongoing effort to standardize this functional specification through the Global Grid Forum (GGF).