Storage Resource Manager v2.2:
Grid Technology for Dynamic Storage Allocation and Uniform Access

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Storage Resource Manager:
Experience and Use-cases (GSM-WG)

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Agenda

- ***HEP use-cases and requirements***
  - Usage of spaces
  - Protecting spaces from inappropriate usage
  - Features of a storage service
- ***Presentation of state-of-the-art in SRM v2.2 – areas of concern***
  - Default spaces
  - Definition of the protocol for read/write requests involving spaces.
- ***Discussions:***
  - VOMS-aware SRM (honoring VOMS/FQANs on spaces and namespaces) – Patrick Fuhrmann (DESY)
  - Priority and shares
  - Quotas
- ***Requirements from other communities***
  - Encryption and security – Ezio Corso (ICTP)
  - NFS v4.1

The LHC Grid paradigm

- ***Storage Services*** are ***crucial*** components of the ***Worldwide LHC Computing Grid*** (WLCG) infrastructure spanning more than 200 sites and serving computing and storage resources to the High Energy Physics LHC communities.

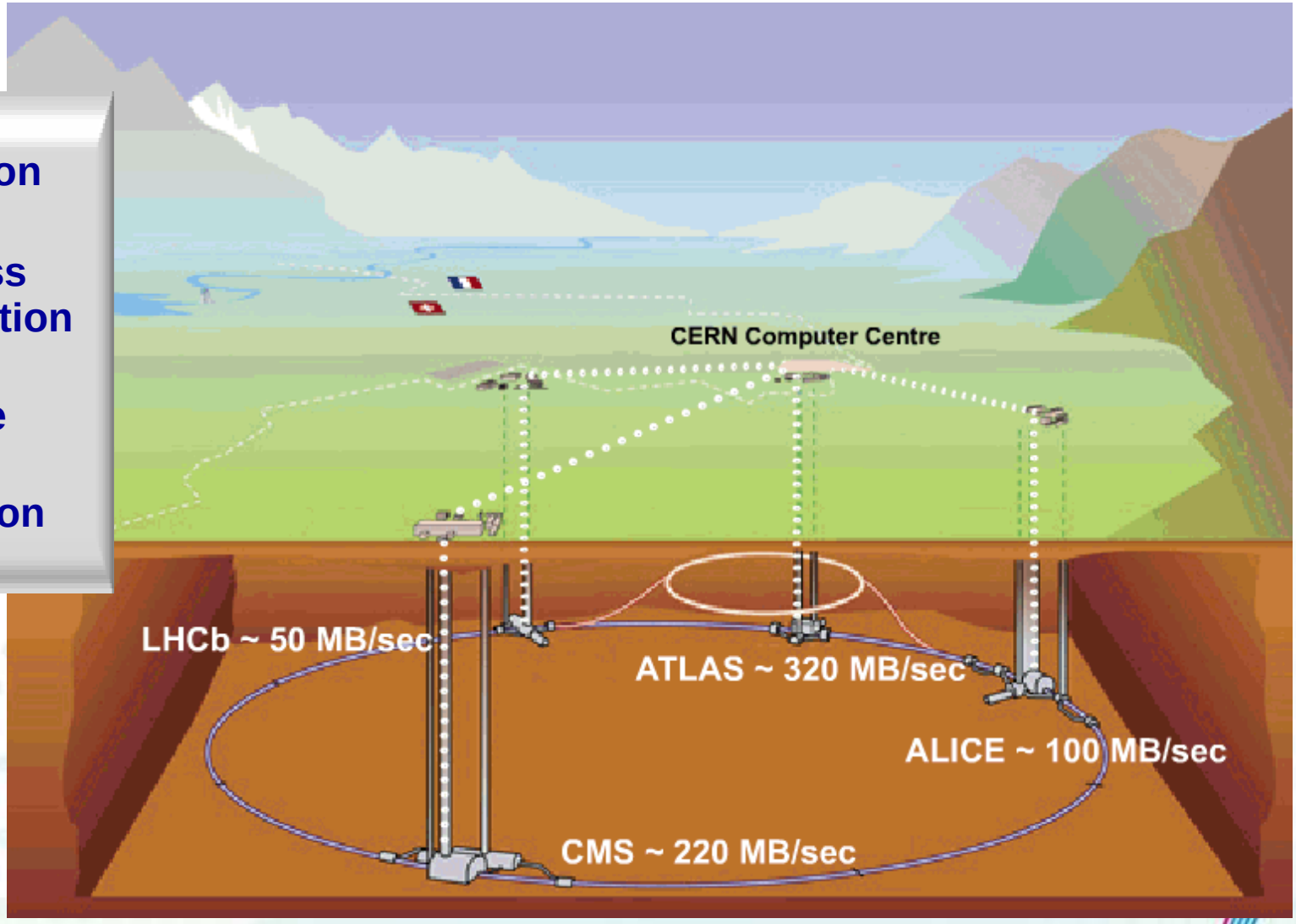
- Up to ***tens of Petabytes of data*** are collected every year by the 4 LHC experiments at CERN.

- It is crucial to ***efficiently transfer*** "raw" data to ***big computing centers (Tier-1s).*** Such centers contribute with their storage and computing power to permanently store the data reliably and to the first pass analysis.

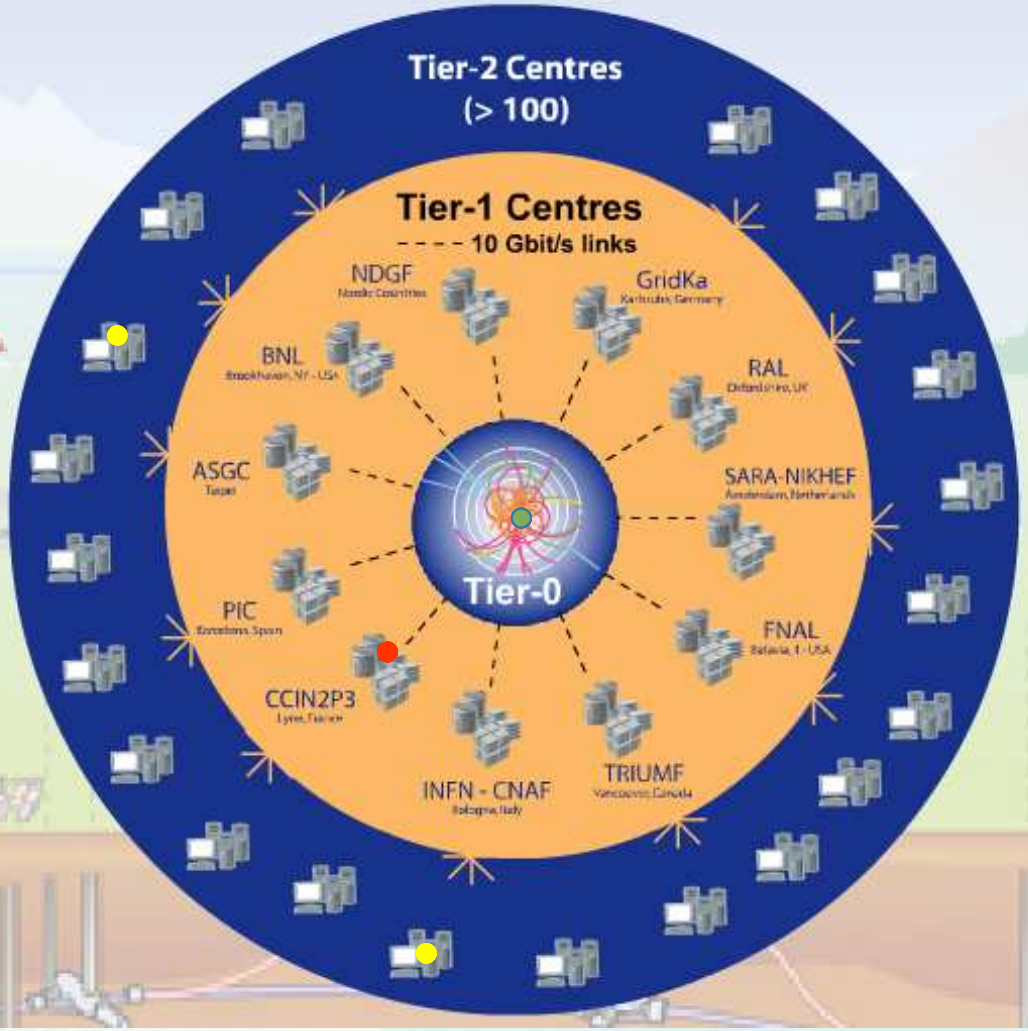
- An important role is also covered by the smaller ***computing centers (Tier-2s)*** that provide experiments with the ***results of the simulation***. Such results need to be transferred to Tier-1s, safely stored permanently, and analyzed as well.

Computing at CERN for LHC

- **Acquisition**
- **First pass reconstruction**
- **Storage**
- **Distribution**



Tier-0 Tier-1 Tier-2



Tier-0 (CERN):
- Data recording
- First-pass reconstruction
- Data distribution

Tier-1 (11 centres):
- Permanent storage
- Re-processing
- Analysis

Tier-2 (>200 centres):
- Simulation
- End-user analysis

The Classic Storage Element

- ***The Classic SE*** : an optimized FTP server with Grid authentication and authorization.
  - The first Storage Server in the Grid *based on Globus GridFTP*
  - Very simple solution that included simple and complex tape-based systems
- What are the *capabilities* of such a service ?
  - No possibility to query the service itself about its status, space available, etc. (one has to rely on the Information System)
- Higher level management and functionalities through *implementation specific interfaces*
  - Selection of data pools for specific activities (protocols, data pattern access, paths, etc.)
  - Data removal
  - Copy facilities
- How are *data access*ed on such a storage server ?
  - Protocols supported: NFS/file, rfio, root, gsiftp
  - Discovery of related information
- What about *space management* ?
  - Sometimes very hard
  - No explicit support for tape backend (pre-staging, pool selection, etc.)

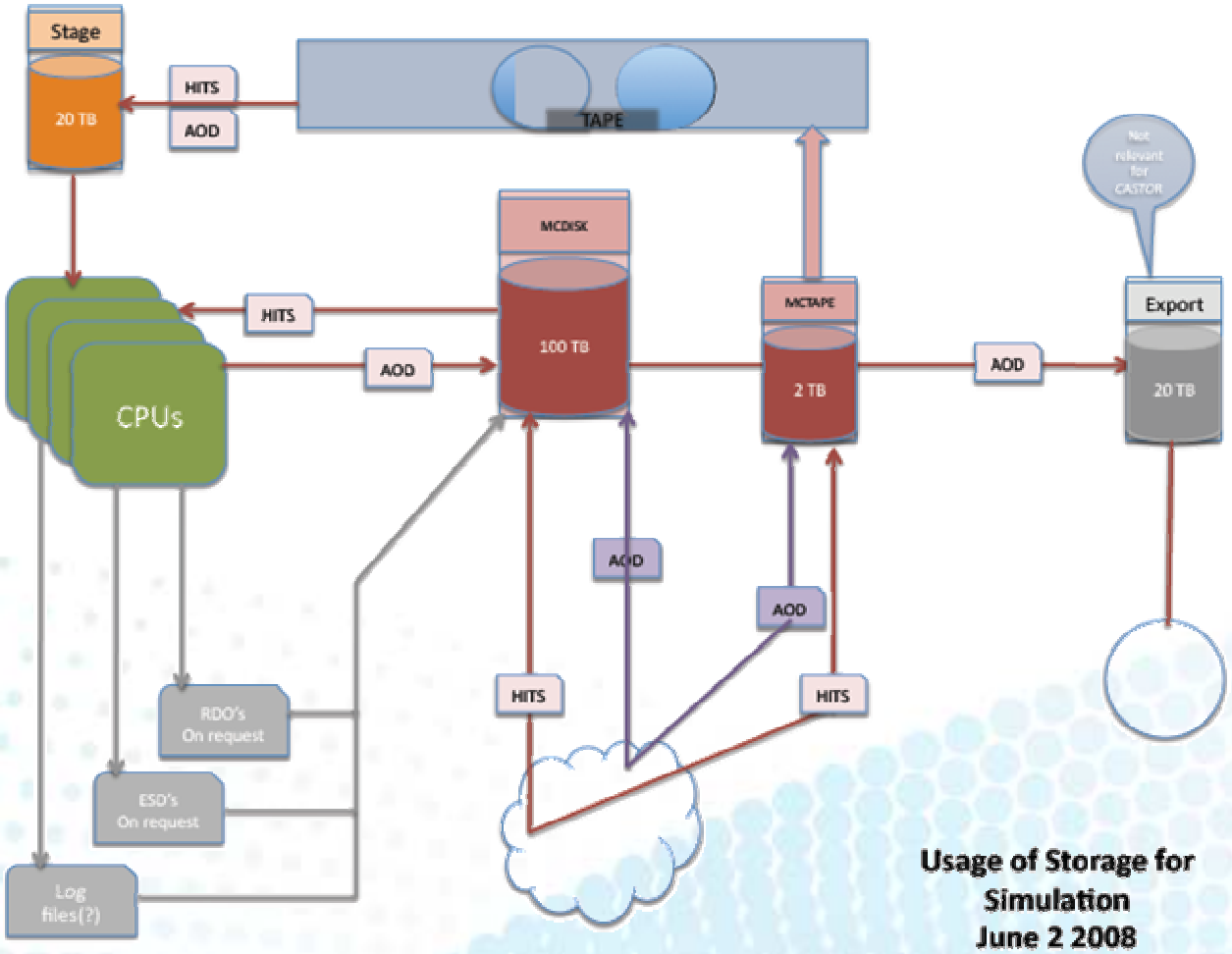
Requirements by dates

- In ***June 2005*** the ***Baseline Service Working Group*** published a report:
  - http://lcg.web.cern.ch/LCG/peb/bs/BSReport-v1.0.pdf
  - A Grid Storage Service is mandatory and high priority.
  - The experiment requirements for a Grid storage service are defined
  - Experiments agree to use only high-level tools as interface to the Grid Storage Service
- In ***May 2006*** at FNAL the WLCG Storage Service Memorandum of Understanding (MoU) was agreed on:
  - http://cd-docdb.fnal.gov/0015/001583/001/SRMLCG-MoU-day2%5B1%5D.pdf

Basic Requirements

- Support for Permanent Space and Space Management capabilities
  - Buffer allocations for different activities to avoid interference
    - Supporting data acquisition
    - Supporting data reconstruction
    - Supporting user analysis
- Support for Storage Classes (quality of spaces)
  - Custodial vs. Replica
  - Online or Nearline
- Support for Permanent files (and volatile copies) and their management
- Namespace Management and Permission Functions
- Data Transfer and File Removal Functions
- File access protocol negotiation

ATLAS setup for simulated data reprocessing



Usage of Storage for Simulation June 2 2008

More general scenarios

- Running a job on a local machine with input files
  - Check space
  - Transfer all needed input files
  - Ensure correctness of files transferred
  - Monitor and recover from errors
  - Manage file streaming
  - Remove files to make space for more files
- If storage space is a shared resource
  - Do the above for many users
  - Enforce quotas
  - Ensure fairness of space allocation and scheduling

More general scenarios

- To do that on a Grid
  - Access a variety of storage systems
  - Authentication and authorization
  - Access mass storage systems
- Distributed jobs on the Grid
  - Dynamic allocation of remote spaces
  - Move (stream) files to remote sites
  - Manage file outputs and their movement to destination site(s)

The Storage Resource Manager v2.2

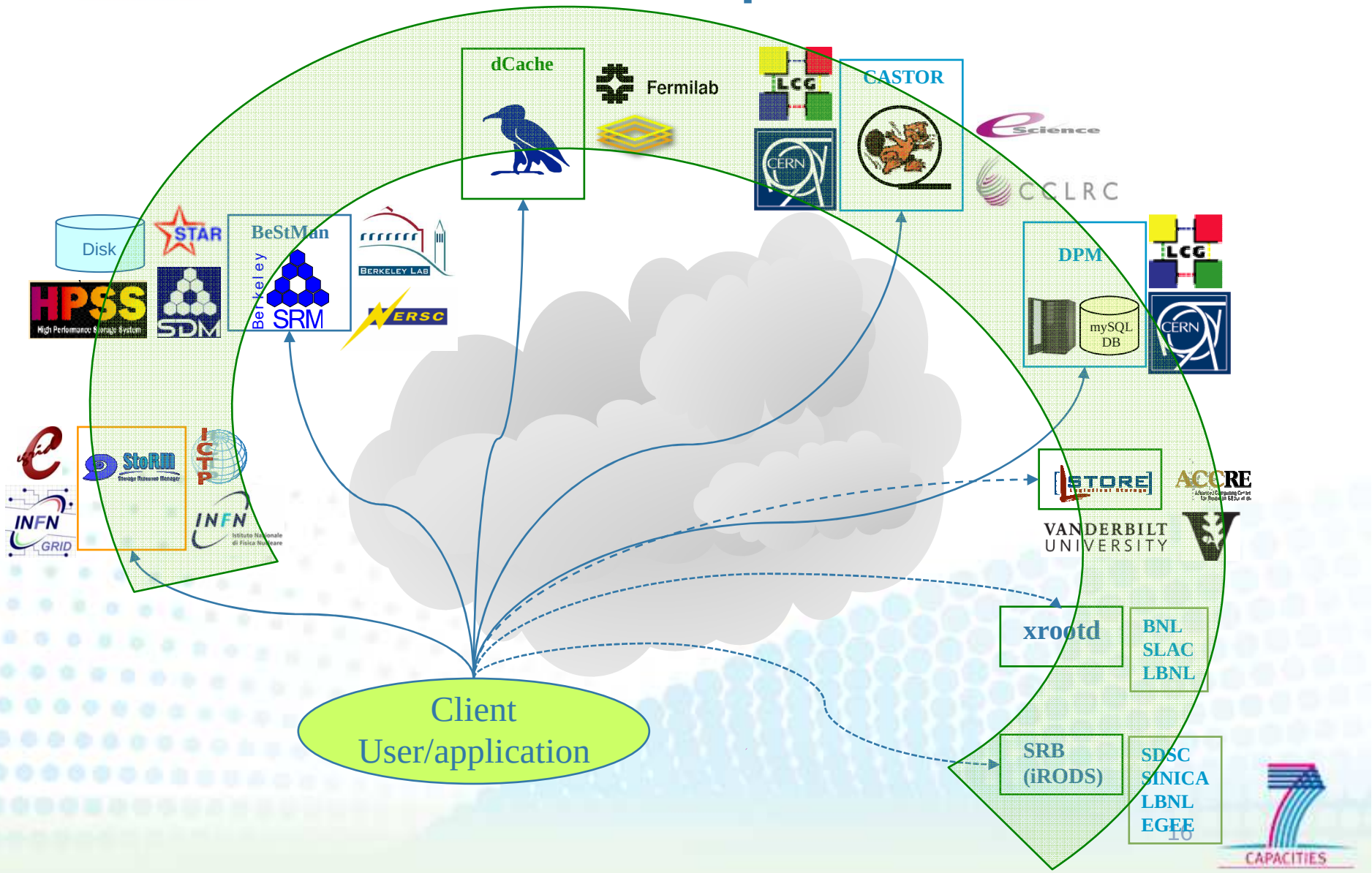
- The *Storage Resource Manager* (SRM) is an interface definition and a ***middleware component*** whose function is to provide ***dynamic space allocation*** and ***file management*** on shared storage components ***on the Grid***.
- More precisely, the SRM is a ***Grid service*** with several different implementations. Its main specification documents are:
  - A. Sim, A. Shoshani (eds.), The Storage Resource Manager Interface Specication, v. 2.2, available at http://sdm.lbl.gov/srm-wg/doc/SRM.v2.2.pdf.
  - F. Donno et al., Storage Element Model for SRM 2.2 and GLUE schema description, v3.5 available at: http://glueschema.forge.cnaf.infn.it/uploads/Spec/V13/SE-Model-3.5.pdf

The Storage Resource Manager v2.2

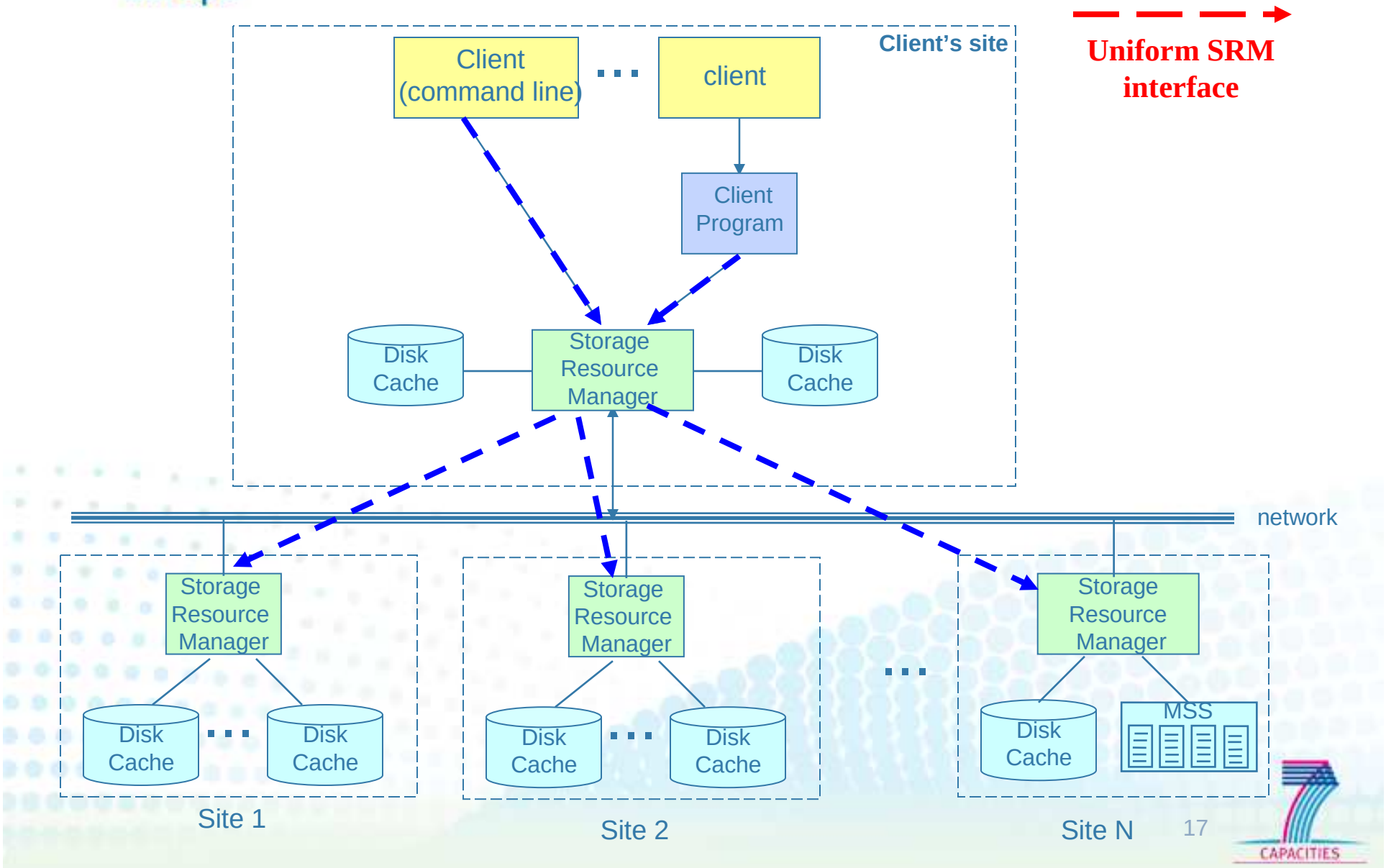
- The SRM Interface Specification lists the service requests, along with the data types for their arguments.

- Function signatures are given in an implementation-independent language and grouped by functionality:
  - *Space management* functions allow the client to reserve, release,and manage spaces, their types and lifetimes.
  - *Data transfer* functions have the purpose of getting les into SRM spaces either from the client's space or from other remote storage systems on the Grid, and to retrieve them.
  - Other function classes are *Directory*, *Permission*, and *Discovery* functions.

Available implementations



Interoperability



History

- 7 year of Storage Resource Management (SRM) activity
- Experience v.1.1 (basic SRM) – 2001
  - MSS: Castor (CERN), dCache (FNAL, DESY, NDGF), HPSS (LBNL, ORNL, BNL), JasMINE (Jlab), MSS (NCAR)
  - Disk systems: dCache (FNAL), DPM (CERN), DRM (LBNL)
- SRM v2.0 spec – 2003
- SRM V2.2 – enhancements introduced for WLCG
  - Several implementations of v2.2
  - Extensive compatibility and interoperability testing
  - MSS: Castor, dCache/{Enstore,TSM,OSM,HPSS}, HPSS (LBNL), JasMINE (Jlab)
  - Disk systems: BeStMan (LBNL), dCache (FNAL, DESY), DPM (CERN), StoRM (INFN/CNAF, ICTP/EGRID)
- Open Grid Forum (OGF)
  - Grid Storage Management (GSM-WG) at GGF8, June 2003
  - SRM collaboration F2F meeting – Sept. 2006
  - SRM v2.2 spec submitted for OGF recommendation – Sep. 2007
  - SRM v2.2 spec accepted – May 2008

Who is involved

- CERN, European Organization for Nuclear Research, Switzerland
  - Lana Abadie, Paolo Badino, Olof Barring, Jean-Philippe Baud, Tony Cass, Flavia Donno, Akos Frohner, Birger Koblitz, Sophie Lemaitre, Maarten Litmaath, Remi Mollon, Giuseppe Lo Presti, David Smith, Paolo Tedesco
- Deutsches Elektronen-Synchrotron, DESY, Hamburg, Germany
  - Patrick Fuhrmann, Tigran Mkrtchan, Paul Millar, Owen Synge
- Nordic Data Grid Facility
  - Matthias, Gerd
- Fermi National Accelerator Laboratory, Illinois, USA
  - Matt Crawford, Dmitry Litvinsev, Alexander Moibenko, Gene Oleynik, Timur Perelmutov, Don Petravick
- ICTP/EGRID, Italy
  - Ezio Corso, Massimo Sponza
- INFN/CNAF, Italy
  - Alberto Forti, Luca Magnoni, Riccardo Zappi
- LAL/IN2P3/CNRS, Faculté des Sciences, Orsay Cedex, France
  - Gilbert Grosdidier
- Lawrence Berkeley National Laboratory, California, USA
  - Junmin Gu, Vijaya Natarajan, Arie Shoshani, Alex Sim
- Rutherford Appleton Laboratory, Oxfordshire, England
  - Shaun De Witt, Jens Jensen, Jiri Menjak
- Thomas Jefferson National Accelerator Facility (TJNAF), USA
  - Michael Haddox-Schatz, Bryan Hess, Andy Kowalski, Chip Watson

Some notes

- The SRM specification has still inconsistencies and it is incomplete
- It is a first attempt to provide a uniform control interface to storage systems
- It has been done to demonstrate feasibility and usefulness
- We think we are converging toward a useful protocol and interface

The SRM space

Definition: An ***SRM SPACE*** is a logical view of an ***online*** physical storage allocation that is reserved for read/write operations on files.

An *SRM SPACE* is characterized by several properties:

Retention Policy Information (Retention Quality and Access Latency)
Owner
Connection Type (WAN , LAN)
Supported File Access/Transfer Protocols
Space Token
Space Token Description (optional)
Status
Total Size
Guaranteed Size
Unused Size
Assigned Lifetime
Left Lifetime
Client Networks

Types of Spaces

- ***Retention quality***
  - Custodial (High quality)
  - Output (Middle quality)
  - Replica (Low Quality)
- ***Access latency***
  - On-line [Immediately available to the application]
  - Near-line [Requires latency before data can be accessed]
- Spaces can be reserved for a ***lifetime***
  - No limit on number of spaces
- ***Space reference handle*** is returned to client
- A ***space token description*** is a tag that identifies a “chunk of space” with given characteristics (such as its storage quality, size, protocols supported, etc.)
- Nothing is specified concerning ***permissions and allowed operations on spaces***.

Types of Spaces

- ***Default spaces***
  - Files can be put into an SRM without explicit reservation
  - Defaults are not visible to client
  - Not defined concept and behavior

SRM Files

Definition: A ***FILE*** is a set of data with the following properties:

- SURL (Site URL)
- PFN
- Size
- Creation Time
- Modification Time
- Storage Type (PERMANENT is the only allowed value in WLCG)
- Retention Policy Info (Retention Policy, Access Latency)
- File Locality (ONLINE, NEARLINE, ONLINE_AND_NEARLINE, LOST, NONE[=0 size], UNAVAILABLE [temporary hardware failure])
- Array of Space Tokens
- File Type (File or Directory)
- Assigned Lifetime
- Left Lifetime
- Permissions
- Checksum Type
- Checksum Value
- Array of Sub Paths (if the file is a directory)

File Storage Type

- ReleaseWhenExpired (***Volatile***)
  - Temporary files with a lifetime guarantee
  - Files are kept by the storage system for their lifetime
  - Files can be removed by SRM when released or when lifetime expires
- NeverExpired (***Permanent***)
  - No lifetime
  - Files can only be removed by creator (owner)
- WarnWhenExpired (***Durable***)
  - Files with a lifetime that CANNOT be removed by SRM
  - Files can only be removed by the creator
  - If lifetime expires – invoke administrative action (e.g. notify owner, archive and release space)

SURLs, TURLs, SFNs, PFNs

- A ***Site URL (SURL)*** allows a user to contact a Storage Service at a site asking for file access
  - srm://pcrd24.cern.ch:8443/srm/managerv2?SFN=/flatfiles/cms/output10
  - srm://pcrd24.cern.ch:8443/srm/managerv1?SFN=/flatfiles/cms/output10
  - srm://pcrd24.cern.ch:8443/flatfiles/cms/output10
  - **srm – control protocol for the storage service**
  - **Fully specified SURL**
- A ***Transport URL (TURL)*** is temporary locator of a replica accessible via a specified access protocol understood by the storage service
  - rfio://lxshare0209.cern.ch/data/alice/ntuples.dat
- A ***Site File Name (SFN)*** is the file location as understood by a local storage system
  - /castor/cern.ch/user/n/nobody/file?svcClass=custorpublic&castorVersion=2
- A ***Physical File Name (PFN)*** is the physical entry in the storage name space:
  - /data/atlas/raw/run29340.dat

File copies

A FILE can have several COPYs in several spaces.

Definition: A ***COPY*** of a file is a logical view of a physical instance of the file in a given SPACE. It is characterized by the following properties:

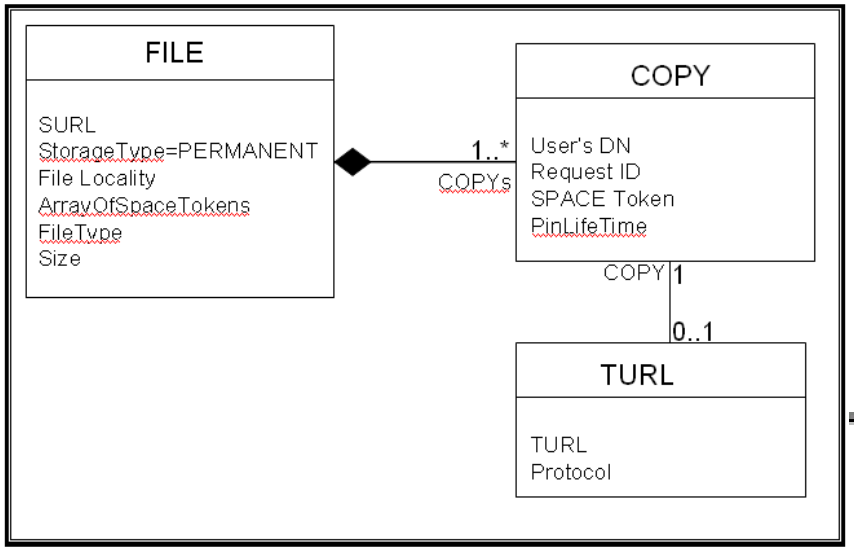
- User's DN (the DN of the user who has instantiated this copy)
- Request ID (of the request generating the copy: srmPrepareToPut, srmPrepareToGet, srmBringOnline)
- SPACE Token (of the space where the copy resides – this is optional)
- PinLifetime (the time the copy is guaranteed to be in the online space where the copy resides – it is defined in the srmBringOnline). The PinLifetime of a copy suggests to the system that the copy is needed by the application and therefore such a copy should not be garbage-collected while its PinLifetime is still valid. At the moment srmPrepareToPut and srmCopy do not allow to specify the PinLifetime for the resulting created copy.

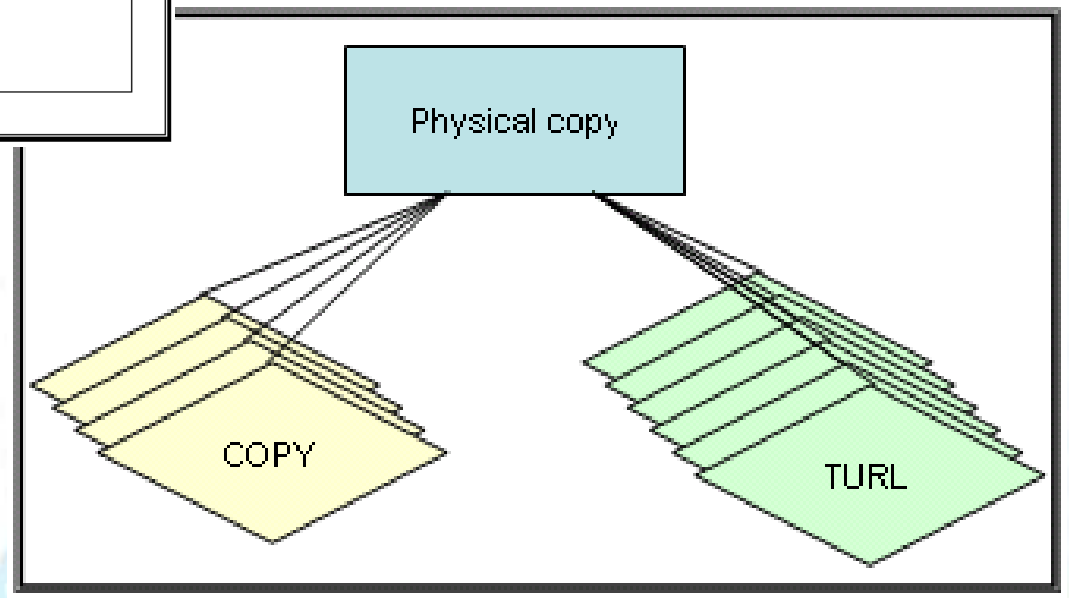
SRM TURLs

***Definition**: A **TURL** is the transport URL associated to a COPY of a FILE in a SPACE. It is characterized by the following properties:*

- *TURL (transport URL associated to a file access/transfer protocol)*
- *User's DN (the DN of the user who has instantiated this TURL)*
- *Request ID (of the request generating the copy: srmPrepareToPut, srmPrepareToGet)*
- *SPACE Token (of the space where the copy resides – this is optional)*
- *PinLifetime (the time for which the TURL must remain valid)*
- *A TURL is generated by the system after a srmPrepareToGet or srmPrepareToPut request and is associated to the request that has generated it. A TURL refers to one COPY of the same file and it might be associated to one or more different physical copies of the same file.*

Files, copies and TURLs





File Access protocols

- SRM v2.2 allows for the *negotiation of the file access protocols*
  - The application can contact the Storage Server asking for a list of possible file access protocols. The server responds providing the TURL for the supported protocol

- Supported file access protocols in WLCG are:
  - [gsi]dcap
  - Gsiftp
  - [gsi]rfio
  - file

SRM Methods (partial list)

Space Management Functions
srmReserveSpace
srmReleaseSpace
srmUpdateSpace
srmGetSpaceMetaData
srmGetSpaceTokens
srmPurgeFromSpace
srmChangeSpaceForFiles

Permission Functions
srmSetPermission
srmGetPermission
srmCheckPermission

Directory Functions
srmMkdir
srmRmdir
srmRm
srmLs
srmMv

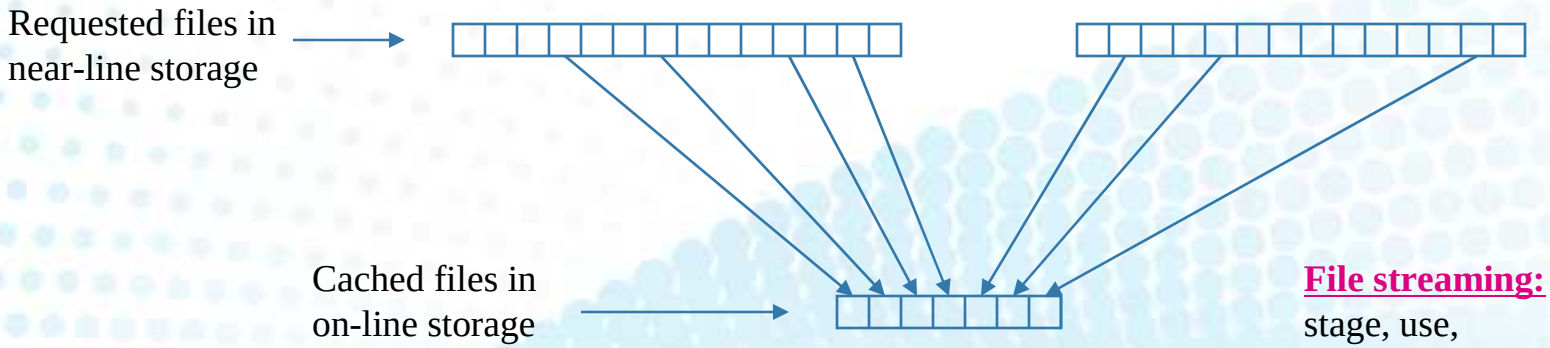
Discovery Functions
srmPing
srmGetTransferProtocols

Data Transfer Functions
srmPrepareToGet
srmPrepareToPut
srmBringOnline
srmCopy
srmReleaseFiles
srmPutDone
srmAbortRequest
srmAbortFiles
srmSuspendRequest
srmResumeRequest

Status Functions
srmStatusOfGetRequest
srmStatusOfPutRequest
srmStatusOfCopyRequest
srmGetRequestSummary
srmGetRequestToken

Multi-files request

- Getting multiple files
  - Required: array of SURLs
  - Optional: space type, space handle, protocol list
  - Optional: total retry time
- Managing request queue
  - Allocate space according to policy, system load, etc.
  - Bring in as many files as possible
  - Provide information on each file brought in or pinned
  - Bring additional files as soon as files are released
  - Support file streaming



SRM WLCG Usage Agreement

- *Only static space reservation supported*
- *Permanent files (and volatile copies)*
- *Storage classes:*
  - *CUSTODIAL-NEARLINE: T1D0*
  - *REPLICA-ONLINE: T0D1*
  - *CUSTODIAL-ONLINE: T1D1*
- *No tape transitions allowed*
- *No concept of file primary copy*

SRM WLCG Usage Agreement

- *Supporting pinning for Put and Copy*
- *Allowing for space tokens on Get and BringOnline and Copy operations*
- *No need for ChangeSpaceForFiles: Get + Token and PurgeFromSpace*
- *Protecting spaces from misusage (VOMS ACLs on spaces)*
- *ReleaseFiles without RequestID.*
- *PurgeFromSpace allowed for FQANs*

SRM at work

- Europe : WLCG/EGEE
  - 177+ deployments, managing more than 10PB
    - 116 DPM/SRM
    - 54 dCache/SRM
    - 7 CASTOR/SRM at CERN, CNAF, PIC, RAL, Sinica
    - StoRM at ICTP/EGRID, INFN/CNAF
- US
  - Estimated at about 20 deployments
  - OSG
    - dCache/SRM from FNAL
    - BeStMan/SRM from LBNL
    - BeStMan-Gateway
      - Skeleton SRM for local implementation
    - SRM-Xrootd: using BeStMan-Gateway for Xrootd
  - ESG
    - DRM/SRM, HRM/SRM at LANL, LBNL, LLNL, NCAR, ORNL
  - Others
    - JasMINE/SRM from TJNAF
    - L-Store/SRM from Vanderbilt Univ.
    - BeStMan/SRM adaptation on Lustre file system at Texas Tech

SRM testing and validation

- **Storage Resource Managers (SRMs) are based on a common interface specification.**
  - SRMs can have different implementations for the underlying storage systems.
  - Compatibility and interoperability need to be tested according to the specification. – Black box testing
- **Availability test**
- **Basic test**
- **Use case test**
- **Interoperability test**
- **Stress test**

SRM testing and validation

- ***S2 test suite for SRM v2.2 from CERN***
  - Basic functionality, tests based on use cases, and cross-copy tests, as part of the certification process
  - Supported file access/transfer protocols: rfio, dcap, gsidcap, gsiftp
  - S2 test cron jobs running 5 times per day.
    - https://twiki.cern.ch/twiki/bin/view/SRMDev
  - Stress tests simulating many requests and many clients
    - Available on specific endpoints, running clients on 21 machines

SRM testing and validation

- ***SRM-Tester from LBNL***
  - Tests conformity of the SRM server interface according to the SRM spec v1.1, and v2.2
  - Supported file transfer protocols: gsiftp, ftp, http and https
  - Test cron jobs running twice a day.
    - http://datagrid.lbl.gov
  - Reliability and stress tests simulating many files, many requests and many clients
    - Available with options, running clients on 8 node cluster
    - Planning to use OSG grid resources

- Java-based SRM-Tester and C-based S2 test suite complement each other in SRM v2.2 testing

SRM testing and validation

OpenGridForum Europe

SRM v2.2 daily test reports for dev sites

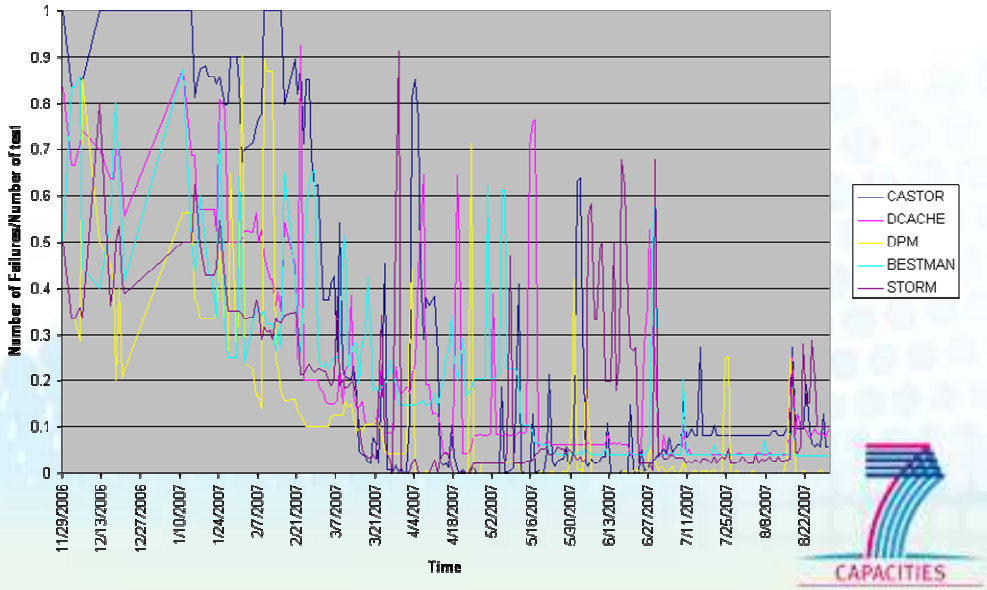
Monitoring Home | legend | site endpoint information ASGC / LBNL

Test Date: 06-12-2007_13_00 raw

Operations	CASTOR	DPM	dCache	BeStMan	StoRM
srmPing	Ok	Ok	Ok	Ok	Ok
srmPrepareToPut	Ok	Ok	Ok	Ok	Ok
srmStatusOfPutRequest	Ok	Ok	Ok	Ok	Ok
srmPutDone	Ok	Ok	Ok	Ok	Ok
srmPrepareToPut-OverAll	Ok	Ok	Ok	Ok	Ok
srmPrepareToGet	Ok	Ok	Ok	Ok	Ok
srmStatusOfGetRequest	Ok	Ok	Ok	Ok	Ok
srmReleaseFiles	Ok	Ok	Ok	Ok	Ok
srmPrepareToGet-OverAll	Ok	Ok	Ok	Ok	Ok
srmBringOnline	Ok	Ok	Ok	Ok	Ok
srmStatusOfBringOnlineRequest	Ok	Ok	Ok	Ok	NA
srmBringOnline-OverAll	Ok	Ok	Ok	Ok	Ok
srmLs	Ok	Ok	Ok	Ok	Ok
srmStatusOfLsRequest	Ok	Ok	Ok	Ok	Ok
srmLs-OverAll	Ok	Ok	Ok	Ok	Ok
srmMv	Ok	Ok	Ok	Ok	Ok
srmRm	Ok	Ok	Ok	Ok	Ok
srmMkdir	Ok	Ok	Ok	Ok	Ok
srmRmdir	Ok	Ok	Ok	Ok	Ok
srmReserveSpace	Failed	Ok	Ok	Ok	Ok
srmStatusOfReserveSpaceRequest	NA	NA	Ok	NA	NA
srmReserveSpace-OverAll	Failed	Ok	Ok	Ok	Ok
srmGetSpaceMetaData	N.T.	Ok	Ok	Ok	Ok
srmGetSpaceTokens	Ok	Ok	Ok	Ok	Ok
srmReleaseSpace	N.T.	Ok	Ok	Ok	Ok
srmGetTransferProtocols	Ok	Ok	Ok	Ok	Ok
srmCopy-gsiftp	N.S.	N.S.	Ok	Ok	Ok
srmStatusOfCopyRequest-gsiftp	NA	NA	Ok	Ok	Failed
srmCopy-gsiftp-OverAll	N.S.	N.S.	Ok	Ok	Failed
srmCopy-pull-BeStMan	Ok	Ok	Ok	Ok	Ok
srmStatusOfCopyRequest-pull-BeStMan	Ok	Ok	Ok	Ok	Ok
srmCopy-pull-BeStMan-OverAll	Ok	Ok	Ok	Ok	Ok
srmCopy-pull-CASTOR	N.S.	N.S.	N.S.	N.S.	N.S.
srmStatusOfCopyRequest-pull-CASTOR	NA	NA	NA	NA	NA
srmCopy-pull-CASTOR-OverAll	N.S.	N.S.	N.S.	N.S.	N.S.
srmCopy-pull-DPM	N.S.	N.S.	N.S.	N.S.	N.S.
srmStatusOfCopyRequest-pull-DPM	NA	NA	NA	NA	NA
srmCopy-pull-DPM-OverAll	N.S.	N.S.	N.S.	N.S.	N.S.
srmCopy-pull-dCache	Ok	Ok	Ok	Ok	Ok
srmStatusOfCopyRequest-pull-dCache	TimedOut	Ok	Ok	Ok	Ok
srmCopy-pull-dCache-OverAll	TimedOut	Ok	Ok	Ok	Ok
srmCopy-pull-StoRM	Ok	Ok	Ok	Ok	Ok
srmStatusOfCopyRequest-pull-StoRM	Failed	Failed	Failed	Failed	TimedOut
srmCopy-pull-StoRM-OverAll	Failed	Failed	Failed	Failed	TimedOut
srmCopy-push-BeStMan	N.S.	N.S.	Ok	Ok	Ok
srmStatusOfCopyRequest-push-BeStMan	NA	NA	Ok	Ok	TimedOut
srmCopy-push-BeStMan-OverAll	N.S.	N.S.	Ok	Ok	TimedOut
srmCopy-push-CASTOR	N.S.	N.S.	Ok	Ok	Ok
srmStatusOfCopyRequest-push-CASTOR	NA	NA	TimedOut	Ok	TimedOut
srmCopy-push-CASTOR-OverAll	N.S.	N.S.	TimedOut	Ok	TimedOut
srmCopy-push-DPM	N.S.	N.S.	Ok	Ok	Ok
srmStatusOfCopyRequest-push-DPM	NA	NA	Ok	Ok	TimedOut
srmCopy-push-DPM-OverAll	N.S.	N.S.	Ok	Ok	TimedOut
srmCopy-push-dCache	N.S.	N.S.	Ok	Ok	Ok
srmStatusOfCopyRequest-push-dCache	NA	NA	Ok	Ok	TimedOut
srmCopy-push-dCache-OverAll	N.S.	N.S.	Ok	Ok	TimedOut
srmCopy-push-StoRM	N.S.	N.S.	Ok	Ok	Ok
srmStatusOfCopyRequest-push-StoRM	NA	NA	Ok	Ok	TimedOut
srmCopy-push-StoRM-OverAll	N.S.	N.S.	Ok	Ok	TimedOut
GridFTP-Get	Ok	Ok	Ok	Ok	Ok
GridFTP-Put	Ok	Ok	Ok	Ok	Ok

SRM test	CERN C2	CNAF C2	CERN C2-1	BNL dCache	DESY dCache	FZK dCache	NDGF dCache	FNAL dCache	CERN DPM	UKED DPM	UKGL DPM	LAL DPM	LBNL BeStMan	CNAF StoRM	CNAF StoRM2	UKBR StoRM
CheckGarbageSpaceCollector	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
CheckSize	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
ExtendFileLifeTime	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
FileNames00	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
FileNames01	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
GetRemoved01	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
GetStatusPartialEx	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
GetStatusPartialNe	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
LsDirCountOffset	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
LsDirDetail	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
LsDirFull	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
LsFullDetail	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
LsNonExistent	Out Log	Out	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
LsTopDir	Out Log	Out	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
Mkdir00	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
MvBeingPut	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
MvDirBeingPutInto1	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log
MvDirBeingPutInto	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log	Out Log

Use Case: Period 29/11/2006 - 30/08/2007



CAPACITIES

SUMMARY

- The SRM specification definition and implementation process has evolved in a ***world-wide collaboration effort*** with developers, independent testers, experiments and site administrators.
- SRM v2.2 based services are now in production. SRM v2.2 is the storage interface mostly used in WLCG and OSG.
- Many of the SRM v2.2 needed functionalities are in place. Further development is needed for meeting the requirements.
- The GLUE Information System schema supports SRM v2.2.
- The SRM-Tester and S2 testing frameworks provide a powerful validation and certification tool.
- Storage coordination and support bodies have been setup to help users and sites.
- Cumulative experience in OGF GSM-WG
  - Specifications SRM v2.2 now accepted

More information

- SRM Collaboration and SRM Specifications
  - http://sdm.lbl.gov/srm-wg
  - Developer's mailing list: srm-devel@fnal.gov
  - OGF mailing list : gsm-wg@ogf.org

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Proposal for DPM quotas

- Unix-like quotas
  - Quotas are defined per disk pool
  - Usage in a given pool is per DN and per VOMS FQAN
  - Primary group gets charged for usage
  - Quotas in a given pool can be defined/enabled per DN and/or per VOMS FQAN
  - Quotas can be assigned by admin
  - Default quotas can be assigned by admin and applied to new users/groups contacting the DPM

Proposal for DPM quota interfaces

- Unix-like quota interfaces
  - User interface
    - dpns-quota gives quota and usage information for a given user/group (restricted to the own user information)
  - Administrator interface
    - dpns-quotacheck to compute the current usage on an existing system
    - dpns-repquota to list the usage and quota information for all users/groups
    - dpns-setquota to set or change quotas for a given user/group