DRMAA: Distributed Resource Management Application API

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DRMAA history

- BOF at GGF 3 in Frascati, Oct 2001
- WG status at GGF 4, Toronto, February 2002

- Participation from PBS, SGE, Intel, LoadLeveler, Condor, Cadence, Globus GRAM, University of Potsdam
- Sideline engagement from EnFuzion, Entropia, LSF, GridIron, UD

03 Jul: Close public comment Jun
04 1Q: 2 Reference implementation prototypes:
  C implementations UofW Condor, Sun's SGE
  CPAN Perl DRMAA-C module
  Sun's SGE Java
  Feedback from reference implementations fed back into spec.
04 Jun: DRMAA recommendation document accepted by GFSC

In a Nutshell

- DRMAA scope and purpose:
  - Submit, control & monitor, and query status of jobs.
  - DRMAA library could be implemented on top on OGSA and DRM systems.

- **Weekly con calls**
  - Toll Free: (866)545-5198 Code: 6898552
  - Regular: (865)521-8904

- E-mail: drmaa-wg@gridforum.org

- **Archive: http://www-unix.gridforum.org/mail_archive/drmaa-wg/threads.html**

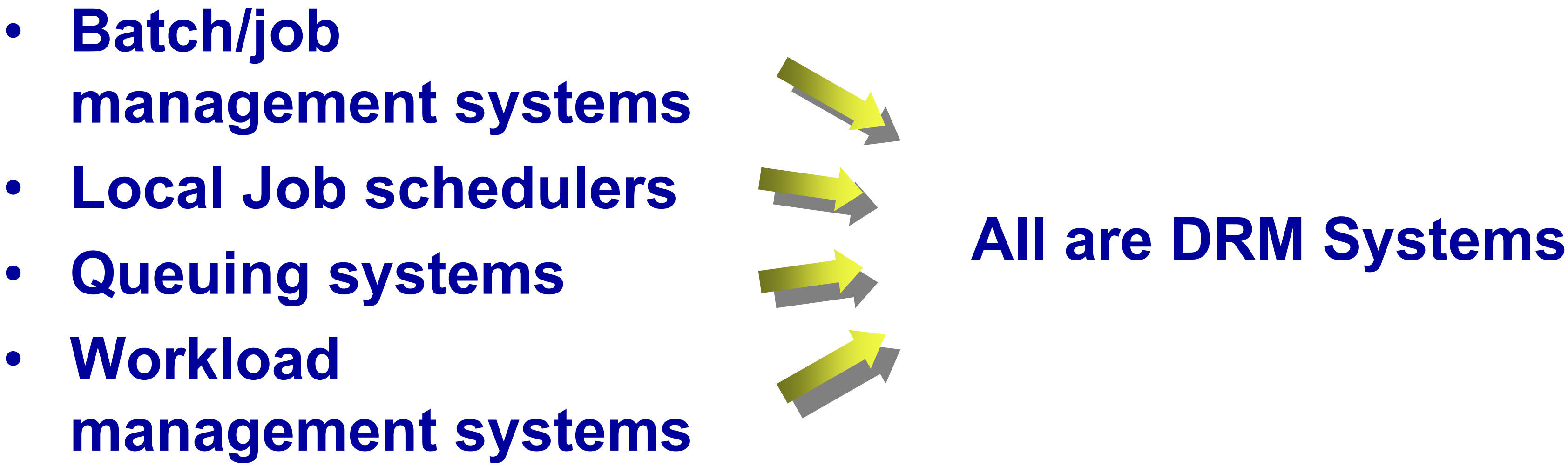
DRMAA as a Third Type of Parallelism

- Threads on SMP machine
  - OpenMP
  - Win Threads, PThreads
- MPI
  - DVSM
  - MPI + OpenMP
- Grid and compute center type computing
  - Grid web services (OGSI/OGSA)
  - DRMAA (compiled, interpreted languages)

Why DRMAA?

- **Adoption of distributed computing solutions in industry is both widespread and 'early adopter'**
  - Commercial applications by independent software vendors (ISVs)
  - Commercial distributed resource management (DRM) systems
  - Scripted command-line integration by end users
  - Very little direct interfacing of ISV apps to DRM systems
- **Adoption is self-limiting to industries where gain exceeds the pain**
- **Fundamental shift in the adoption pattern requires shifting the DRM integration to the ISV**

Distributed Resource Management (DRM) Systems



- **Batch/job management systems**
- **Local Job schedulers**
- **Queuing systems**
- **Workload management systems**

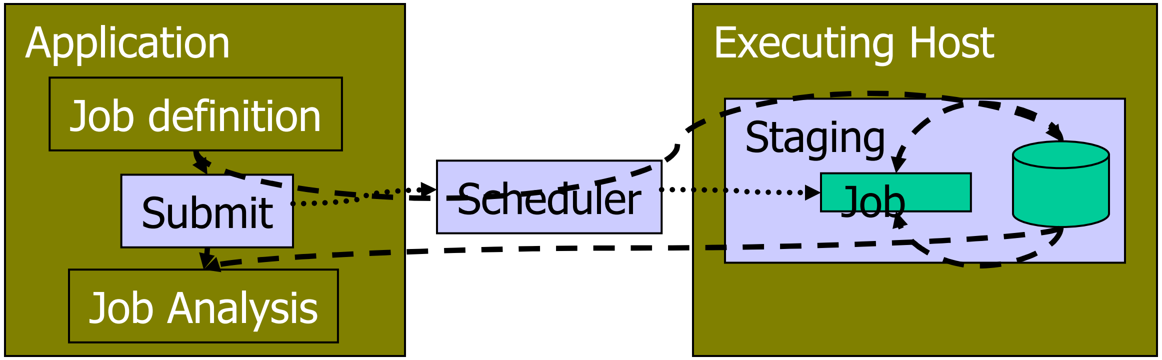
All are DRM Systems

Motivation for DRMAA

There are many DRM solutions available to end users and things keep changing (2003 state of affairs)

Independent Suppliers	Open Source / University	OEM Proprietary	Peer-to-Peer
Platform Computing ***LSF***	**Veridian** ***OpenPBS***	**IBM** ***LoadLeveler***	***EnFuzion***
Altair ***PBS Pro***	**Univ of Wisc** ***Condor***	**Sun** ***Sun Grid Engine***	**Entropia** **United Devices** **Parabon**
DataSynapse	**Sun** ***Grid Engine***		***Grid Iron***

Resource Management Systems Differ Across Each Component



	Interface Format	Execution Environment	Platform Mix
LSF	Has API plus Batch Utilities via “LSF Scripts”	User: Local disk exported System: Remote initialized (option)	Unix ←/ → Windows
Grid Engine	GDI API Interface plus Command line interface	System: Remote initialized, with SGE local variables exported	Unix only
PBS	API (script option) Batch Utilities via “PBS Scripts”	System: Remote initialized, with PBS local variables exported	Unix ←→ Windows
DataSynapse	Proprietary API.	User: Remote initialized	Unix ← → Windows

DRMAA Charter

- **Develop an API specification for the submission and control of jobs to one or more Distributed Resource Management (DRM) systems.**
- **The scope of this specification is all the high level functionality which is necessary for an application to consign a job to a DRM system including common operations on jobs like termination or suspension.**
- **The objective is to facilitate the direct interfacing of applications to today's DRM systems by application's builders, portal builders, and Independent Software Vendors (ISVs).**

Scope: Run a Job API

(Steps from: Ten Actions when SuperScheduling”, GGF SchedWD 8.5, J.M. Schopf, July 2001)

- **Phase 1: Resource Discovery**
  - Step 1 Authorization Filtering
  - Step 2 Application requirement definition
  - Step 3 Minimal requirement filtering
- **Phase 2 System Selection**
  - Step 4 Gathering information (query)
  - Step 5 Select the system(s) to run on
- **Phase 3 Run job**
  - Step 6 (optional) Make an advance reservation
  - **Step 7 Submit job to resources**
  - Step 8 Preparation Tasks
  - **Step 9 Monitor progress (maybe go back to 4)**
  - **Step 10 Find out Job is done**
  - Step 11 Completion tasks

Characterizing DRMAA

- **High level attributes**
  - Application centric
  - Ease of use for end users
  - Focused on programming model
- **Benefits**
  - Faster distributed application deployment
  - Opportunity for new applications
  - Increased end user confidence
  - Improvements in Resource Management Systems
  - Distributed application portability

What have been the Issues?

- **Language bindings**
  - C/C++
  - Perl, Python
  - Fortran, Java
- **General features**
  - DRMAA sessions
  - Asynchronous job monitoring
  - Protocol based
  - Scalability
  - Wide characters
- **Libraries**
  - Serial / thread safe
  - Tracing / diagnosis
- **Advanced features**
  - Debugging support
  - Data streaming
  - Security
  - Categories

Implementation characteristics

- C-API library interface - no protocol
  - Simplifies utilization by ISV's
- Shared library binding
  - Prerequisite to allow end user to select DRM technology of their choice
- Library supports only one DRM system per implementation
  - Simultaneous support of different DRM systems is beyond the scope of DRMAA

API groups

- Init/exit
- Job template interfaces
  - Allocate/delete
  - Setter/getter job template routines
- Job submit
  - Individual jobs
    - One time
    - Multiple times – templates (version 2)
  - Bulk jobs, implicit parameterization
- Job monitoring and control
- Auxiliary or system routines
  - trace file specification
  - error message routines
  - informational interfaces

Job Template

- Functions to create/delete job template
  - job_template drmaa_allocate_job_template (void)
  - void drmaa_delete_job_template (job_template jt)
- Setter/getter job template routines
  - int drmaa_set_attribute(job_template jt, string name, string value);
  - int drmaa_set_vector_attribute(job_template jt, string name, string array values);
  - string drmaa_get_attribute(job_template jt, string name);
  - string array drmaa_get_vector_attribute(job_template jt, string name);

Job Submission

- Jobs submitted to the DRM system are identified via a job identifier
- For flexibility reasons a job identifier should be a string
- Single job identifiers are returned by
  - int drmaa_run_job(string job_id, job_template jt)
- Bulk job submissions return multiple job identifiers
  - int drmaa_run_bulk_job(string array job_ids, job_template jt, int start, int end, int incr)

Job Monitoring, Control, and Status

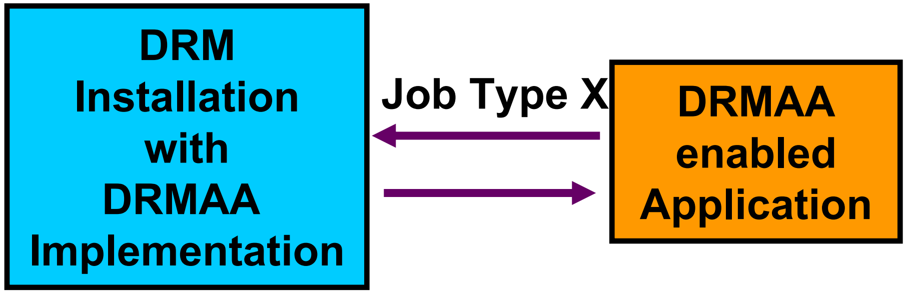
- Monitoring/Control functions
  - int drmaa_control(string job_id, int action);
  - int drmaa_synchronize(string array job_ids, signed long timeout, boolean dispose);
  - int drmaa_job_ps(string job_id, int remote_ps);
- Blocking and non-blocking waiting for one or more jobs to finish (like wait4(2))
  - string drmaa_wait(string jobid, int status, int timeout, string rusage);
  - Use Posix functions drmaa_wifexited, etc. to get more information about failed jobs.

Native DRMS Options

- The end user interacts with the DRMS via native_resource_options parameter.
  - Simple solution
  - DRMAA implementation ignores the DRMAA DRMS implicitly used and disallowed options
  - Dist. Appls. Developers and DRMS vendors are not involved in the local environment spec.
  - The burden is on the end users to define the execution environment
    - Need to know DRM
    - Need to know the remote application installation

Job Categories

Site A

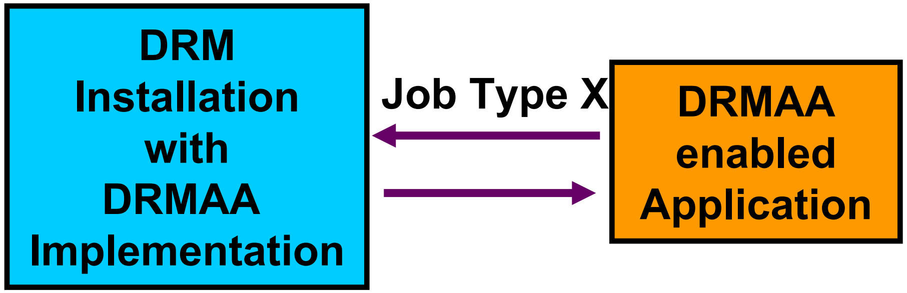

DRM Installation with DRMAA Implementation

Job Type X

DRMAA enabled Application

- Cluster consists of machines where X jobs run and others where they don’t run

Site B


DRM Installation with DRMAA Implementation

Job Type X

DRMAA enabled Application

- X jobs run at all machines in cluster