Using Sun Grid Engine and Globus to Schedule Jobs Across a Combination of Local and Remote Machines

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The Team

✓ EPCC

- Edinburgh Parallel Computing Centre
- Part of the University of Edinburgh in Scotland
- “ A technology-transfer centre for high-performance-computing”
- http://www.epcc.ed.ac.uk

✓ Project Personnel

- Terry Sloan
  - Project leader - tms@epcc.ed.ac.uk
- Thomas Seed
- Ali Anjomshoaa
- Geoff Cawood
- Paul Graham

The Project

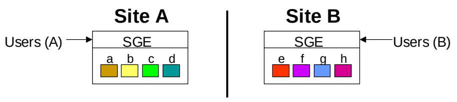
✓ A collaboration between EPCC and Sun

- Called simply ‘Sungrid’ within EPCC
- 57 person months of EPCC effort
- Significant staff contribution from Sun

The Project

✓ Project scenario

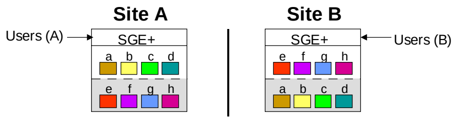
- Two collaborating sites A and B both have some machines
- Both sites run Sun Grid Engine (SGE) to schedule jobs
- Local demand for machines is variable
  - Sometimes it exceeds supply
  - Other times machines lie idle



The Project

✓Ideal Situation

- If sites A and B could expose their machines to each other across the internet through SGE…
  - Both sites could enjoy through-put efficiency improvements
  - Large gains when one site is busy while the other is idle



Site A

Users (A)

SGE+

a b c d

e f g h

Site B

SGE+

Users (B)

e f g h

a b c d

The Project

✓Final goal

- Develop a job-scheduler based on SGE which can schedule jobs across a combination of local and remote machines
- Globus will provide a secure means of running jobs on remote sites

Project Status

✓Self-education and code analysis

- Current phase
- Learning about SGE internals and Globus
- Documenting relevant sections using UML

✓Phase 1 scheduler – very basic capability

✓Phase 2 scheduler – extensions

Workshop Goals

✓Meet new colleagues

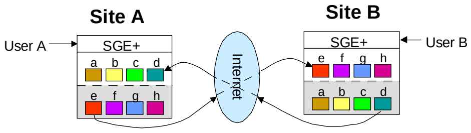
✓Learn more about the internals of SGE

✓Find out about any other attempts to extend SGE functionality over multiple sites

✓Solicit feedback on the solution approaches we might adopt

- Three approaches outlined in the remaining slides

1. Transparent Scheduling



✓ Outline

- SGE+ is SGE enhanced to work with remote machines
- Both sites can run SGE+
- Change scheduler to take local/remote issues into account
- Modify daemons (execd, commd etc.) to work across internet?
- Or use globus calls to fork jobs and query machine and job status?

1. Transparent Scheduling

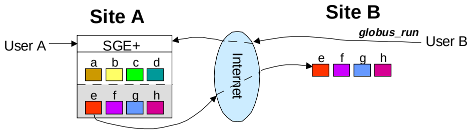
✓ Pros

- Simple approach (?)
- Usability – nothing new for users to learn

✓ Cons

- Low quality scheduling decisions (?)
  - Neither SGE+ system knows exactly what jobs are running on a machine
  - May be a time-lag in getting query results back from remote site
- Duplicated scheduling effort
  - Both SGE+ systems are trying to do the same thing - wasteful
- Poor scalability
  - With N sites, might need N execd daemons per machine
- Queue control – awkward to turn off remote access temporarily
  - Have to explicitly ask other sites to stop forking jobs
- Remote load management tool is by-passed
  - Remote administrator might not want lots of forked jobs

2. Centralised Scheduling



✓ Outline

- Similar to previous approach but one site (A) nominated as master
  - All jobs from all sites are submitted through the master
- Site A runs SGE+ as described in previous approach
- Users at site B call globus_run to submit jobs to the enhanced SGE+ running at site A

2. Centralised Scheduling

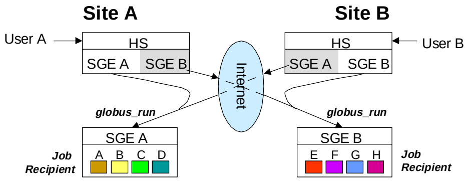
✓ Pros

- Good scheduling decisions due to accurate information
- Under the remote daemons scheme:
  - Site B users might still be able to enjoy SGE job monitoring
  - Site B administrator might still have convenient queue control

✓ Cons

- Need back-up server/site
  - Users at B will not want to wait for A to come back up
- Political issues
  - Site B administrator loses control – may not be acceptable
- Need very high degree of co-operation
  - Correct software applications installed and maintained
  - User-support
  - Accounting issues

3. Hierarchical Scheduling



✓ Outline

- Build a new higher-level scheduler that schedules across globus job-recipients rather than individual machines or queues

3. Hierarchical Scheduling

✓ Outline continued

- Define a ‘globus job-recipient’ as a machine or load-management tool that can:
  - Receive jobs via globus and execute them
  - Respond to queries (sent via globus) about machine and job status
- Modify SGE to provide such a job-recipient interface
  - If it doesn’t already… (qstat may be enough?)
- Introduce a new higher-level Hierarchical Scheduler (HS) to schedule across job-recipients
  - Each site has its own HS
  - Only users at site A can submit jobs to the HS at A
  - Only users at site B can submit jobs to the HS at B
  - When a job arrives at a HS, it queries the job-recipients then decides which one to send the job to

3. Hierarchical Scheduling

✓ Pros

- Problem decomposition
  - Divide and conquer
  - Usually a good idea
- Should give reasonable efficiency improvements
- Local scheduling decisions made locally, as today
- Queue access controlled locally
  - Administrator can turn queues on/off easily through SGE, as today
- Extensible
  - Just make each HS aware of new job-recipients
- No ‘behind-the-scenes’ job-forking
  - Jobs arrive at a site through the intended entry point so SGE has full knowledge about what jobs are running, as today

3. Hierarchical Scheduling

✓ Cons

- Large effort to build new HS tool and front-end
- Scheduling decision duplication
  - HS decision algorithm may be very similar to what SGE does already
- HS scheduling is coarser-grained
  - So decisions might not be as good as centralised scheduling
- HS user-interface uncertain
  - What information on job progress would the HS user see?
- Political issues
  - This may not be what our project proposers want/expect

Any Comments?

- ✓ If you have any comments on these approaches please come and talk to us!
- ✓ We are very interested to hear your opinions
- ✓ Danke schön!