Planning the SCEC Workflows: Pegasus at work on the Grid

The Grid is a complex, distributed and heterogeneous execution environment. Running applications requires the knowledge of many grid services: users need to discover the available resources and schedule the jobs onto them, essentially composing detailed application workflow descriptions by hand. This leaves users struggling with the complexity of the Grid and weighing which resources to use, where to run the computations, where to access the data etc. Thus there is a need to automate the workflow generation and execution process as much as possible.

**Pegasus: Planning for Execution in Grids** [http://pegasus.isi.edu](http://pegasus.isi.edu)
- Maps from abstract to concrete workflow.
- Isolates the user from many Grid details.
- Automatically locates physical locations for both components (transformations) and data, via Globus RLS and the Transformation Catalog.
- Finds appropriate resources to execute the components (via Site Catalog interfaces).
- Interfaces with external site selectors.
- Publishes newly derived data products.
- Reuses existing data products where applicable.
- Supports on demand staging of binary executables.
- Supports clustering of small executables for efficient execution.
- Partitions large workflows for efficient planning.
- Provides job recovery by re-planning the workflow. Also uses certain scheduler mechanism to retry jobs a set number of times.

**SCEC Workflows and Pegasus**
- Pathway2 ÇWorkflow generated using CAT (Composition Analysis Tool) ontology based workflow composition tool or PCT (Pathway Composition Tool).
- CyberShake ÇTwo types of workflows. End to End containing all the preprocessing including seismogram analysis jobs generated using the WINGS (ontology based) workflow generator and a java dax generator for generating just the seismogram analysis workflow.
- These workflows are planned using Pegasus and executed on various SCEC resources and Teragrid.
- On Teragrid the resources are provisioned ahead of time using condor glideeins thus reducing scheduling and queuing overhead.
- Earthworks ÇWave Propagation analysis Portal allows to configure parameters for the analysis.
- Earthworks portal generates the workflow and gives it to Pegasus for planning and execution on the grid.
- It also monitors the execution of the workflow and allows a user to query generated files by querying the Metadata Catalog.

**SCEC CyberShake Statistics**
- Workflows for 11 sites completed
  - LADT, LBP, USC, PAS, SMCA, WNGC, SABD, FFI, CSUN, SBSM, CCP
- Ran approx 400k jobs.
- Computed over 2.5years worth of computation.

**Other Success Stories**
- Laser Interferometer Gravitational Wave Observatory (LIGO) [http://www.ligo.caltech.edu](http://www.ligo.caltech.edu)
- Montage [http://montage.ipac.caltech.edu](http://montage.ipac.caltech.edu)
- BLAST Genome Analysis and Database Update [http://www-blast.mcs.anl.gov/pdq/pdq.htm](http://www-blast.mcs.anl.gov/pdq/pdq.htm)
- ATLAS Monte Carlo data production
- Sloan Digital Sky Survey galaxy cluster finding [http://www.sdss.org](http://www.sdss.org)

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