Leveraging Pegasus 4.0 and GlideinWMS for Executing Data Intensive Workflows on OSG

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Overview

- Pegasus is a system for mapping and executing abstract application workflows over a range of execution environments.
- The output is an executable workflow that can be executed over a variety of resources (Clouds, XSEDE, OSG, Campus Grids, Clusters, Workstation)
- Pegasus can run workflows comprising of millions of tasks.
- Pegasus Workflow Management System (WMS) consists of three main components: the Pegasus mapper, Condor DAGMan, and the Condor schedd.
- The mapping of tasks to the execution resources is done by the mapper based on information derived from static and/or dynamic sources. Pegasus adds and manages data transfer between the tasks as required.
- DAGMan takes this executable workflow and manages the dependencies between the tasks and releases them to the Condor schedd for execution.

Pegasus Features

- Clustering of small tasks into large clusters for performance.
- Optimized data transfers and ability to use different protocols.
- Data reuse in case intermediate data products are available
- Work flow-level checkpointing
- Automatic data cleanup
- Reduces data footprint
- Support for workflow and task level notifications
- Integrates with Resource Provisioners like GlideinWMS.
- Support for Shell Code Generator

Data Staging Configurations Supported by Pegasus

- Shared Filesystem (Head Node and the worker nodes of execution sites share a filesystem)
- Non Shared Filesystem with Staging Site (Head Node and Worker Nodes don’t share a filesystem). Data is staged from an external staging site
- CondorIO (Head Node and Worker Nodes don’t share a filesystem). Data is staged from the submit host using Condor File Transfers

Pegasus 4.0 improvements for running on GlideinWMS

- GlideinWMS provides an excellent dynamic execution environment for Pegasus workflows
- Pegasus 4.0 introduces new advanced data handling capabilities
- Contains improved support for running workflows in non-shared filesystem scenarios such as on top of GlideinWMS.
- Pegasus now optionally separates the data staging site from the workflow execution site for more flexible data management.
- A new feature is PegasusLite - an autonomous lightweight execution environment to manage jobs on the compute nodes and handles data movement/from such jobs against the workflow staging site
- Pegasus 4.0 is currently available on the OSG XSEDE and OSG Engagement glideinWMS submit nodes

Large Scale Hierarchal Workflows

- Nodes in a workflow can be tasks or another workflow (DAX).
- Scales up-to order of millions of tasks
- Each sub workflow is mapped when it is ready for execution.

Galactic Plane Workflow

Astronomy and Physics
- Galactic Plane for generating mosaics from the Spitzer Telescope
- Used to generate tiles 360 x 40 around the galactic equator
- A tile 5 x 5 with 1 overlap with neighbors
- Output datasets to be used in NASA Sky and Google Sky
- One workflow run for each of 17 bands (wavelengths)
- Each sub workflow uses 3.5TB of input imagery (1.6 million files)
- Each workflow consumes 30K CPU hours and produces 900 tiles in FITS format

Proposed Runs on Xsede and OSG
- Run workflows corresponding to each of the 17 bands
- Total Number of Data Files ~ 18 million
- Potential Size of Data Output ~ 86 TB

Monitoring and Debugging Capabilities

- Workflow Progress can be tracked through a database.
- Stores provenance of data used, produced and which software was used with what parameters
- Retries computations in case of failures.
- Monitoring and Debugging tools to debug large scale workflows.

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http://pegasus.isi.edu