A Slurm Odyssey: Slurm at Harvard
FAS Research Computing

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Slurm User Group 2017
Berkeley, CA
Overview

• Research Computing at Harvard

• Odyssey

• Slurm on Odyssey

• Monitoring and Optimizing Slurm

• Future Work
Job Openings

• Area Lead, Data Science & Research Facilitation

• Sr. Site Reliability Engineer

• Software Infrastructure Engineer

• Research Computing Support Specialist

• Visit: https://www.rc.fas.harvard.edu/about/employment/
ODYSSEY

Harvard’s Largest Cluster
60K+ Cores
35PB+ Storage

Nodes
2100

RAM
260 TB

CUDA
1 million

24.7M CPU Hours/month
2.8M Jobs Run/month

8 Miles Network Cabling

Racks
190

Network Ports
5000+

Configuration Lines
300,000

InfiniBand Switching
56 Gb/s

600+ Active Lab Groups

3 Data Centers
Holyoke, MA
Boston, MA
Cambridge, MA

Total Square Footage
10,000+
Odyssey 3

- 29 Dell M1000 Chassis with 16 M630 Blades: 464 nodes
- Each Blade has 128 GB and two 16 Core Intel Broadwell Chips: 14,848 cores
- Connected by Mellanox FDR Interconnect
- Slated for community release November 2017
Slurm on Odyssey

• Odyssey 1.0 ran LSF, Odyssey 2.0+ has been using Slurm since 2013 beginning with version 2.6.5

• Current Slurm version 17.02.7
  – Upgrade to keep pace with minor releases
  – For major releases we wait till first .1 release to ensure stability
  – Built with:
    • Lua
    • MariaDB
    • HWLoc
    • PMI2

• Slurm Master CentOS 7, Compute Nodes CentOS 6
  – Planning on full CentOS 7 by December 2017
### Slurm on Odyssey

<table>
<thead>
<tr>
<th></th>
<th>general</th>
<th>serial_requeue</th>
<th>Interact</th>
<th>Bigmem</th>
<th>Unrestricted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time Limit</strong></td>
<td>7 days</td>
<td>7 days</td>
<td>3 days</td>
<td>No limit</td>
<td>No limit</td>
</tr>
<tr>
<td><strong># Nodes</strong></td>
<td>134</td>
<td>1289</td>
<td>8</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td><strong># Cores/Node</strong></td>
<td>64</td>
<td>Varies</td>
<td>64</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td><strong>Memory/Node (GB)</strong></td>
<td>256</td>
<td>Varies</td>
<td>256</td>
<td>512</td>
<td>256</td>
</tr>
</tbody>
</table>

- 116 Partitions, mostly for various PI owned hardware

- TRES Billing: Memory: 0.25G and AMD: 1CPU, Sandy Bridge: 2CPU and Haswell/Broadwell: 4CPU, and 0.5 for serial_requeue
Slurm on Odyssey

Scheduler Parameters

• Primary Loop
  – default_queue_depth: PartitionNumber*10
  – partition_job_depth: 10

• Backfill Loop
  – bf_continue
  – bf_window: 11520 min
  – bf_resolution: 600 s
  – bf_max_job_test: 10000
  – bf_max_job_start: 1000
  – bf_max_job_user: 10
  – bf_min_prio_reserve: 10000000 (equivalent of Fairshare 0.5)

• Other Parameters
  – preempt_youngest_first
  – max_rpc_cnt: 8
Slurm on Odyssey

• Scheduling Priority:
  – Fairshare
    • Each Group gets 100
    • Groups that purchase hardware get Fairshare:
      – AMD: 1
      – Ivy Bridge: 2
      – Broadwell: 4
    • Fairshare HalfLife: 2 days

  – Job Age
    • Maximum score is equivalent to Fairshare 0.5
    • 7 day maximum score
Monitoring

- [https://github.com/fasrc/slurm-diamond-collector](https://github.com/fasrc/slurm-diamond-collector)
- Giovanni Torres’ Sdiag Monitor
Monitoring
Monitoring
Monitoring
Testing And Optimization

- [https://github.com/fasrc/stdg](https://github.com/fasrc/stdg)

- Simple bash scripts that generate test decks based on a configuration file

- Performance Testing
  - Odyssey 2 grew from 28,000 cores to 60,000 cores. User count and number of jobs also increased.
  - Engaged in a study to optimize scheduler to maximize throughput and lower latency
  - Changes
    - AMD Abu Dhabi -> Intel Haswell
    - HDD -> SSD
    - Mysql 5.1 -> MariaDB 10.1.18
    - CentOS 6 -> CentOS 7
  - Result: 10x speed up in scheduler performance
Fairshare Testing
Future Work

• Consolidate Partitions
  – Make High Priority Partition with a Fairshare Gate
  – Move From PI Owned Partitions to Fairshare Resource Allocation
  – Make GPU Specific Requeue Queue
  – Use Constraints for Serial Queues

• Integrate Fairshare Calculation and Assignment with User Portal

• Feature Requests:
  – Have Pending Jobs Count Against Fairshare
  – Reservation Charge Back
  – Negative Match Constraint
  – slurm.conf Syntax Checker