Slurm
Recent Releases and Roadmap

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SchedMD

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Version 17.11

- Released November 2017
- Federated Clusters
- Heterogeneous Jobs
- Billing TRES
Federation

- Scale out by scheduling multiple clusters as one
- Submit and schedule jobs on multiple clusters
- Unified views and jobid’s
- Established through a central slurmdbd
- Managed with sacctmgr command
Federation Capabilities

- **Job Distribution**
  - Jobs distributed across federation
  - Unique job IDs

- **Unified Views**
  - Appear as one cluster

- **Easy Administration**
  - Add/remove clusters to/from the federation with database commands
Unified Views

- Unified views provided with --federation command line option
  - Made default with FederationParameters=fed_display slurm.conf option
  - squeue, sinfo, sacct, sreport, sview etc.
  - --local, --clusters/-M options override federated view

```bash
$ export SQUEUE_FORMAT2=jobarrayid:8,cluster:.8,statecompact:.4,origin:.8,siblingsviable:.16,siblingsactive:.16,timeused:.8,numnodes:.6,nodelist:.12,reason:.15

$ squeue

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<th>ST</th>
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<th>VIABLE_SIBLINGS</th>
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```
Design Goals

- **Performance**
  - Little to no reduction in throughput of each cluster, performance scales with cluster count

- **Scalability**
  - No reduction in scalability of individual clusters

- **Ease of use**
  - Unified enterprise-wide view, minimize change in user interface

- **Stability**
  - No change in behavior for clusters not explicitly placed into a federation
Configuration

- A cluster can only be part of one federation at a time
- Jobs can’t span clusters
Persistent Connections

- Clusters talk to each other over persistent connections
  - Reduces communication overhead -- only authenticate once
  - Broken connections detected immediately and established when needed
  - Controller and SlurmDBD use the same code
Job Submission

- sbatch, salloc, srun supported
- Jobs submitted to local cluster
- Sibling jobs submitted to all “viable” clusters
  - viable == all clusters ||
  - --clusters=<clusters> & --cluster_constraint=<features>
- Job stays on the local cluster -- even if not viable -- to coordinate and route requests to/from sibling clusters
  - Job starts, updates, cancellations
Scheduling

- Federated jobs contain the locations of all “sibling” jobs
- Each cluster independently schedules each sibling job
- Coordinates with “origin” cluster to start job
  - The origin cluster is determined from the job id
  - Prevents multiple jobs from being started at the same time
  - Policies in place to handle if origin cluster fails
- Once sibling job is started, origin cluster revokes remaining siblings jobs
- Batch jobs can be requeued to federation
Heterogenous Jobs

- Join resource allocation requests into a single job.
- As an example, this makes it easy to allocate a job with 10 Haswell nodes and 1000 KNL nodes.
  - Currently, this is difficult to accomplish, and requires careful manipulation of --constraint and CPU count calculation.
Submitting Heterogeneous Jobs

- Multiple independent job specifications identified in command line using ":" separator
- The job specifications are sent to slurmctld daemon as a list in a single RPC
- The entire request is validated and accepted or rejected
- Response is also a list of data (e.g. job IDs)

```
$ salloc -n1 -C haswell : -n256 -C knl bash
```
Heterogeneous Batch Jobs

- Job components specified using "::" command line separator OR
- Use "#SBATCH" options in script separating components using "#SBATCH packjob"
- Script runs on first component specified

```
$ echo my.bash
#!bin/bash
#SBATCH -n1 -C haswell
#SBATCH packjob
#SBATCH -n256 -C knl
...
$ sbatch my.bash
```
Billing TRES

- New “billing” TRES
  - On by default -- AccountingStorageTRES
  - Enforce limits on usage calculated from partition’s TRESBillingWeights
  - Use existing limits (GrpTRESMins, GrpTRESRunMins, GrpTRES, MaxTRESMins, MaxTRES, etc.)
  - Usage seen with scontrol show jobs, sacct, sreport.
Version 18.08

- Release scheduled for August 2018
- Google Cloud support (integration scripts provided)
- Support for MPI jobs that span heterogeneous job allocations
- Support for multiple backup slurmds
- Improvements to KNL scheduling and CPU binding
- Cray
  - Manage persistent DataWarp allocations without allocating compute nodes. ("--nodes=0")
  - "scontrol show dwstat" - report output from 'dwstat' command
and Beyond!

- cons_tres
  - First step in replacing cons_res
  - Enable Generic Resources (GRES) to be scheduled backfilled just like CPUs
    - Focus for first release will be for improved GPU scheduling
  - Job commands will be updated with new options