NSF/IUCRC CAC PROJECT

MONITORING, VISUALIZING, AND PREDICTING HEALTH STATUS OF HPC CENTERS

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AGENDA

- SLURM Architecture
- Resources and energy accounting
- Tools for gathering data from SLURM

SLURM FEATURES

- SLURM: Simple Linux Utility for Resource Management
- Open-source: freely available under the GNU General Public License.
- Portable: written in C with a GNU autoconf configuration engine.
- Modular: support different kind of scheduling policies, interconnects, libraries, etc
- Scalable: designed to operate in a heterogeneous cluster with up to tens of millions of processors.
- Power management: Power used by job is recorded; Idle resources can be powered down until needed

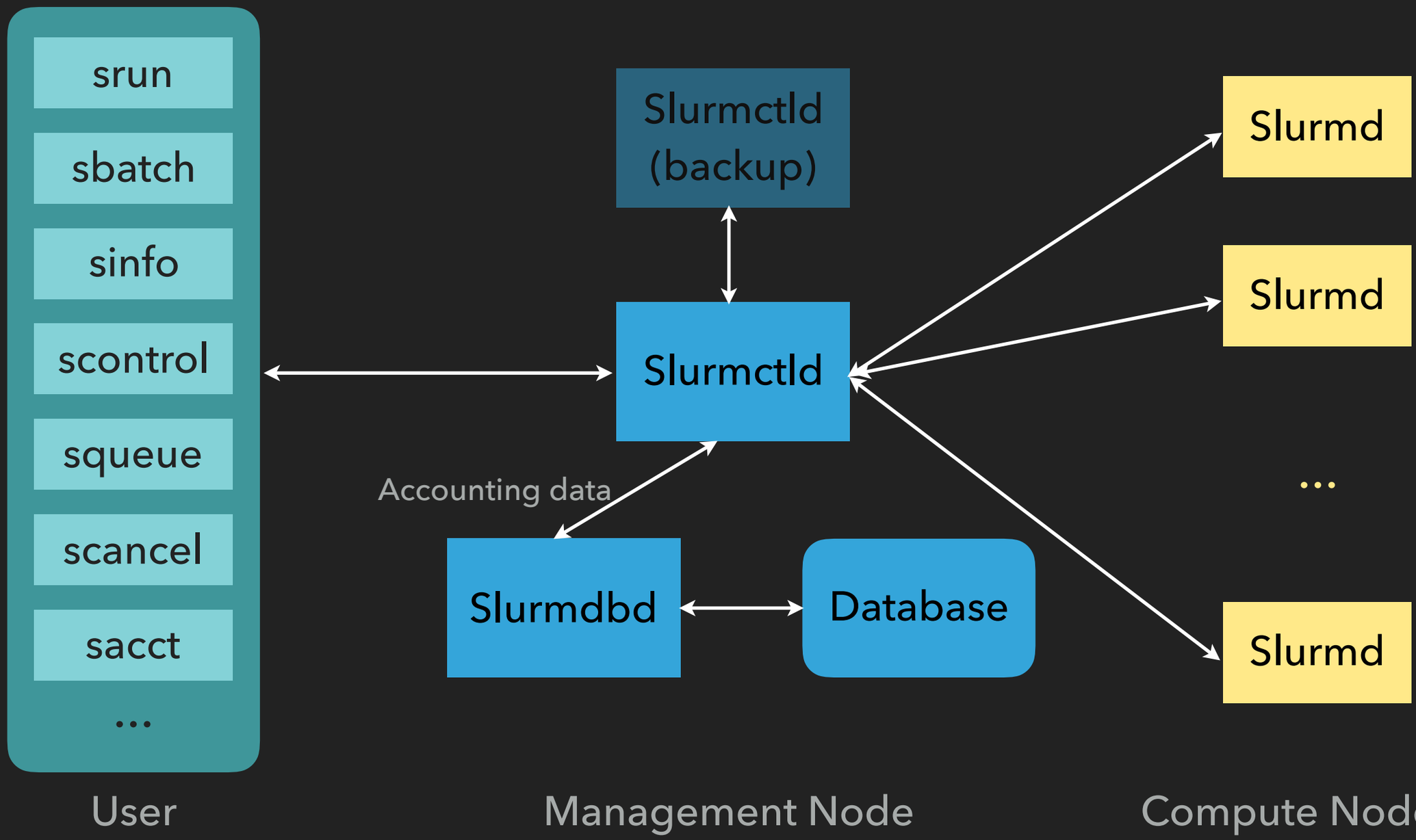
Ref: http://www.sc-camp.ogr/2015/SLURM_Toturial_SCcamp2015.pdf

SLURM ARCHITECTURE

Job Management

Job priorities,
Resource matching

Resource Management



Ref: https://slurm.schedmd.com

SLURM PLUGINS

- Dynamically linked objects loaded at run time based upon configuration
- Various system-specific plugins available

Slurm Kernel (65% of code)					
Authentication Plugin	MPI Plugin	Job Submit Plugin	Accounting Storage Plugin	Resources Accounting Plugin	…

Ref: https://slurm.schedmd.com

Cgroups(Control Groups)

- A Linux kernel mechanism
- Limit, isolate and monitor resources usage
- CPUset and Memory subsystem
  - Collects information concerning CPU time and Memory RSS(Resident Set Size, i.e. the portion of memory occupied by a process that is held in RAM)
  - Values reported as a new job characteristics in the accounting database of SLURM

```
$ srun -n32 ./malloc
$ sacct -j 167
```

JobID	JobName	Partition	MaxRSS	AveRSS	MaxPages	AvePages	MinCPU	AveCPU	Elapsed	State	Ntasks	AllocCPUs	ExitCode
167	malloc	shared	61311K	5722K	239.24G	99893129K	00:03.000	00:03.000	00:01:10	COMPLETED	32	32	0

Ref: http://www.sc-camp.ogr/2015/SLURM_Toturial_SCcamp2015.pdf

ENERGY ACCOUNTING

- Dedicated Plugins for Support of in-band collection (IPMI/RAPL), out-of-band collection (Round-robin database to handle time series data)
- Profiling with HDF5 file format (one HDF5 file per job on each node)
- SLURM built-in tools for extraction of HDF5 profiling data
- acct_gather_energy Plugin, called from slurmctld to collect energy consumption data for nodes.

```
Other plugins:
  infiniband network accounting
  filesystem traffic accounting
  …
```

Ref: http://www.sc-camp.ogr/2015/SLURM_Toturial_SCcamp2015.pdf

TOOLS

Slurm-web

- Provides both a web dashboard and s REST API with views of current states
- Relies on PySLURM library to get data from Slurm workload manager

Splunk

- Ingests log messages and other log-like data
- Can create alerts on data and trends

SPACE

- Stackable Plugin Architecture for SLURM Controller Extension
- Usable as slurmctld generic plugin
- Extensive job information
- Minimal performance impact

Ref:
https://github.com/edf-hpc/slurm-web
https://slurm.schedmd.com/SLUG19/LANL_Splunk.pdf
https://github.com/splunk
https://slurm.schedmd.com/SLUG18/SPACE_SLUG2018.pdf

QUESTIONS?/COMMENTS?