SLURM Bank

A collection of wrapper scripts giving "GOLD-like capabilities" for managing resources to SLURM

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Talk Outline

Introduction

- **SLURM Bank** is a collection of wrapper scripts to give simple banking capability to SLURM
- Create SLURM Associations; add users
- Deposit time with `GrpCPUMins`
- Simple interface for admins and users

Developers

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Historical Background

- Funding agencies require **accounting** for justifying use of resources
- Alternative software solutions:
  - Moab (commercial)
  - Sun Grid Engine (forks?)
  - Torque + Maui + GOLD
- TCHPC used SLURM + Maui + GOLD:
  - Issues: **reliability**, performance, scalability
- Didn't need many features from GOLD: **simple accounting**
- Discussions on the `[slurm-dev]` mailing list (Apr 2011)
- Not an official work-sponsored project — driven by local devops

Offline PHP/MySQL Project Database

- We already collect info about “projects” running on our clusters
  - title
  - abstract
  - project leaders and members
  - funding stream
  - project start/end dates
  - **requested CPU hours**
- High-level details published online

Goals of SLURM Bank

- **Simple** banking system for admins and users
- Well-defined workflow using existing slurm features/tools
    - targeted at simplifying existing tools

Design

- Flat hierarchy of Associations
- Hard time limits per Association
- No half-life decay, no usage reset
- Set `GrpCPUMins` on an Association
  - The is the “account balance”

Design

- Use info provided by SLURM tools
  - `sacctmgr`, `sshare`, `sinfo`, `sacct`
- But have a single command (similar in spirit to `git` and its sub-commands)
  - Self-documenting
- Fix “CPU hour” as the unit (rather than minutes or seconds)

Implementation

- Rapid prototyping a proof-of-concept
  - Shell / Perl wrappers
- Single command `sbank` similar to `git`
  - Wrapper around `sacctmgr`, `sshare`, `sinfo`, `sacct`
  - Use parsable output
- Terminology: SLURM Association == sbank Project

Features

Single wrapper script `sbank` to allow the following:

- admin creates projects (SLURM associations)

```
sbank project create -c mycluster -a myproject
```

- admin adds users, add/refund hours

```
sbank project useradd -c mycluster -a myproject -u someuser
sbank deposit -c mycluster -a myproject -t 1000
```

```
sbank refund job -j 5345
```

- tools for users to check balance, query, estimate, submit

```
sbank balance statement -u
```

Limitations

- Reads usage info from `sshare`
  - No half-life decay is possible, for hard limits
- No lifetime/expiry of Associations / Projects
- Untested for multi-cluster
- No hierarchy of Associations
- No per-user limits within an Association

Our Experiences

- In production for over a year at TCHPC on 3 clusters
- `sbank balance statement` written to slurm.out file by SLURM Epilog
  - not always noticed by users
- No overdrafts!
  - run out of hours == people problem
- Heavy users vs light users
  - no usage decay with fairshare

TCHPC

Future Work

- Re-factor the implementation using SLURM API
- Investigate if `sreport` can be queried for usage info, instead of `sshare`
    - could re-enable half-life decay, and let fairshare work as intended!
- **Feature request**: add Association lifetimes/expiry to slurmdbd
    - similar to start- and end-times for reservations

Conclusions

- Currently deployed on SL5.x, SLURM 2.4 (also worked with 2.2 and 2.3)
- Funding agencies don't care too much what software, so long as they get a report
- Users haven't complained about changes in workflows, learning new command
  - users are silent mostly!
- As a sysadmin, much happier! Much more reliable than slurm+maui+gold

Admin Walk-Through: Install

- On a RHEL 5.x clone (with bash/Perl, and slurm):
- `rpmbuild -ta -without docs slurm-bank-1.0.tar.gz`
- On a generic Linux system:
- `make install`
- Docs: `man sbank` or `sbank help`
- Simple tests: `make test`

Admin Walk-Through: Setup

- Set the parameters in `slurm.conf`

```
AccountingStorageEnforce=limits
PriorityType=priority/multifactor
PriorityUsageResetPeriod=NONE
PriorityDecayHalfLife=0
```

- If you haven't registered the cluster with `sacctmgr`, there's a wrapper:
- `sbank cluster create mycluster`

Admin Walk-Through: Create Projects

- Create SLURM Associations with:
- `sbank project create -c mycluster -a myproject`
- Can also delete:
- `sbank project delete -c mycluster -a myproject`
- Associate users with the project:
- `sbank project useradd -c mycluster -a myproject -u someuser`
- And remove:
- `sbank project userdel -c mycluster -a myproject -u someuser`

Admin Walk-Through: Policy

Decide on a local policy

- Figure out how many CPU hours are available on the cluster
- Decide on how many projects to support and how many hours to allocate to each project
- Decide on how much to over-subscribe
- Create associations for each project or group, perhaps setup a hierarchy of projects
- Allocate hours to the projects/groups
- Review projects and usage
- Go to start

Admin Walk-Through: Deposit Hours

- Deposit hours to a project:
- `sbank deposit -c mycluster -a myproject -t 1000`
- Remove hours:
- `sbank deposit -c mycluster -a myproject -t -500`

Admin Walk-Through: Refund Hours

- If a job has failed you may want to refund the hours that the job has used, to do this you need to know the job id
- `sbank refund job -j 5345`
- The refund command will look up slurmdbd, look up the association and the elapsed time. The elapsed time will be deposited back to the association where it originally ran from.
- In general this should be left as a people issue.

End-User Walk-Through: My Balances

- To check your balances:
- `sbank balance statement -u`

```
User                Usage |           Account       Usage | Account Limit   Available (CPU hrs)
---------- ----------- + ---------------- ----------- + ------------- -----------
paddy                  24 |            MSCHPC          62 |       315,360     315,298
paddy                  13 |             TCHPC          30 |       315,360     315,330
```

End-User Walk-Through: My Team Balances

- To check the balances of your associations, including other members of the associations:
- `sbank balance statement`

```
$ sbank balance statement
User              Usage |          Account       Usage | Account Limit   Available (CPU hrs)
---------- ----------- + ---------------- ----------- + ------------- -----------
adamssl               0 |           MSCHPC          62 |       315,360     315,298
jose                 38 |           MSCHPC          62 |       315,360     315,298
paddy *              24 |           MSCHPC          62 |       315,360     315,298

darach                0 |            TCHPC          30 |       315,360     315,330
jtang                17 |            TCHPC          30 |       315,360     315,330
paddy *              13 |            TCHPC          30 |       315,360     315,330
```

End-User Walk-Through: Just the Hours

- To see the unformatted balance in a single association:
- `sbank balance statement -a tchpc`

```
315330
```

TCHPC

End-User Walk-Through: All Associations

- To see the balances of all associations in the cluster:
- `sbank balance statement -A`

```
User             Usage |          Account       Usage | Account Limit   Available (CPU hrs)
---------- ----------- + ---------------- ----------- + ------------- -----------

root                 0 |             ROOT           0 |             0           0

adamssl              0 |           MSCHPC          62 |       315,360     315,298
jose                38 |           MSCHPC          62 |       315,360     315,298
paddy *             24 |           MSCHPC          62 |       315,360     315,298

darach               0 |            TCHPC          30 |       315,360     315,330
jtang               17 |            TCHPC          30 |       315,360     315,330
paddy *             13 |            TCHPC          30 |       315,360     315,330

tom                113 |           HPC-03      30,030 |       100,000      69,970
fred            10,220 |           HPC-03      30,030 |       100,000      69,970
bob             19,697 |           HPC-03      30,030 |       100,000      69,970
```

End-User Walk-Through: Estimate Time

- How many CPU hours will a given number of nodes+cores for a given wall-time take?
- `sbank time estimate -N 64 -c 2 -t 72`

```
9216
```

- Or check how many hours a given script would require:
- `sbank time estimatescript -s sample-job1.sh`

```
3072
```

End-User Walk-Through: Wrapper to sbatch

- Print expected balance when submitting a script:
- `sbank submit -s sample-job1.sh`

```
log: Getting balance for jtang
User             Usage |          Account       Usage | Account Limit   Available (CPU hrs)
---------- ----------- + ---------------- ----------- + ------------- -----------
jtang               20 |            TCHPC          32 |       315,360     315,328
log: Checking script before submitting
warn: no account specified in the script, using default: tchpc
Current balance      =    315,328
Requested hours      =      3,072
Expected balance     =    312,256
log: sbatch'ing the script
```

Additional Commands

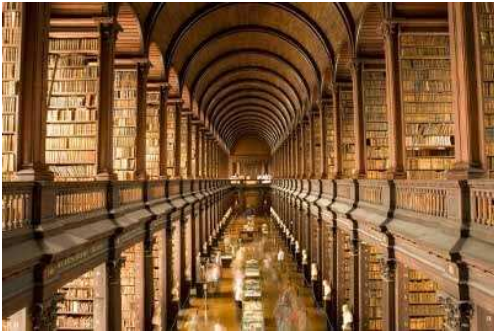
- Not banking per-se, but a few useful utilities we added
- Display CPU hours per cluster per period
- `sbank cluster cpuhrs`

```
Cluster = lonsdale  Cores =   1216  Period = year   Avail =   10,652,160 hrs
Cluster = lonsdale  Cores =   1216  Period = month  Avail =      875,520 hrs
Cluster = lonsdale  Cores =   1216  Period = week   Avail =      204,288 hrs
Cluster = lonsdale  Cores =   1216  Period = day    Avail =       29,184 hrs
```

- Display max core count (or min)
- `sbank cluster cpupernode`
- `sbank cluster cpupernode -m`
- Convert SLURM time to hours
- `sbank time calc -t 1-03:00:00`

  ```
  27
  ```
- `sbank time calc -t 4-01:00:00`
  ```
  97
  ```

Questions ?



Download/Contact Links

- TCHPC: `http://www.tchpc.tcd.ie/`
- GitHub: `https://github.com/jcftang/slurm-bank`
- Docs: `http://jcftang.github.com/slurm-bank/`
- Jimmy Tang, Digital Repository of Ireland (DRI)
  `jtang@tchpc.tcd.ie`
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