EMSL

Pacific Northwest NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

The Road to DevOps HPC Cluster Management

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SCIENTIFIC INNOVATION THROUGH INTEGRATION

Short EMSL Computing History

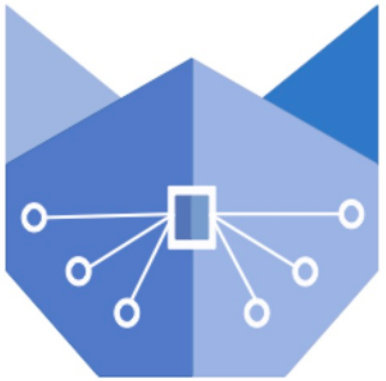
- MPP2 – First Generation Cluster
  - One of the first Linux Clusters in the top 5
  - One of the earliest deployments Lustre
  - ~1000 nodes – How do you install it?
  - More than a year for deployment and acceptance
- Chinook – Second Generation
  - Let's do it again – only bigger!
  - Deployment took months
  - Time to strike out on our own
    - Drop vendor product
    - Use open source tools – xCAT

Next Cluster

- Cascade – Third Generation
  - Hardware only procurement
  - Same configuration repository
  - Deployed with Scientific Linux 6
  - From delivery to acceptance to full production in weeks
  - Upgraded to CentOS 7 without user problems

Open Source advantages

- xCAT
  - Source is available to modify and contribute back changes
  - Decouple hardware, operating system, and management software
- Git
  - Track all changes made to xCAT database
  - Store all configurations and scripts
  - Facilitate collaboration between administrators
- Gitlab
  - Facilitate collaboration between administrators
  - Track work being done
  - Store Documentation for new/unfamiliar administrators



Monthly Outages

- Every month take an outage
  - Makes the system more up-to-date for the users
  - Reduces the number of unplanned outages
  - Gives administrators full unfettered access to make changes
  - Drives development cycles
  - ~1.5% yearly downtime

Weekly Meetings

- Week 1
  - What work was completed during the last outage? – outage minutes
  - What went wrong that needs to be changed?
  - What can be done better?
- Week 2
  - Plan the tasks/priorities for up upcoming outage
- Week 3
  - Evaluate what will be complete by outage
  - Schedule outage (plan resources & check for interdependencies)
- Week 4
  - Burn the cluster to the ground and build it up again

Gitlab

- Issue Tracking
  - All work is tracked in Gitlab using issues
  - Progress is tracked to determine what will and what won’t go into the upcoming outage
  - Admin/Developer only use
- Documentation
  - All procedures are documented
  - They are never complete and need almost constant updating
  - Gitlab provides easy web and markdown file wikis
  - Procedures are occasionally tested by outside driver outages

Disadvantages of Traditional Management

- “Organically” Grown – Install a system and make changes as needed
  - Upgrades are near impossible
  - “How did we get here?”
  - “How do we upgrade?”
  - “How do we prevent user interruption?”

Working with (around) xCAT

- Automated table backups checked into git
- Difficult to test changes on test cluster and merge into production
- Move configurations out of xCAT's databases into revision control
- Use glue script to jump from xCAT config into scripts stored in revision control

```
#!/bin/sh

set -x # Log everything the script is doing
scriptdir=$1
shift

for i in $scriptdir/* # For every file in the directory passed on the command line.
do
        if [ -x $i ] # Make sure the script is executable
        then
                if ! $i $* # Execute postscript and check the results
                then
                        set +x                                  # If the script fails,
                        echo "Error executing $i postscript" # log the error
                        exit 1                                  # and bail
                        set -x
                fi
        fi
done
```

```
.
..
00_savenodeinfo -> /install/postscripts/msc/custom/savenodeinfo
01_configics -> /install/postscripts/configics
05_mkresolvconf -> /install/postscripts/mkresolvconf
10_syncfiles -> /install/postscripts/syncfiles
15_configxcathost -> /install/postscripts/configxcathost
20_setup_sssd -> /install/postscripts/msc/custom/setup_sssd
30_hardeths -> /install/postscripts/hardeths
40_rsyslog -> /install/postscripts/msc/custom/rsyslog
50_remoteshell -> /install/postscripts/msc/custom/remoteshell
60_mountscratch -> /install/postscripts/msc/custom/mountscratch
70_rc-local -> /install/postscripts/msc/custom/rc-local
80_hugepages -> /install/postscripts/hugepages
```

MSC's Implementation of Cluster as Code

- All configurations are checked into repositories and are checked out minutely on the clusters' management nodes
  - Any change attempted outside git are stashed and removed
- Any change gets committed to the development branch and is tested on test cluster
  - Prior to outages, development is merged into production
- Easily track changes to configurations and can track down when/why the change was made
- Example on github - https://github.com/EMSL-MSC/MscClusterMgmt

Next Cluster

- New Cluster – Next Generation
  - Hardware only procurement
  - Will be deployed with CentOS 7
  - Planned upgrade to CentOS 8 in its lifetime
  - Same configuration repository
  - Expected smooth transition based on past performance

Questions?

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