Reducing Cluster Compatibility Mode (CCM) Complexity

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Agenda

• What CCM does
• Services Provided by CCM
• CCM Today
• Shortcomings of the Current Design
• CCM Revised
What CCM Does

- Cray CLE software stack supports extreme scalability mode (ESM) applications
  - Must be relinked against Cray libraries
  - Some applications must/should be recompiled
- Many applications, written for whitebox clusters, cannot be relinked
- CCM allows ISV and third party MPI applications to run out of the box on Cray systems
- CCM does not impact concurrent or sequential ESM applications
Cray CLE Design

- CLE designed for large scale
- Minimalist compute node image
- No disk on compute nodes
- Limited external network connectivity to compute nodes
CCM Supported Functionality

- **Make Aries network behave like whitebox cluster**
  - Third party MPIs can set up Aries network
  - High speed TCP and IBVerb MPI
  - SSH/RSH authentication to/between compute nodes
  - External network connectivity for licensing
  - User authentication
- **Make compute node behave as cluster compute node**
  - Location of some executables
  - Writeable /tmp
  - Shared libraries from /dsl filesystem
# CCM Environment Create/Release

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<tr>
<th>ESM Nodes: ALPS, Aries, CLE</th>
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## CCM Environment Create/Release

### CCM Create:
- Start Network Services: `rpcbind`, `xinetch`, `nsd`, `ypbind`, `dbus-daemon`
- Setup Aries Network: **authentication keys, cookies**
- Setup RootFS: `writeable /tmp, /dev/urandom, /etc/ssh, /var/*`

### Application Runtime:
- **High Speed TCP with IAA, IBVerbs, application launch with SSH/RSH,**
- Dynamic libraries from `/dsl fs, writeable /tmp, normal binary location`

### CCM Release:
- Stop Network Services, Remove RootFS bindmounts, Deconfigure Aries:
- **Reset the compute nodes for next ESM job**
CCM Application Runtime Notes

- `ccmr`**un** uses Cray ALPS to run `ccmla`**unch** on head node, which runs 3**rd** party MPI launcher.
- Application launcher (e.g. `mp`**iexec**) **starts actual** application
- `ccmlo`**g**i**n** call Cray ALPS to run `ccmla`**unch** program on compute nodes, starts interactive SSH shell on compute node to act as head node.
CCM Today

- Tight coupling with workload manager (WLM)
  - WLM Prologue calls CCM prologue, sets up CCM environment
  - WLM Epilogue calls CCM epilogue, removes CCM environment
- `ccmrunc`/`ccmlogin` call ALPS, which runs `ccmlaunch` program on compute nodes, finishing setup
CCM Today - Workflow

- Batch Prologue
- Some Setup
- Aprun of ccmrun/ccmlogin
- More Setup
- Compute Application
- End of ccmlaunch
- Some Release
- More Release
- Batch Epilogue
- NHC App
- NHC CCM
Shortcomings of the Current Design

- CCM prologue uses screen scraping of stdout from ALPS `apstat` and WLM status commands
  - Required customized code for each WLM
  - Changes in command output can cause failure
- Nodelist file limited by kernel
- Timeouts can be a challenge
  - WLM Prologue/Epilogue timeouts are short
  - NodeHealthChecker (NHC) likes long timeouts
  - Epilogue calls NHC concurrent with ALPS NHC
CCM Revised

• CCM Prologue/Epilogue decoupled from WLM
  • CCM prologue invoked with first `ccmrund/ccmlogin`
  • CCM epilogue invoked when ALPS is ready to cancel the batch job reservation
• Data Path through ALPS, no screen scraping
• Nodelist file generated by ccmlaunch, on compute node, with data from ALPS
CCM Revised - NHC

- NHC no longer run during CCM epilogue
- At the end of all reservations, NHC runs `nhc_ccm_test.sh plugin`
  - No-op for non-CCM jobs
  - CCM cleanup checking for CCM jobs
- Normal NHC timeouts
- `ccmr`un and `ccmlogin` interface remains the same
CCM Today - Workflow

Aprun of ccmrun/ ccmllogin

All of Setup

Compute Application

End of ccmlaunch

All of Release

NHC

nhc_ccm_test
CCM Revised – Logging Differences

- CCM prologue output no longer written to batch job stdout/stderr
- Apsys writes CCM prologue/epilogue start and end information to apsys logfile
  - Contains batch jobid and ccmrun/ccmlogin apid
- CCM prologue/epilogue write additional information to ccm-YYYYMMDD file on SMW
- NHC still writes to console logfile, but now tagged with nhc_ccm_test.sh plugin name
CCM Revised - Configuration

- Configurable ALPS timeout for CCM prologue and epilogue in alps.conf
  - prologTimeoutCCM, default 120 seconds
  - epilogTimeoutCCM, default 120 seconds
- New ccm.conf setting used by ccmlogin to allow more ssh attempts, SSH_MAX_CONNECTION_TIMEOUT
CCM Release Schedule

• Both ALPS and WLM CCM prologue/epilogue services supported for CLE5.2UP04
• Subsequent releases contain only Revised CCM

• Note: CCM is not currently available for Native Slurm, but similar SSH functionality is planned for Rhine
CCM Summary

- CCM allows users to run cluster applications on Cray systems
- Revised CCM design removes integration with WLMs
- ALPS controls all of CCM setup/release, and the full path of control data
- NHC `nhc_ccm_test.sh` plugin for CCM cleanup
- More resilient, more supportable
- Coming soon
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