DataWarp Administration Tutorial

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Introductions

- **Dave Paul**
  - LBNL/NERSC
  - Member of the Computational Systems Group
  - Focus on filesystem stability on Cray systems, including DataWarp
  - Involved with the NERSC DataWarp Early User program
- **Ben Landsteiner**
  - Cray Inc. for 9 years
  - DataWarp architect
  - Prior projects include ALPS, WLMs, KNC, kernel

Agenda

- Introductions and Format (5 minutes; done)
- DataWarp Introduction (25 minutes)
- System Configuration & Tuning (30 minutes)
- Log files & Analysis (30 minutes)
- Break (30 minutes)
- Slurm & DataWarp (30 minutes)
- Common Problems & Solutions (30 minutes)
- Tools for DataWarp System Administration (30 minutes)

Format

- **Plenty of material in the tutorial**
  - Slide material augments the official documentation
  - If something isn't clear, let us know and we will try to improve it
- **Please ask questions throughout!**
- **Some examples come from NERSC**
  - Log files used in tutorial available on request

DataWarp Introduction

Overview – What is DataWarp?

- **DataWarp is an IO Accelerator**
  - An implementation of the Burst Buffer concept, plus more
- **Has both Hardware & Software components**
- **Hardware**
  - XC service node, directly connected to Aries network
  - PCIe SSD Cards installed on the node
- **Software**
  - DataWarp Service daemons
  - DataWarp Filesystems (using DVS, LVM, XFS)
  - Integration with WorkLoad Managers (Slurm, M/T, PBSpro)

Usage overview (scratch)

Without DataWarp

```
#!/bin/bash
#SBATCH --ntasks 3200

export JOBDIR=/lus/global/my_jobdir
srun -n 3200 a.out
```

With DataWarp Scratch

```
#!/bin/bash
#SBATCH --ntasks 3200
#DW jobdw type=scratch access_mode=striped capacity=1TiB
#DW stage_in type=directory source=/lus/global/my_jobdir destination=$DW_JOB_STRIPED
#DW stage_out type=directory source=$DW_JOB_STRIPED destination=/lus/global/my_jobdir

export JOBDIR=$DW_JOB_STRIPED
srun -n 3200 a.out
```

Usage overview (cache)

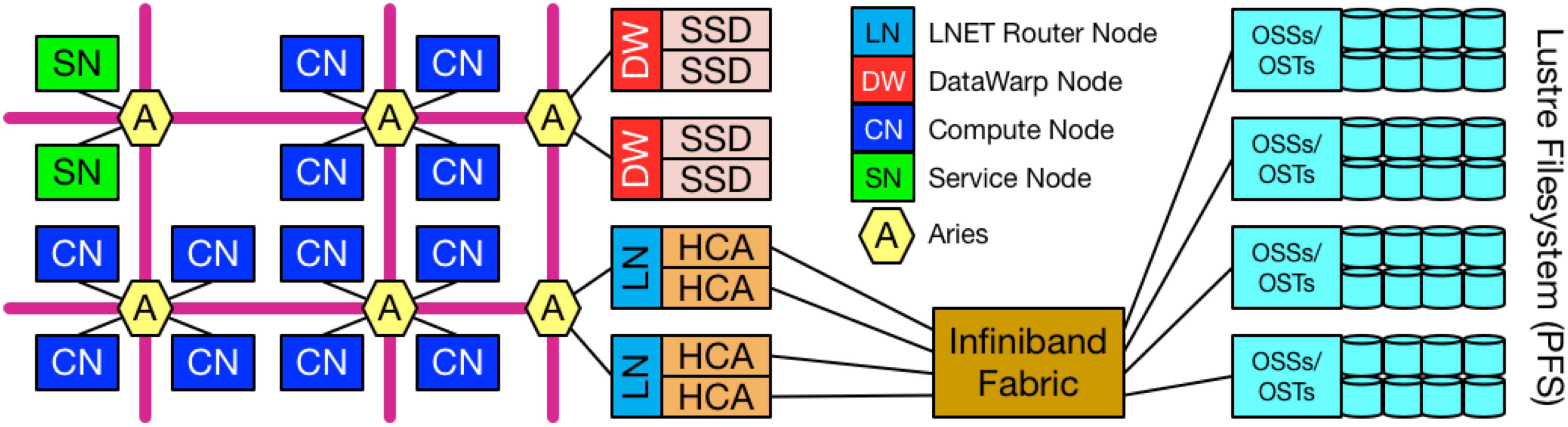
Without DataWarp

```
#!/bin/bash
#SBATCH --ntasks 3200

export JOBDIR=/lus/global/my_jobdir
srun -n 3200 a.out
```

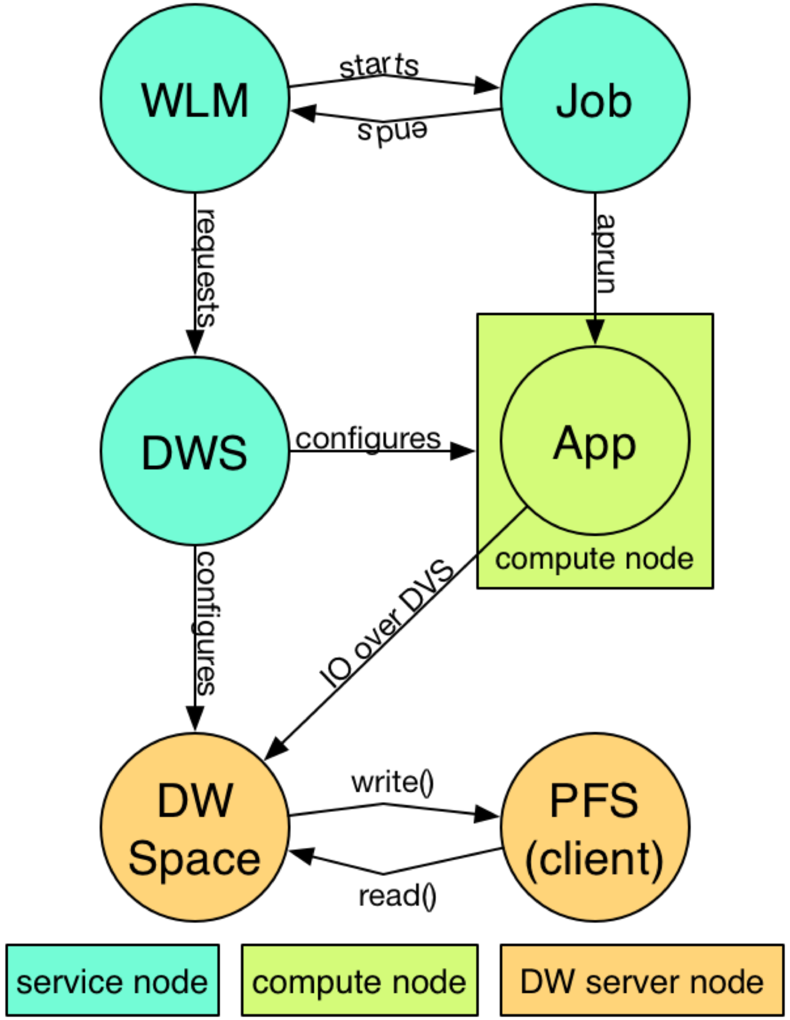
With DataWarp Transparent Caching

```
#!/bin/bash
#SBATCH --ntasks 3200
#DW jobdw type=cache access_mode=striped pfs=/lus/global capacity=10TiB

export JOBDIR=$DW_JOB_STRIPED_CACHE/my_jobdir
srun -n 3200 a.out
```

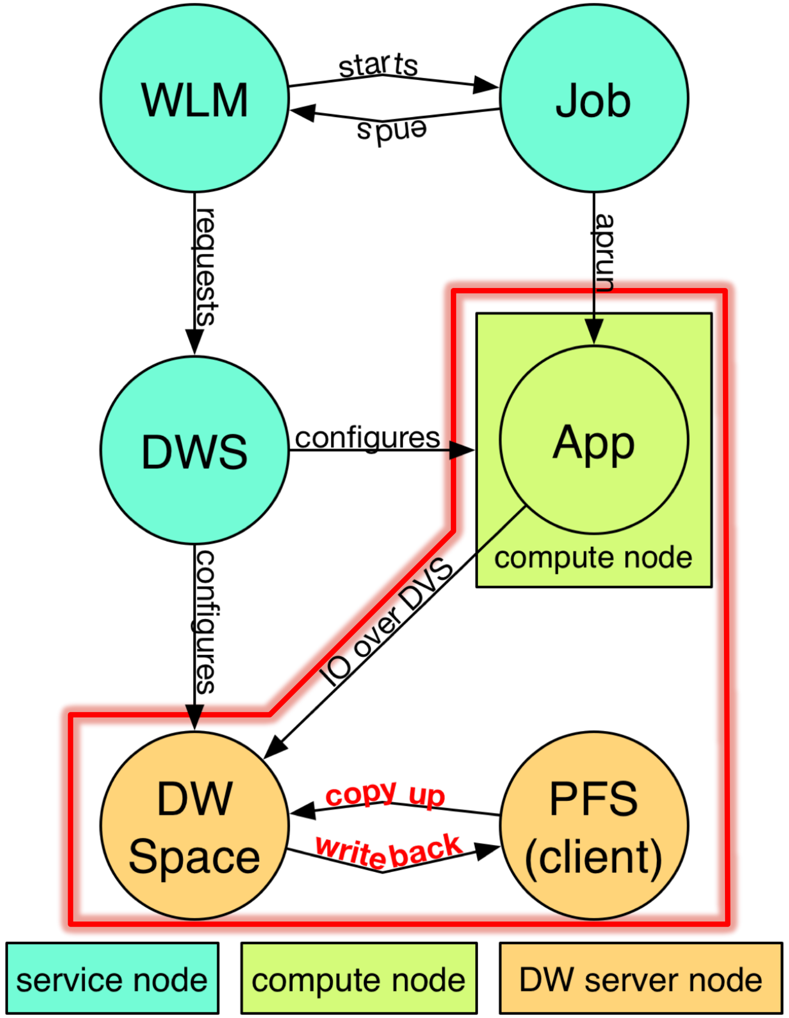
Hardware Overview



Software Overview (Orchestration & Data)

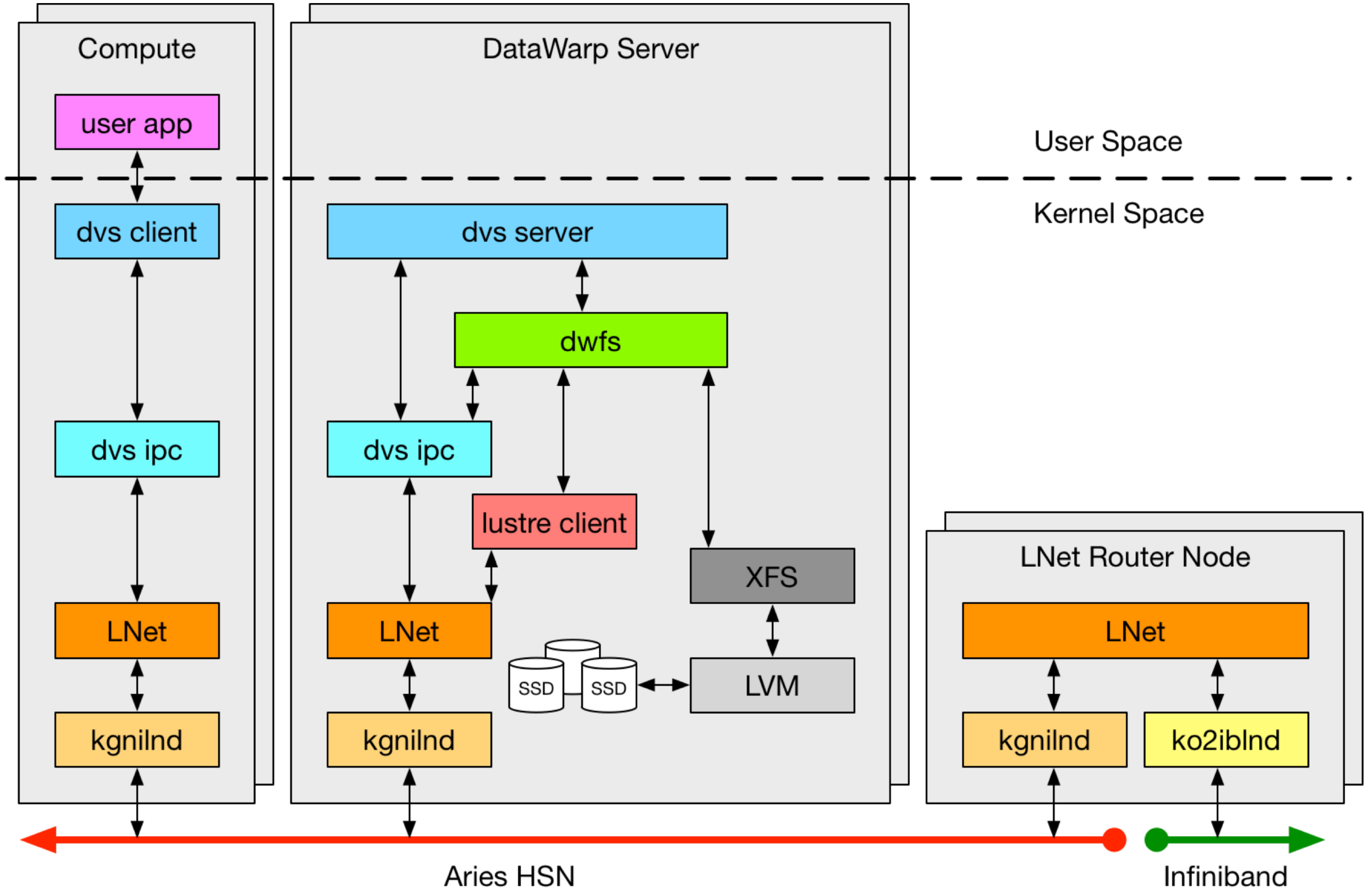


Transparent Cache Data Path

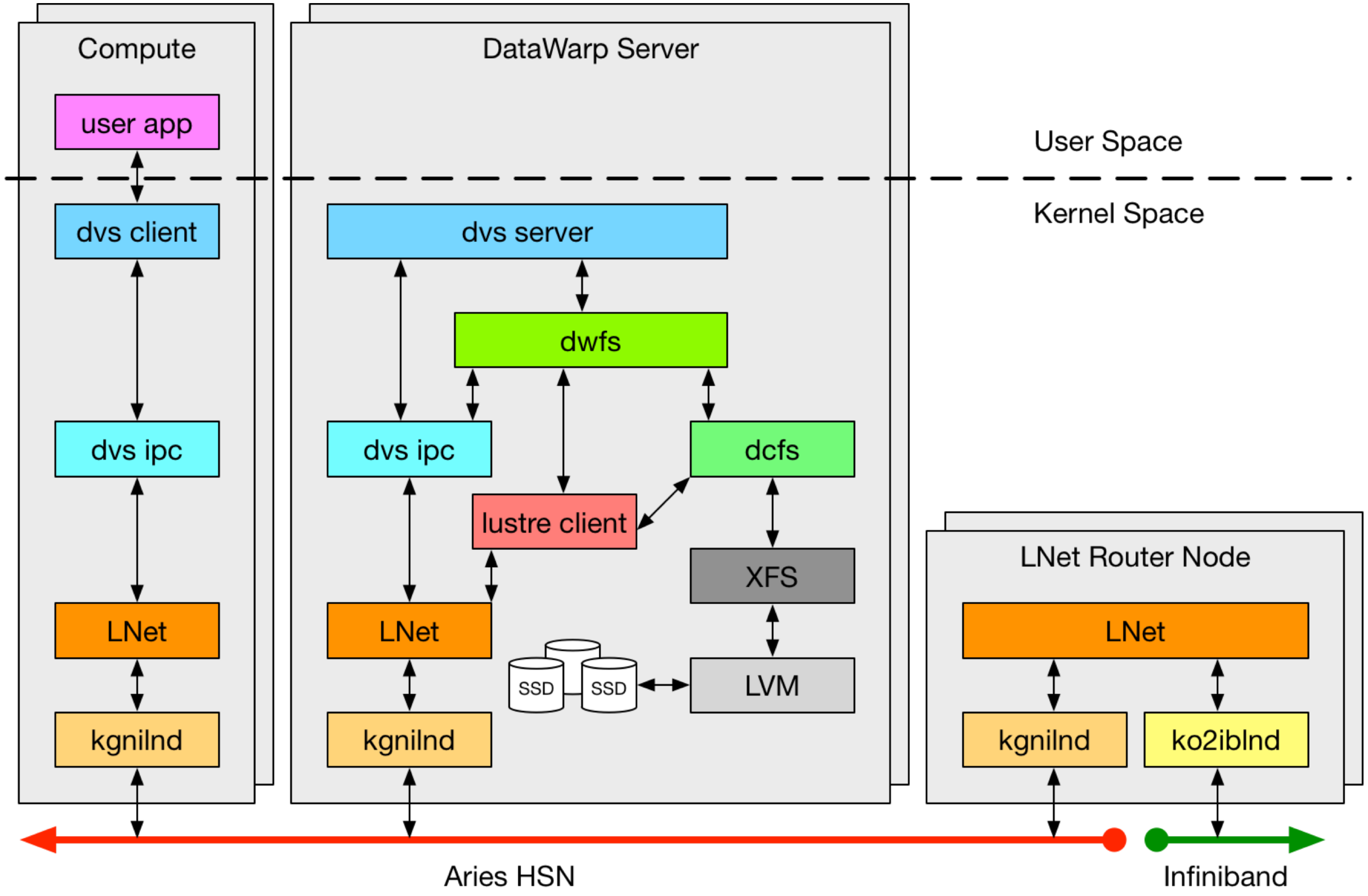


- **Compute nodes**
  - DVS client
- **DataWarp nodes**
  - DVS server
  - SSD space
  - DataWarp File System
  - Data Caching Filesystem
  - PFS client

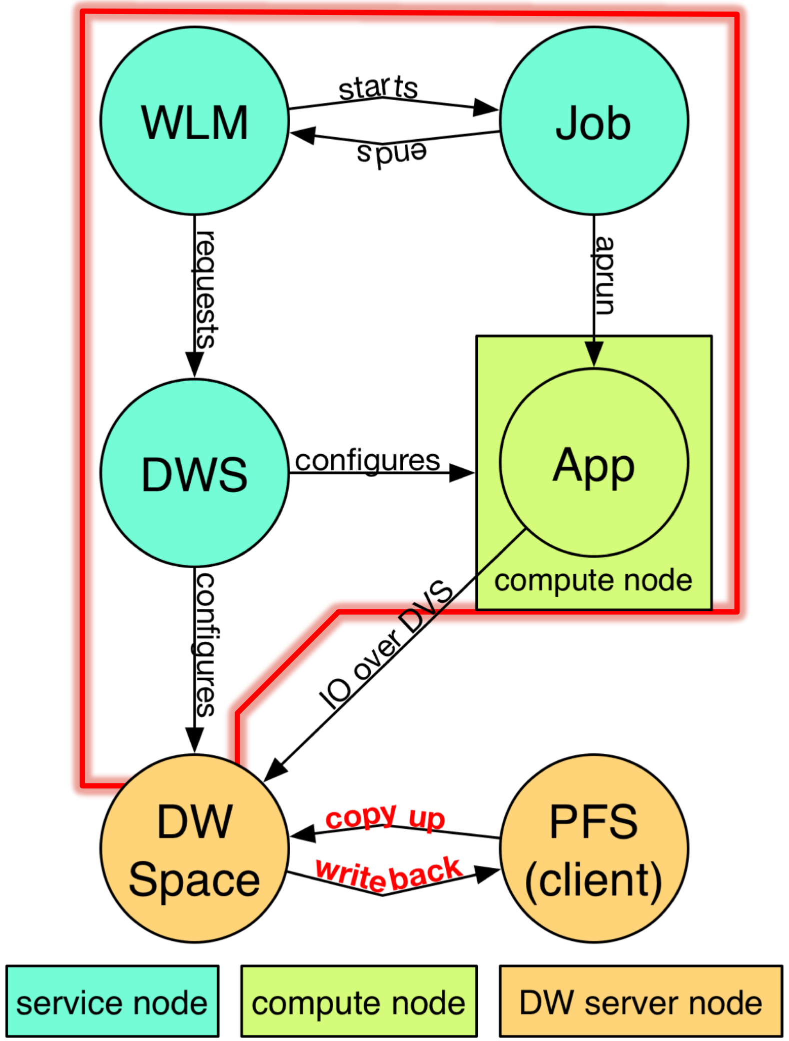
Software Overview (Data path, scratch)



Software Overview (Data path, cache)

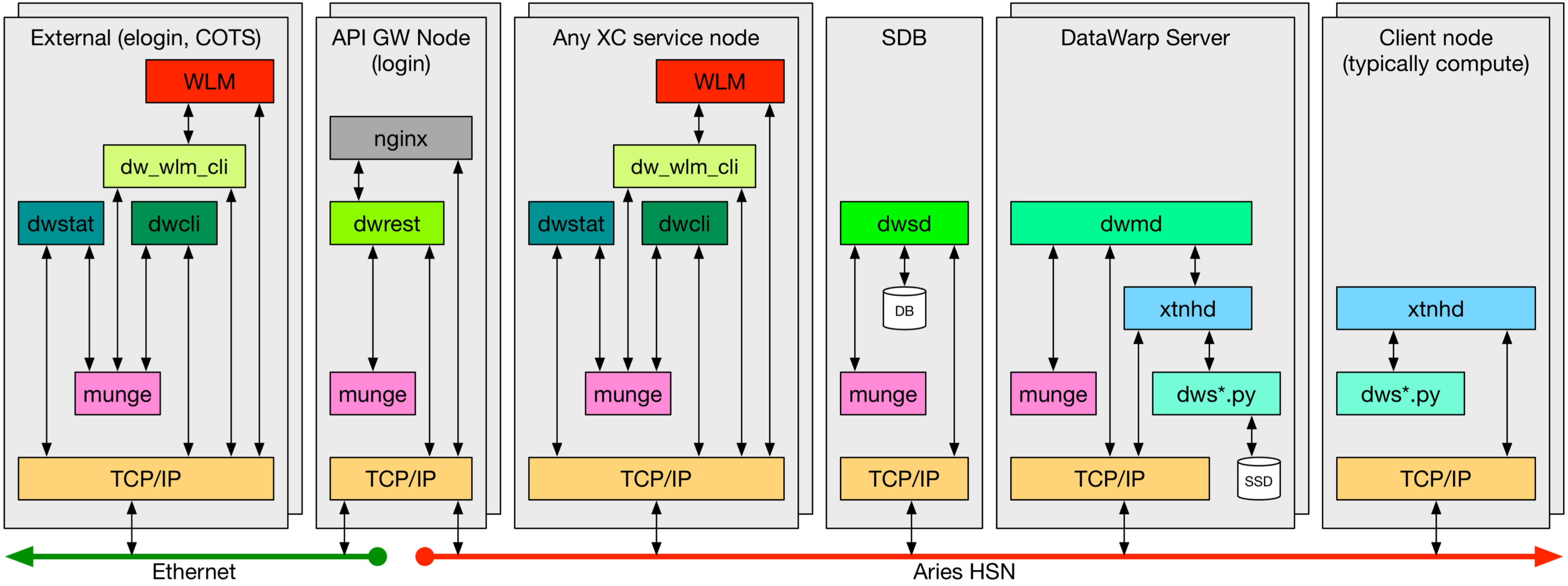


Transparent Cache Orchestration

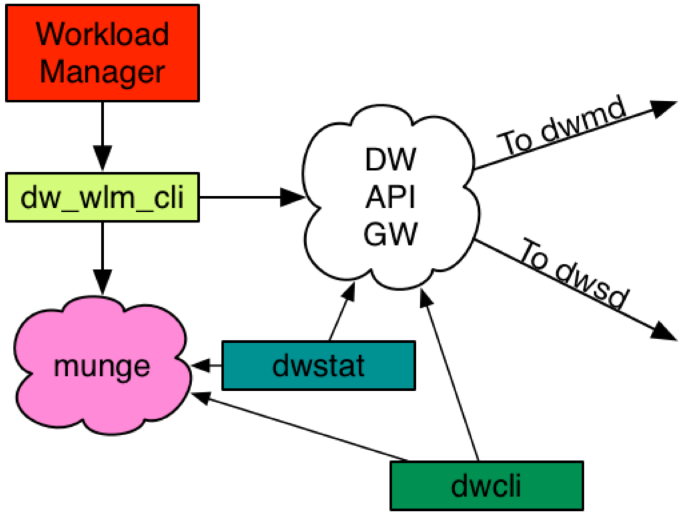


- **Sets up and manages the data path**
- **Workload Managers**
- **DataWarp Service**
- **Node Health services**
  - Scalable fanout of commands
- **MUNGE**
  - Security

Software Overview (Orchestration)

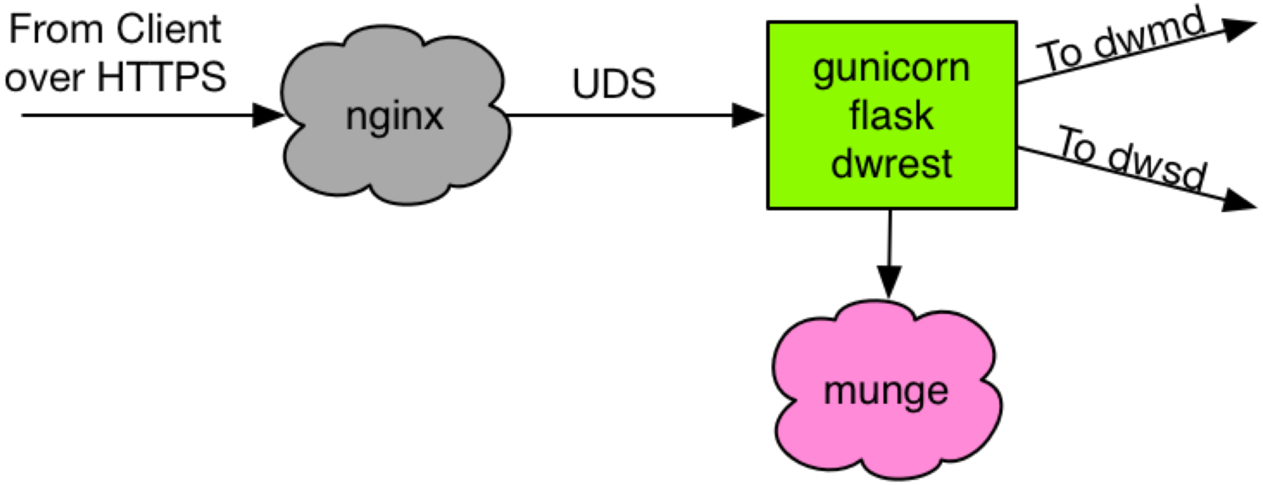


API Clients



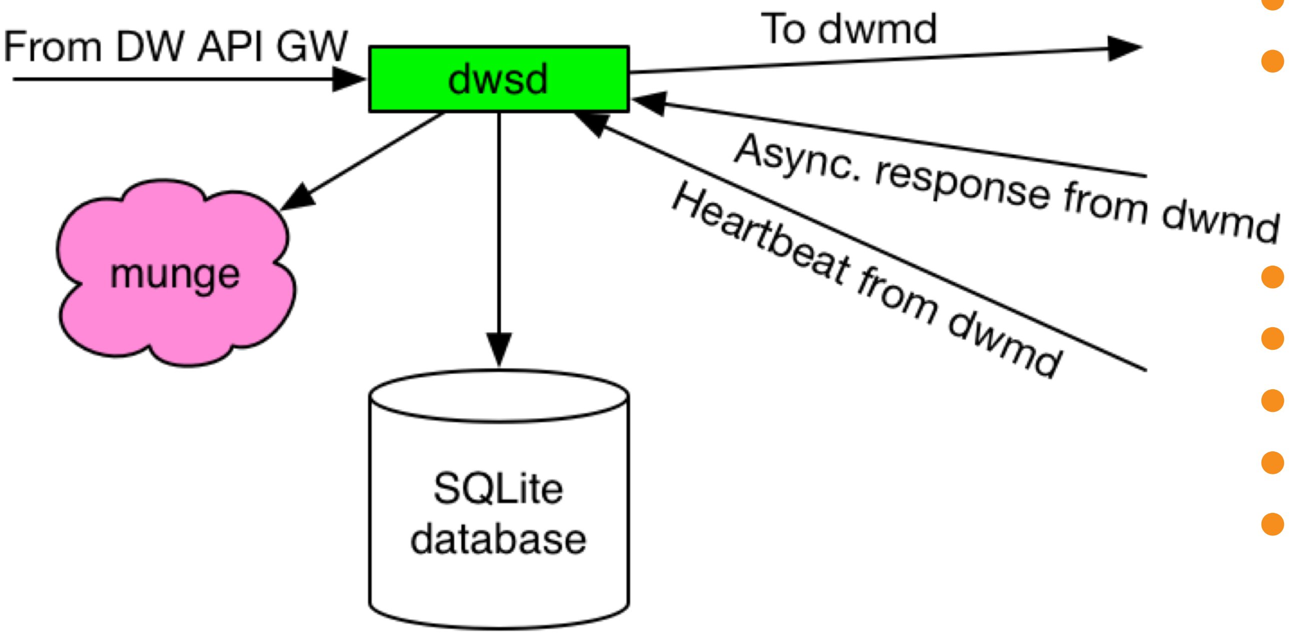
- API clients send requests through the DW API gateway
  - dwrest
- dw_wlm_cli: commandline script for interacting with API GW for WLMs
- dwstat: status command
- dwcli: perform actions
- Authentication through MUNGE
- API GW discovery - dwgateway and libdws_thin0
  - Not shown

API Gateway - dwrest



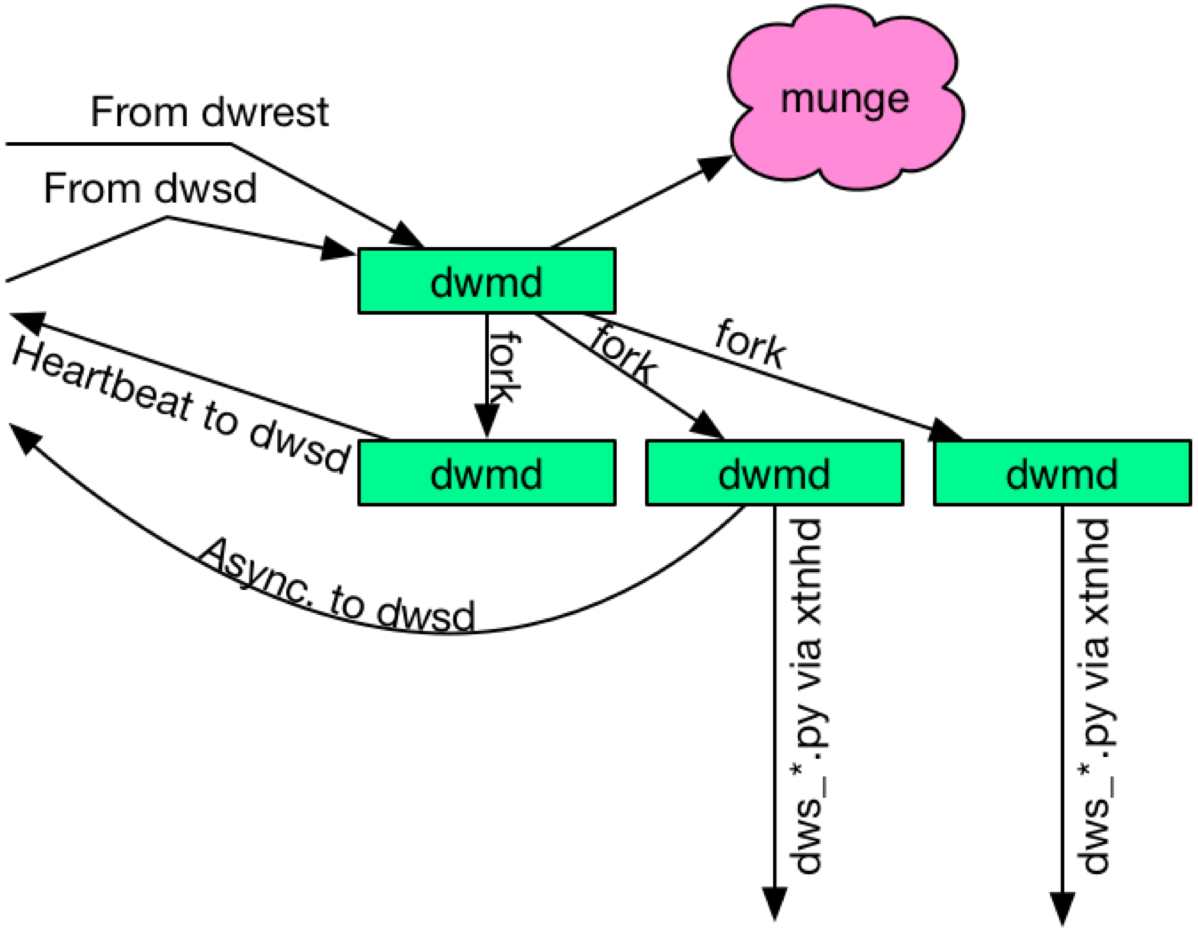
- RESTful API with JSON
- HTTPS
- MUNGE authentication
- dwrest
  - nginx
  - gunicorn
- API GWs on multiple nodes possible
  - Resiliency

dwsd



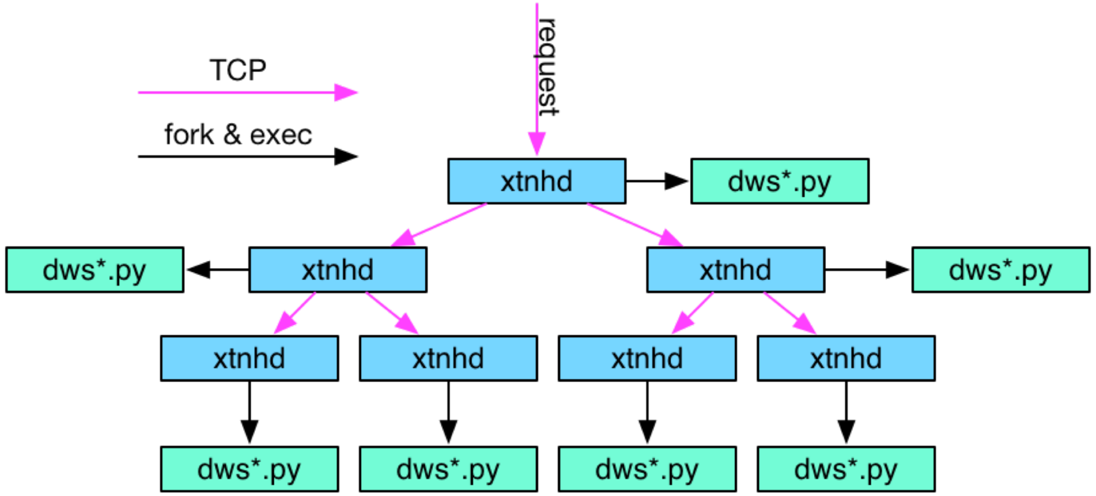
- DataWarp Scheduler Daemon
- Persists state in dwsd.db SQLite file
- Processes requests from API GW
- Dispatches tasks to dwmd, such as interacting with LVM, mounting filesystems, initiating end of job stage out
- Learns about dwmd from heartbeats
- All messages encrypted with MUNGE
- Uses RCA to verify node crashes
- Dispatched requests are asynchronous
- Responses to dwmd requests are received asynchronously

dwmd



- DataWarp Manager Daemon
- Exists on every SSD-endowed node under DWS ownership
- Interacts with LVM volume group dwcache
- dwmd forks for every request
- Periodically heartbeats back to dwsd
- Responses to dwsd requests occur with new socket connection

xtnhd



- Existing Cray software component, part of Node Health
- Scalably executes commands, pushes files, etc via a Tree-based overlay network

dws*.py (ok, and lvm*.py too)

- **Python scripts for performing actual tasks**
  - Creating/destroying logical volume
  - Mounting/unmounting XFS, dwfs, dcfs, DVS mounts
  - Managing swap files
  - Kicking off end-of-job stage-out
  - Checking on health of dwcache volume group
  - Requesting SSD health information from capmc
- **Control data sent via a JSON file pushed with xtnhd**
- **Uses cgroups and “out of order task” (ooot) cache to ensure tasks are carried out *in order***
  - It is possible though unlikely for a teardown task to get processed *before* a setup task, which can lead to admindown nodes

Security within DWS

- **Relies heavily on MUNGE**
  - Works well in environments where UID and GID namespace is identical across nodes
- **DWS daemons only process messages that...**
  - ...are encrypted with MUNGE
  - ...were sent by trusted user IDs

Client security

- Client-API gateway communication over HTTPS
- Client authentication with MUNGE in HTTP header
- Authorization
  - Admins, users, and none
- Admins specified in configuration file, default root and crayadm
- Admins can see everything, do almost anything, and do things on behalf of users
- Users can see things associated with or usable by their user id

System Configuration & Tuning

Points of Configuration

- **cray_dws config set**
- **Over-provisioning**
  - Intel P3608 only
- **LVM setup**
- **Software Runtime**
  - Pools
  - Putting server nodes in to pools
- **WLM**
  - Slurm example

Points of Configuration: cray_dws

- **Specify DataWarp servers in datawarp_nodes node group**
- **Enable cray_ipforward service**
  - DWS uses capmc for SSD health information, which requires access to SMW
- **Enable cray_munge service**
  - DWS uses MUNGE for authentication
- **Enable cray_persistent_data service**
  - Persisting /var/opt/cray/dws ensures DW filesystems and pool data survive reboots
- **Configure cray_dws**
  - Enable the service
  - Set managed nodes to datawarp_nodes node group
  - Set api gateway nodes to login_nodes node group
  - Set external_api_gateway_hostnames to FQDNs of login nodes with external network access to allow eLogin nodes and other non-XC nodes native access to the DataWarp RESTful API
  - Set dwrest_cachemount_whitelist to list of PFS on system
  - Set allow_dws_cli_from_computes if needed
- **Enable cray_dw_wlm service**
  - Configuration options that impact behavior of dw_wlm_cli during failures

Points of Configuration: Over-provisioning

- Intel P3608 SSDs only
- Increases drive lifetime by reducing byte quantity available for filesystems
  - …but probably not needed – your call!
- Replace /dev/nvme0 with /dev/nvme1, /dev/nvme2, /dev/nvme3 to get all devices on a node
- See Cray S-2564 for value for your SSD

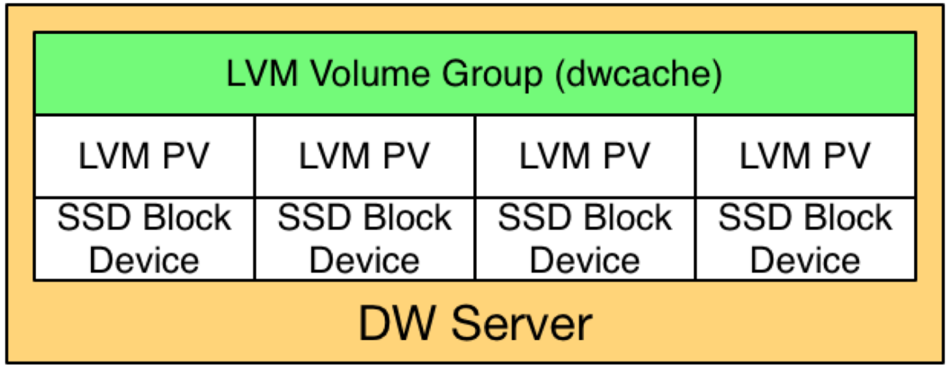
```
dwnode# module load linux-nvme-ctl
dwnode# nvme set-feature /dev/nvme0 \
> -n 1 -f 0XC1 -v 3125623327
```

Points of Configuration: LVM setup

- Only needed one time per set of hardware
- Create Volume Group dwcache from all available SSDs
- Restart dwmd daemon when finished

```
dwnode# pvcreate /dev/nvme0n1 /dev/nvme1n1 \
> /dev/nvme2n1 /dev/nvme3n1
<success output>
dwnode# vgcreate dwcache \
> /dev/nvme0n1 /dev/nvme1n1 /dev/nvme2n1 /dev/nvme3n1
<success output>
dwnode# systemctl start dwmd
```

LVM Volume Group dwcache



LVM Volume Group (dwcache)

LVM PV | LVM PV | LVM PV | LVM PV

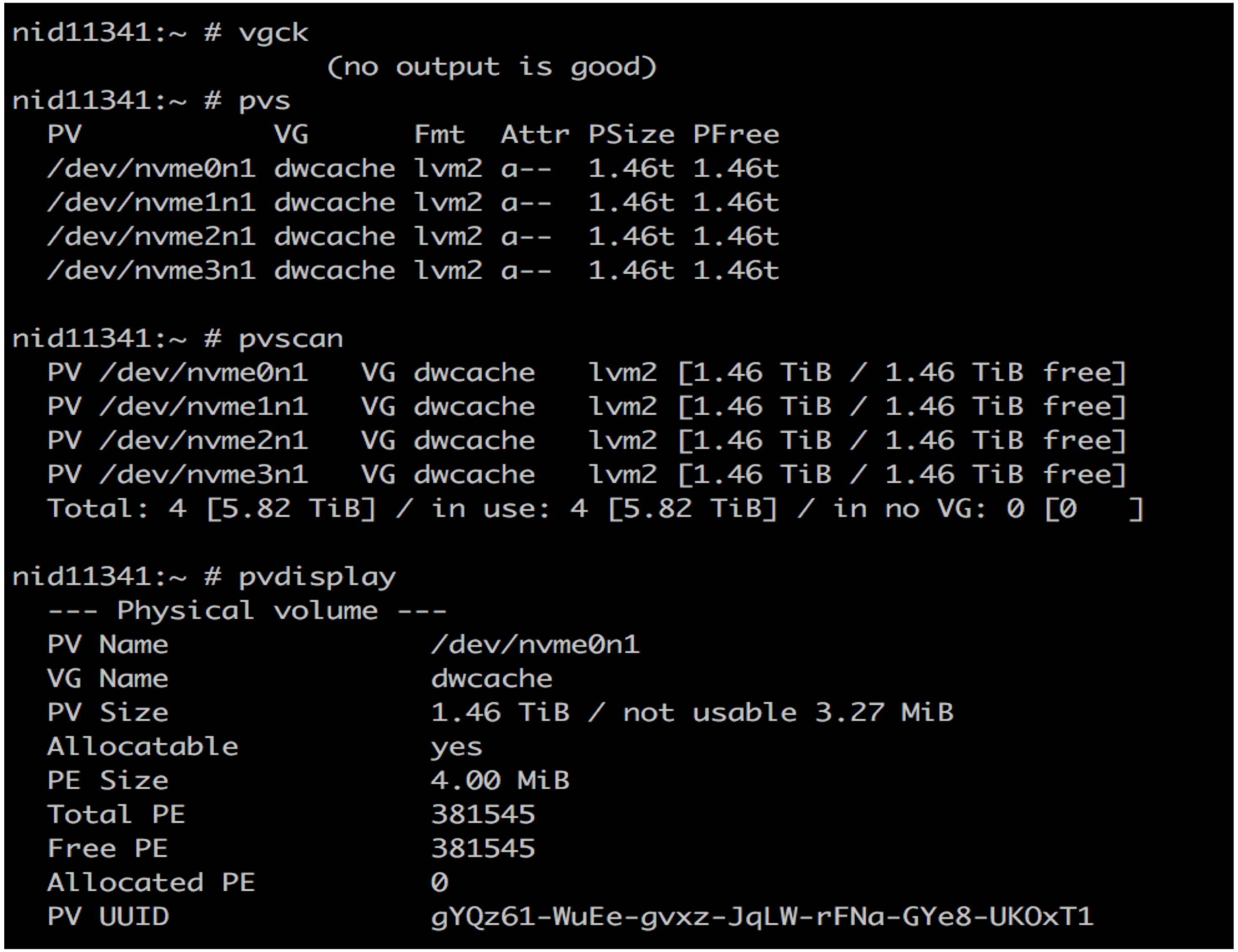
SSD Block Device | SSD Block Device | SSD Block Device | SSD Block Device

DW Server

LVM Tools Bootcamp

- **Logical Volume Manager**
- **Block devices converted to *Physical Volumes* with pvcreate**
  - View PVs with pvs/pvdisplay
- **PVs grouped in to *Volume Groups* with vgcreate**
  - View VGs with vgs/vgdisplay
- ***Logical Volumes* carved out of VGs with lvcreate**
  - View LVs with lvs/lvdisplay
- **Remove with *lvremove*, *vgremove*, or *pvremove***

Underlying SSD file system



```
nid11341:~ # vgck
                  (no output is good)
nid11341:~ # pvs
  PV             VG      Fmt  Attr PSize PFree
  /dev/nvme0n1 dwcache lvm2 a--   1.46t 1.46t
  /dev/nvme1n1 dwcache lvm2 a--   1.46t 1.46t
  /dev/nvme2n1 dwcache lvm2 a--   1.46t 1.46t
  /dev/nvme3n1 dwcache lvm2 a--   1.46t 1.46t

nid11341:~ # pvscan
  PV /dev/nvme0n1   VG dwcache   lvm2 [1.46 TiB / 1.46 TiB free]
  PV /dev/nvme1n1   VG dwcache   lvm2 [1.46 TiB / 1.46 TiB free]
  PV /dev/nvme2n1   VG dwcache   lvm2 [1.46 TiB / 1.46 TiB free]
  PV /dev/nvme3n1   VG dwcache   lvm2 [1.46 TiB / 1.46 TiB free]
  Total: 4 [5.82 TiB] / in use: 4 [5.82 TiB] / in no VG: 0 [0   ]

nid11341:~ # pvdisplay
  --- Physical volume ---
  PV Name               /dev/nvme0n1
  VG Name               dwcache
  PV Size               1.46 TiB / not usable 3.27 MiB
  Allocatable           yes
  PE Size               4.00 MiB
  Total PE              381545
  Free PE               381545
  Allocated PE          0
  PV UUID               gYQz61-WuEe-gvxz-JqLW-rFNa-GYe8-UKOxT1
```

Points of Configuration: Create DWS pool

- **Create a storage pool with dwcli**
- **Pools must have a granularity of at least 16MiB**
- **Nodes can only belong to pools if the node allocation granularity (dwstat nodes) is a factor of the pool granularity**
- **Large granularity**
  - Less sharing & interference
  - Less bandwidth OR more capacity waste
- **Small granularity**
  - More bandwidth potential
  - More interference potential
  - Less capacity waste
  - Server crash will impact more servers

Pool Size Recommendations

- **Recommendations**
  - Turn equalize_fragments on (default as of 6.0.UP05)
  - Pool granularity should be as small as possible, usually 16MiB
  - Pools should consist of nodes that are all the same size, performance
  - If you must mix nodes in a pool with different node allocation granularities, calculate LCM(16MiB, node1 alloc gran, node2 alloc gran, …) and use that
- **Can’t turn equalize_fragments on?**
  - Performance will suffer
  - Use dwpoolhelp tool to assist

dwcli create pool

```
crayadm@login> module load dws

crayadm@login> dwcli create pool --name wlm_pool --granularity 16MiB
create request for pools entity with name = wlm_pool accepted, "dwstat pools" for status

crayadm@login> dwstat pools
    pool units quantity    free  gran
wlm_pool bytes        0       0 16MiB
```

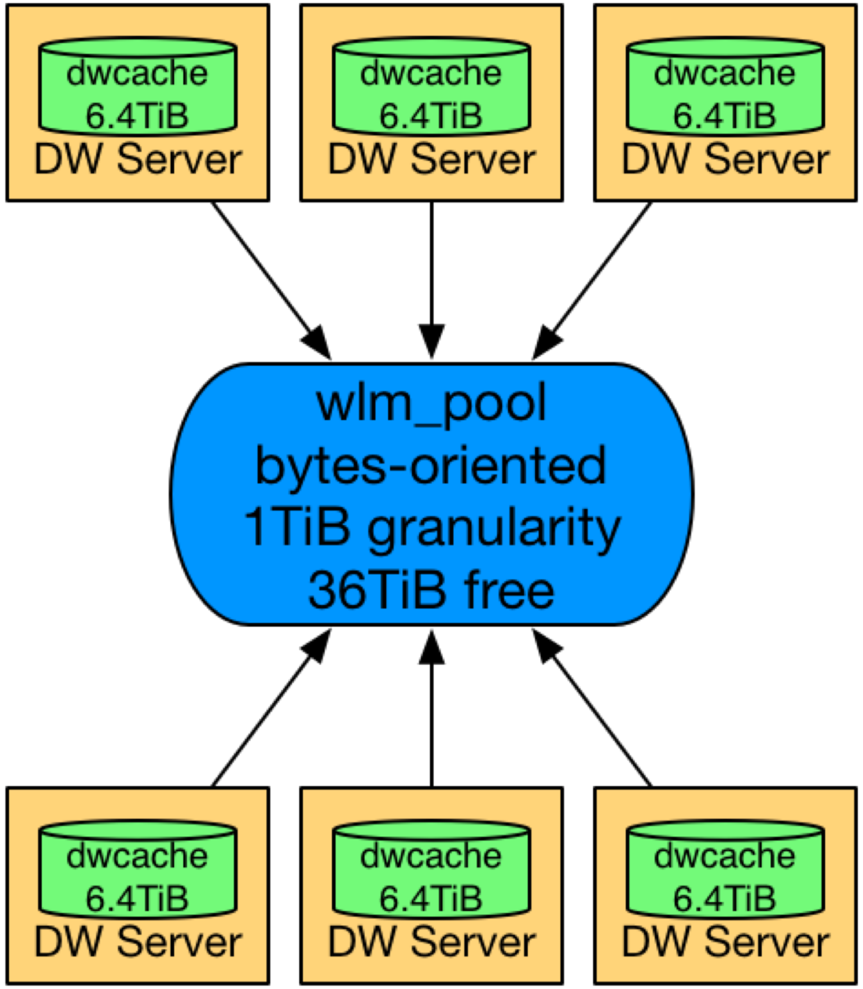
Points of Configuration: Put nodes in to pool

- Find server nodes with dwstat nodes
- Put server nodes into pool with dwcli

```
crayadm@login> module load dws

crayadm@login> dwcli update node --name dwnode --pool wlm_pool
update request for nodes entity with name = dwnode accepted,
"dwstat nodes" for status

crayadm@login> dwstat pools
    pool units quantity     free   gran
wlm_pool bytes  5.82TiB 5.82TiB 16MiB
```

Nodes in a Pool

- **1TiB allocation granularity**
  - This is very high, closer to 16MiB is recommended
- **Depending on your allocation granularity, you can waste space**
  - 0.4TiB per node wasted here



Updating DataWarp Configuration Files

- **Persistent changes should be made through configurator**
- **Immediate, one-time changes can be made to .yaml files directly**
  - Then send SIGHUP or ‘systemctl reload dwsd/dwmd/dwrest’
  - Syntax errors will NOT cause daemons to crash or abort, but they will complain in the log file
- **api-gw:/etc/opt/cray/dws/dwrest.yaml**
- **sdb:/etc/opt/cray/dws/dwsd.yaml**
- **ssd-node:/etc/opt/cray/dws/dwmd.yaml**

Interesting dwsd.yaml Options

- **scratch_limit_action, cache_limit_action: controls what to do when SSD excessive writes detected**
  - Do nothing, log only, error only, log and error
- **Set the following to 0 to disable the SSD write protection by default**
  - scratch_namespace_max_files_default
  - scratch_namespace_max_file_size_default
  - cache_max_file_size_default
  - instance_write_window_length_default
  - instance_write_window_multiplier_default
- **Change DVS stripe size with scratch_stripe_size**
  - Default of 8388608 bytes
- **Change DWFS substripe size with scratch_substripe_size**
  - Default of 8388608 bytes
- **Change DWFS substripe width with scratch_substripe_width**
  - Default of 12 for stripe
  - Default of 1 for private

Interesting dwmd.yaml options

- **61 options in CLE 6.0UP04, all with brief descriptions**
  - Majority are un-interesting path-related configuration options
- **dvs_mnt_opt: custom options for DVS client mounts**
  - dvs_scratch_mnt_opt: scratch only
  - dvs_cache_mnt_opt: cache only
- **dwfs_mnt_opt: custom options for all DWFS mounts**
  - dwfs_scratch_mnt_opt: scratch only
  - dwfs_cache_mnt_opt: cache only
- **dcfs_mnt_opt: custom options for all DCFS mounts**
- **log_mask: enable extra dwmd logging**
- **rscript_debug: enable extra dws*.py debug logging**
- **debug_flag: developer knob**
  - 0x1: Dump child task table
  - 0x2: SIGCHLD related messages
  - 0x4: Heartbeat related messages

dwmd.yaml rscript_debug controls

```
self.dflags = {
        'dws_device_health':       0,
        'dws_n2rns':               1,
        'dws_n2slb':               2,
        'dws_namespace':           3,
        'dws_realm_member':        4,
        'dws_realm_member_reg':    5,
        'dws_swap':                6,
        'dws_sync_tasks':          7,
        'dws_util':                8,
        'lvm_fragment':            9,
        'lvm_info':                10,
        'dws_sync_tasks_dwfs2':    11,
        # insert new script here
        'test':                    30,
        'all_script':              31,
        'all_debug':               32,
        'p_inputfile':             33,
        'p_map_table':             34,
        'p_input':                 35,
        'p_data':                  36,
        'p_path':                  37,
        'p_info':                  38,
        # insert new flag here
        'p_tmpfile':               48,
        # insert new allfile flag here
        'p_tlock':                 55,
        'p_mnt':                   56,
        'level1':                  57,
        'level2':                  58,
        'level3':                  59,
        # 60-62 are reserved for other
actions
        'save_tmp':                63,
    }
```

rscript_debug details

- ‘_input’ prints parameters
- ‘_data’ prints processed input data such as json input data from request
- ‘_path’ prints mount path related
- ‘_info’ is some interesting data.
- 'p_map_table' prints table data such as mount lookup table which is used for finding umount all for destroy.
- ‘p_tmpfile’ prints created tmpfile data.
- ‘p_tlock’ is task related debug output
- ‘p_p_mnt’ is mount related data.
- ‘save_tmp’ is set, dwmd will not remove any tmp input file.
- ‘level3’ turns on 'p_tlock', 'p_input', 'p_data’
- ‘level2’ turns on 'p_path', 'p_mnt’
- 'level1' turns on 'p_info'

Interesting dwrest.yaml options

- **Some options are meant for use outside of WLM**
  - user_mountroot_whitelist
- **Or to protect from misuse**
  - admin_mountroot_blacklist
- **Grant “root like” privileges to DW functionality**
  - admins
- **Flexible but insecure filter for type=cache**
  - cacheroot_whitelist
- **Inflexible but secure filter for type=cache**
  - cachemount_whitelist

Log Files & Analysis

Logging Overview

- **dwsd, dwmd, dwrest log centrally to SMW with LLM**
  - smw:/var/opt/cray/log/p#-<bootsession>/dws
- **Log file per daemon type per day**
- **nginx log files stuck on internal API gateway nodes**
  - Rarely needed anyway
- **Data path tends to log to system console**

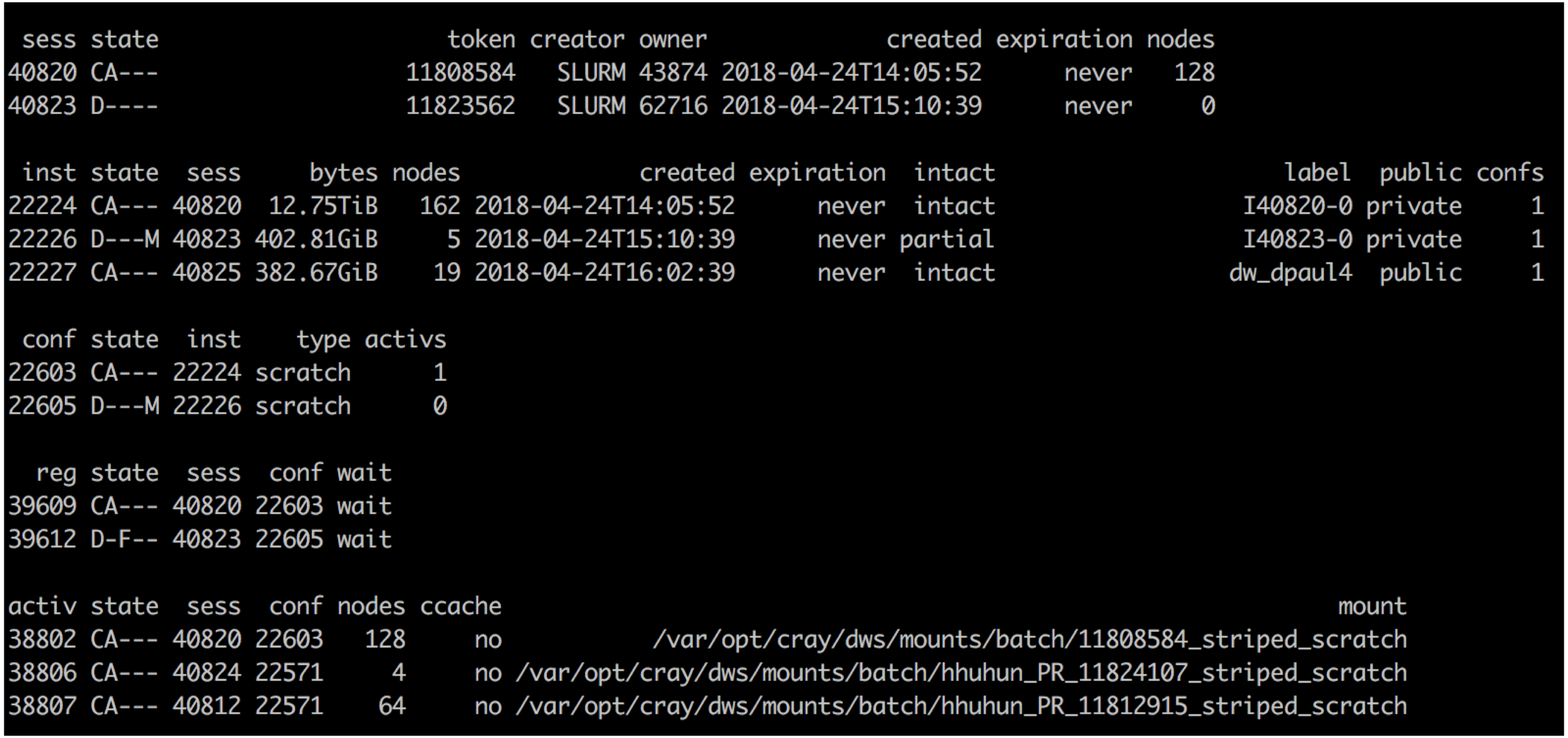
Logfile Navigation

- **nginx log file**
  - Useful for identifying if API clients can reach API gateway nodes
  - Also lists out underling API URIs
- **dwrest log file**
  - Useful in debugging staging issues
- **dwsd log file**
  - Useful to establish when objects were created, destroyed
  - Useful to track when nodes crashed, rebooted
- **dwmd log file**
  - Useful for finding out what exactly encountered difficulty
  - **Tags most lines with DW object info and session token (i.e., WLM job)**

Blown Fuses (a brief detour)

- **The DWS will retry create/destroy operations. Persistent failures on an object, once the number of retries has exceeded, causes that object's fuse to blow**
  - An operation will not be retried while the fuse is blown
- **Blown fuses almost always means a stuck application process (for activations) or a bug (situations that lead to the inability to unmount something)**
- **Replace the fuse with dwcli**
  - dwcli update instance --id 12 --replace-fuse
  - ...but unless the underlying problem is fixed, the fuse may blow again

Blown Fuses (example)



```
 sess state                     token creator owner             created expiration nodes
40820 CA---                  11808584   SLURM 43874 2018-04-24T14:05:52      never   128
40823 D----                  11823562   SLURM 62716 2018-04-24T15:10:39      never     0

 inst state  sess     bytes nodes             created expiration  intact                     label  public confs
22224 CA--- 40820  12.75TiB   162 2018-04-24T14:05:52      never  intact                 I140820-0 private     1
22226 D---M 40823 402.81GiB     5 2018-04-24T15:10:39      never partial                 I140823-0 private     1
22227 CA--- 40825 382.67GiB    19 2018-04-24T16:02:39      never  intact                 dw_dpaul4  public     1

 conf state  inst    type activs
22603 CA--- 22224 scratch      1
22605 D---M 22226 scratch      0

  reg state  sess  conf wait
39609 CA--- 40820 22603 wait
39612 D-F-- 40823 22605 wait

activ state  sess  conf nodes ccache                                                             mount
38802 CA--- 40820 22603   128     no           /var/opt/cray/dws/mounts/batch/11808584_striped_scratch
38806 CA--- 40824 22571     4     no /var/opt/cray/dws/mounts/batch/hhuhun_PR_11824107_striped_scratch
38807 CA--- 40812 22571    64     no /var/opt/cray/dws/mounts/batch/hhuhun_PR_11812915_striped_scratch
```

Why Did the Fuse Blow?

- **Relatively straightforward in CLE 6.0.UP00 and higher**
  - Tedious in prior releases (sorry)
  - dwmd log file tagging (next)
- **Knowing why a fuse blew does not necessarily mean you can prevent it from happening again**
  - Sorry, but you probably have to file a bug with Cray
- **Especially on teardown, sometimes you just have to reboot nodes**
  - But you don't necessarily have to reboot right away!
  - Depending on what is stuck, you may just not be able to access all of DW space until the issue clears up

dwmd log file tagging

- dwmd LLM log file general format is
  - LLM prefix + <task id> + [hostname]: + (tags) + message
- LLM prefix: rfc5424 format
- <task id>: identifier logged in dwsd log
- [hostname]: on which node the message originates
- (tags): object id, session id, session token (i.e., batch job id)
- message: the actual error or success message

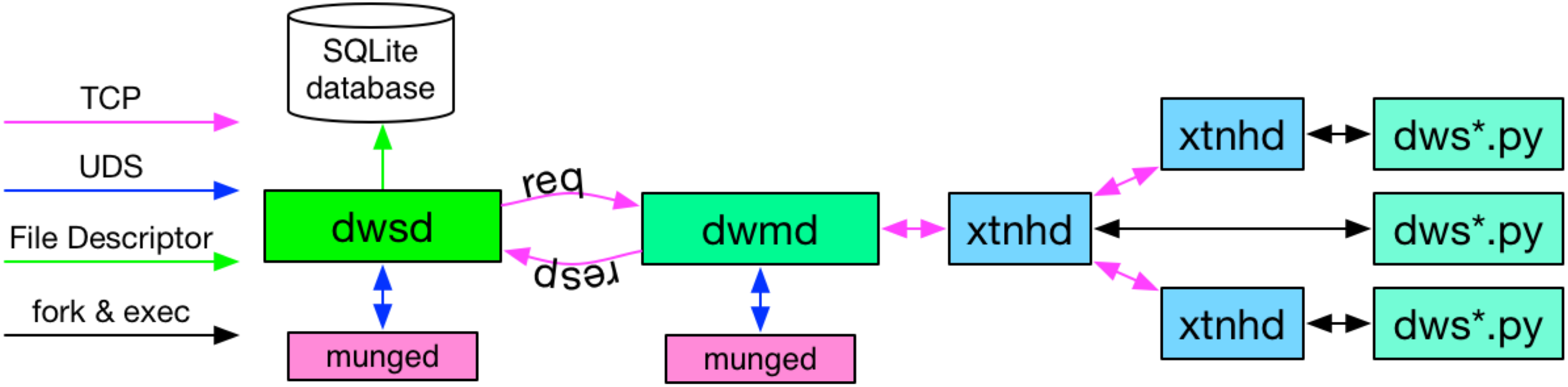
dwmd log file example

```
<150>1 2016-05-29T00:00:47.031371-05:00 c1-0c2s0n2 dwmd 11570 p0-20160528t233312 [dws@34] <681> [nid00350]: (cid:28,sid:27,stoken:32236) dws_realm_member INFO:>>>> mount -t dwfs /var/opt/cray/dws/mounts/fragments/52 /var/opt/cray/dws/mounts/realm-member/50 -o realm_id=27,path=/var/opt/cray/dws/mounts/realm-member/50,server_file=/tmp/tmpdBhJUg,threshold_action=log_and_error,write_window=86400,write_threshold=60473139527680
```

- **LLM prefix + <task id> + [hostname]: + (tags) + message**
- **This message emitted for task id 681**
- **nid00350 generated the message**
- **Message concerns configuration 28, session 27, with session token 32236 (i.e., batch job id)**
- **Takeaway - can search single dwmd log file for batch job id to more quickly identify certain DataWarp issues associated with the batch job**

Why [hostname] is needed

- dws*.py may execute on nodes other than dwmd



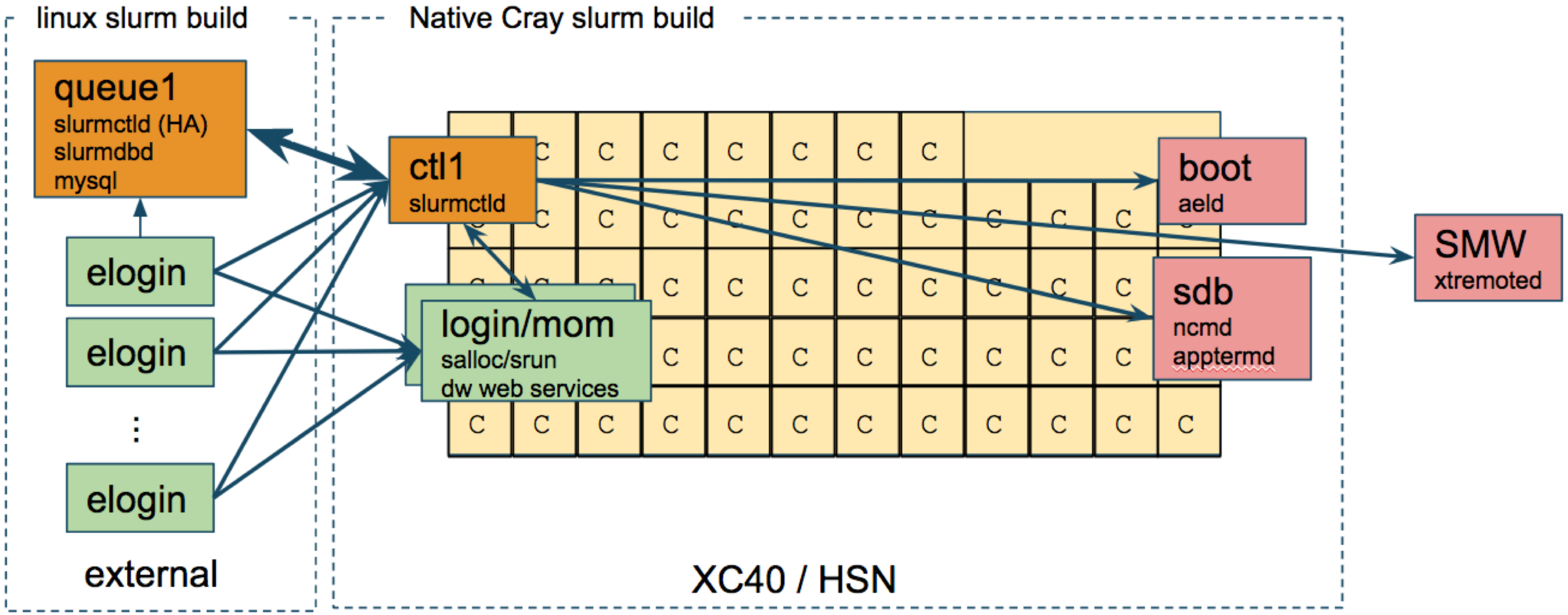
Interactive Example

- As time permits

Break (back in 30!)

Slurm & DataWarp

Architecture of Slurm on Cori



🟩 User accessible, ssh, all network fs, sssd

🟨 Limited user access, require job, limited ssh, all network fs, sssd

🟧 No direct user access, restricted ssh, all network fs, sssd

🟥 No user access, root-only ssh, no network fs, restricted user database

Warning: this is a vastly simplified view of cori slurm deployment and map of interactions

Courtesy D. Jacobsen

Slurm configuration for DataWarp (very simple)

- **slurm.conf : BurstBufferType=burst_buffer/cray**
- **burst_buffer.conf :**
  - **DefaultPool**: name of the pool used by default for resource allocations
    - **wlm_pool**
  - **AltPoolName**: allows for different storage configurations (ex. Granularity size)
  - **DenyUsers**: list of user names and/or IDs prevented from using burst buffers
  - **Flags EnablePersistent**: allows users to create/destroy persistent burst buffers
  - **Flags TeardownFailure**: remove DW allocation on job failure
- **QoS/TRES – control user access, user quotas, usage and report them**

DWS’ dwcli vs. Slurm (one session)

```
# dwcli –j ls session
"created": 1473889069,
"creator": "CLI",
"expiration": 0,
"expired": false,
"id": 9711,
"links": {
  "client_nodes": []
"owner": 95448,
"state": {
"actualized": true,
"fuse_blown": false,
"goal": "create",
"mixed": false,
"transitioning": false
"token": "tractorD”

# scontrol show burst | grep dpaul
Name=tractorD CreateTime=2016-09-14T14:37:49 Pool=wlm_pool Size=7200G State=allocated UserID= dpaul(95448)
```

Slurm status summary

```
# scontrol show burst

Name=cray DefaultPool=wlm_pool Granularity=80G TotalSpace=765600G UsedSpace=50400G
  AltPoolName[0]=tr_cache Granularity=16M TotalSpace=61047200M UsedSpace=6842000M
  Flags=EnablePersistent,TeardownFailure
  StageInTimeout=86400 StageOutTimeout=86400 ValidateTimeout=5 OtherTimeout=300
  GetSysState=/opt/cray/dw_wlm/default/bin/dw_wlm_cli
  Allocated Buffers:
  Name=udabb CreateTime=2018-04-28T13:33:26 Pool=wlm_pool Size=10400G State=allocated UserID=dgh(93131)
  Name=rfmip_modat CreateTime=2018-04-30T21:18:23 Pool=wlm_pool Size=12400G State=allocated UserID=dfeld(96837)
  Name=dpaul_tr CreateTime=2018-04-22T12:38:59 Pool=tr_cache Size=800G State=allocated UserID=dpaul(95448)
  JobID=0_0(2793398) CreateTime=2018-04-31T00:28:50 Pool=(null) Size=0 State=allocated UserID=dfeld(96837)
  JobID=2971140 CreateTime=2018-05-09T14:10:26 Pool=wlm_pool Size=1200G State=teardown UserID=kim(97002)

  Per User Buffer Use:
    UserID=dgh(93131) Used=10400G
    UserID=dfeld(96837) Used=12400G
    UserID=dpaul(95448) Used=800G
    UserID=kim(91002) Used=1200G
```

DWS dwstat (administrator focused)

```
# dwstat most
==============================================
    pool units  quantity      free   gran
tr_cache bytes   5.82TiB   5.82TiB  16MiB
wlm_pool bytes 809.96TiB 627.34TiB 200GiB

sess state        token creator owner             created expiration nodes
9708 CA---      2993022   SLURM 90891 2016-09-14T14:27:48      never     8
9710 CA---      tractorD    CLI 95448 2016-09-14T14:31:43      never     0

inst state sess    bytes nodes             created expiration intact        label public confs
1943 CA--- 9708 27.73TiB   142 2016-09-14T14:27:48      never   true      I9708-0  false     1
1945 CA--- 9710 27.73TiB   142 2016-09-14T14:31:43      never   true      tractorD  true     1
```

Using Datawarp without Slurm

```
$ dwcli create session --expiration 4000000000 --creator $(id -un) --token example- session --owner $(id -u)
--hosts example-node created session id 10

$ dwcli create instance --expiration 4000000000 --public --session 10 --pool example-poolname --capacity
1099511627776 --label example-instance --optimization bandwidth created instance id 8

$ dwcli create configuration --type scratch --access-type stripe --root- permissions 0755 --instance 8 --
group 513 created configuration id 7

$ create activation --mount /some/pfs/mount/directory --configuration 7 --session 10 created activation id 7
```

Slurm job script directives- #DW

```
#!/bin/bash
#SBATCH -n 32 -t 2
#DW jobdw type=scratch access_mode=striped capacity=1TiB
#DW stage_in type=directory source=/lustre/my_in_dir destination=$DW_JOB_STRIPED
#DW stage_out type=directory destination=/lustre/my_out_dir source=$DW_JOB_STRIPED
export JOBDIR=$DW_JOB_STRIPED
cd $DW_JOB_STRIPED
srun –n 32 a.out
```

User Library example - libdatawarp

```
// module load datawarp (to get access to the user library for building)
#include <datawarp.h>

// Get Info on DataWarp Configuration:
int r = dw_get_stripe_configuration(fd, &stripe_size, &stripe_width, &stripe_index);

// Use dw_stage_file_in function to move a file from PFS to DataWarp int r =
dw_stage_file_in(dw_file, pfs_file);

// Use dw_stage_file_out function to move a file from DataWarp to PFS int r =
dw_stage_file_out(dw_file, pfs_file, DW_STAGE_IMMEDIATE);

// Use dw_query_file_stage function to check stage in/out completion
int r = dw_query_file_stage(dw_file, &complete, &pending, &deferred, &failed);
```

Create a Persistent Reservation/Allocation (PR)

```
#!/bin/bash
#SBATCH -p debug
#SBATCH -N 1
#SBATCH -t 00:01:00

        ( Create a Persistent Reservation/Allocation (PR) )
#BB create_persistent name=tractorD capacity=7TB access=striped type=scratch
exit
```

```
        ( Specify PR for a subsequent job - #sbatch omitted)
#DW persistentdw name=tractorD

        ( Copy in data in for the job)
#DW stage_in source=/global/cscratch1/sd/dpaul/decam.tar destination=$DW_PERSISTENT_STRIPED_tractorD/job1/runit.sh type=file

#DW stage_in source=/global/cscratch1/sd/dpaul/src_dir destination=$DW_PERSISTENT_STRIPED_tractorD/job1/ type=directory
```

(continued)

Persistent Reservation/Allocation (PR) cont.

(Run the job)

```
cd $DW_PERSISTENT_STRIPED_tractorD/job1/
srun runit.sh  < src_dir  > output_dir
```

(Save results at job completion – here for clarity, must be at top of script & contiguous)

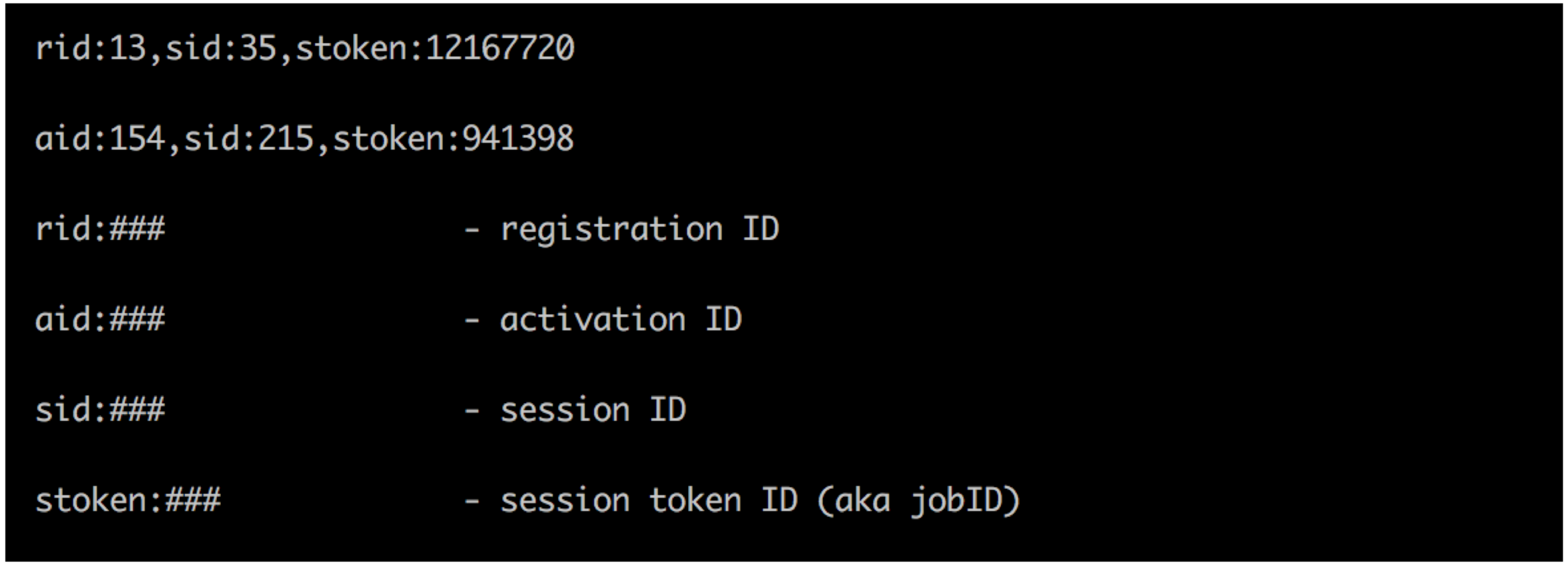
```
#DW stage_out source=$DW_PERSISTENT_STRIPED_tractorD/job1/output_dir
destination=/global/cscratch1/sd/dpaul/job1/ type=directory
```

Transparent Cache features

- BurstBuffer will be used as filesystem cache for all I/O to/from the PFS:

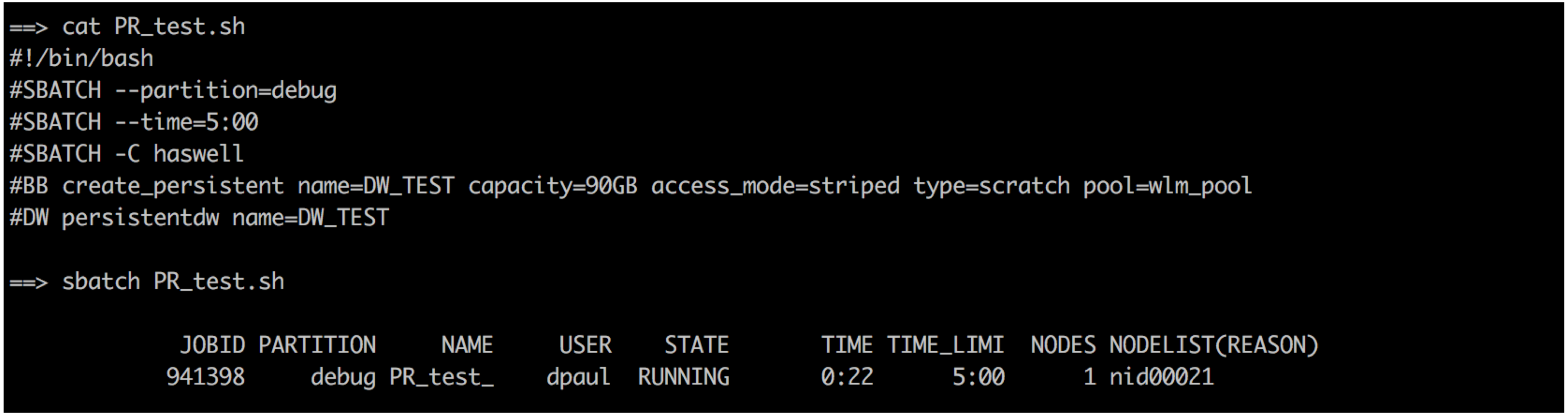
```
#DW jobdw pfs=/global/cscratch1/sd/dpaul/job_output/ capacity=800GB type=cache access_mode=striped
pool=wlm_pool
```

Log legend



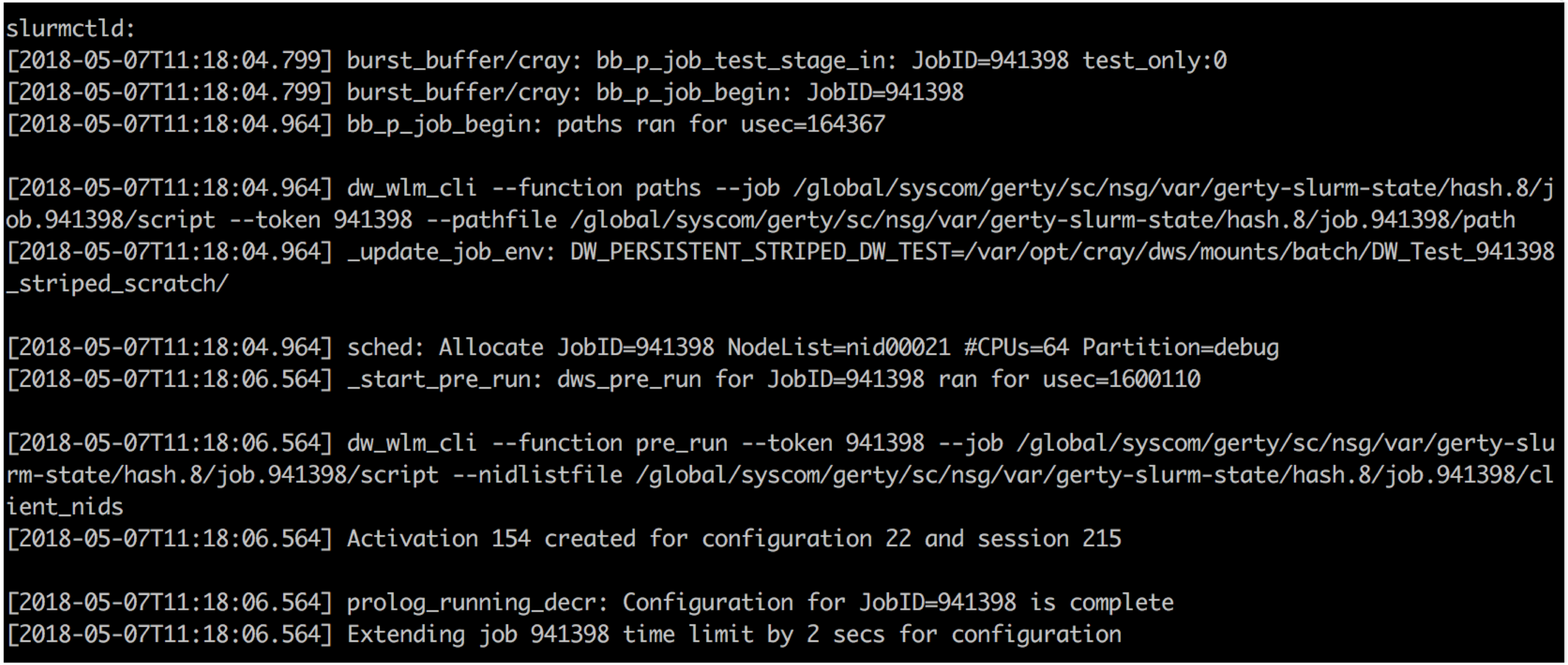
```
rid:13,sid:35,stoken:12167720

aid:154,sid:215,stoken:941398

rid:###                 - registration ID

aid:###                 - activation ID

sid:###                 - session ID

stoken:###              - session token ID (aka jobID)
```

DataWarp creation process outputs



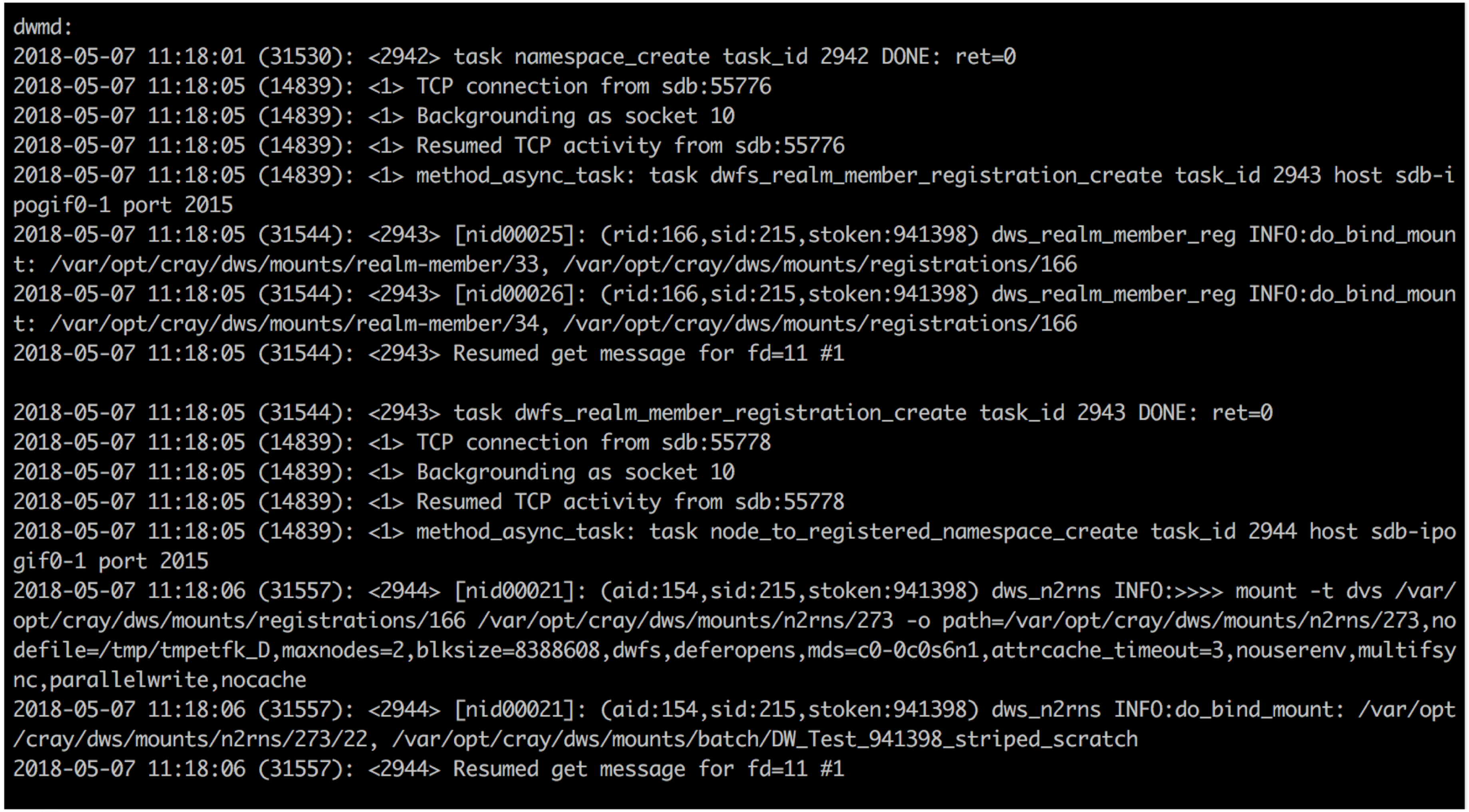
```
==> cat PR_test.sh
#!/bin/bash
#SBATCH --partition=debug
#SBATCH --time=5:00
#SBATCH -C haswell
#BB create_persistent name=DW_TEST capacity=90GB access_mode=striped type=scratch pool=wlm_pool
#DW persistentdw name=DW_TEST

==> sbatch PR_test.sh

             JOBID PARTITION     NAME     USER    STATE       TIME TIME_LIMI  NODES NODELIST(REASON)
            941398     debug PR_test_    dpaul  RUNNING       0:22      5:00      1 nid00021
```

Creation process outputs (slurmctld)



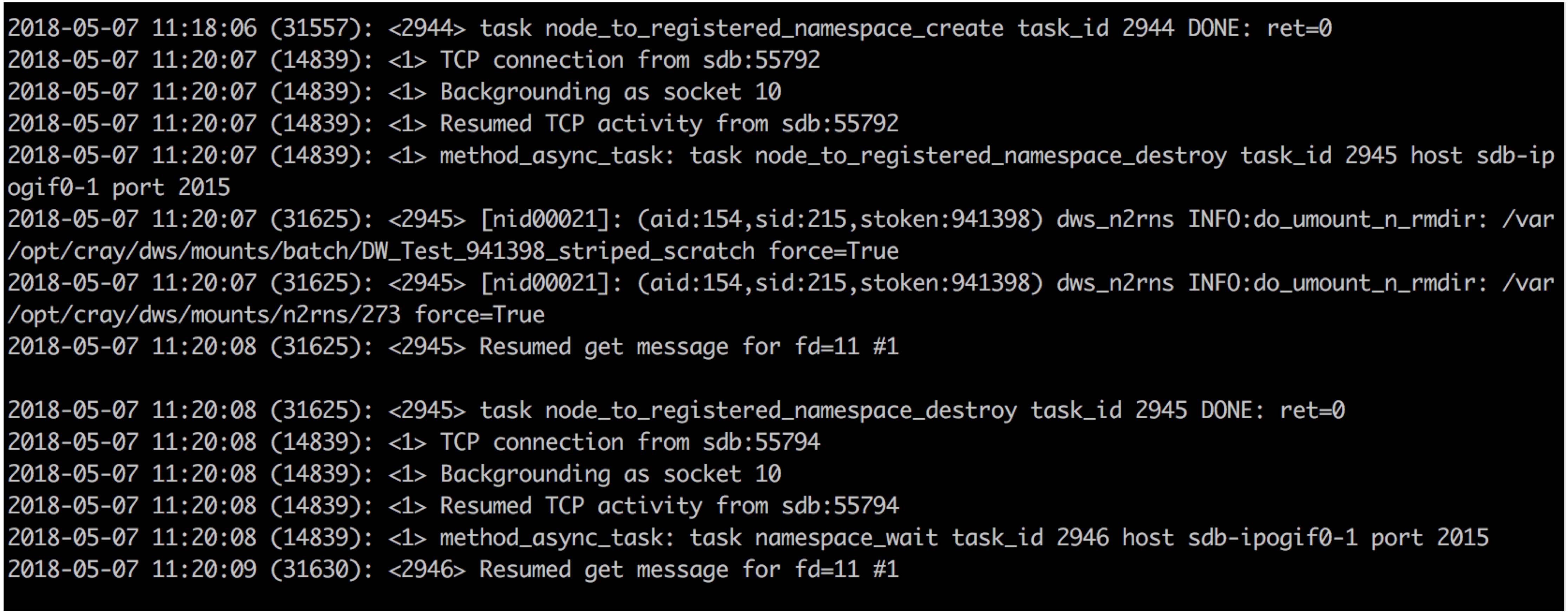
```
slurmctld:
[2018-05-07T11:18:04.799] burst_buffer/cray: bb_p_job_test_stage_in: JobID=941398 test_only:0
[2018-05-07T11:18:04.799] burst_buffer/cray: bb_p_job_begin: JobID=941398
[2018-05-07T11:18:04.964] bb_p_job_begin: paths ran for usec=164367

[2018-05-07T11:18:04.964] dw_wlm_cli --function paths --job /global/syscom/gerty/sc/nsg/var/gerty-slurm-state/hash.8/j
ob.941398/script --token 941398 --pathfile /global/syscom/gerty/sc/nsg/var/gerty-slurm-state/hash.8/job.941398/path
[2018-05-07T11:18:04.964] _update_job_env: DW_PERSISTENT_STRIPED_DW_TEST=/var/opt/cray/dws/mounts/batch/DW_Test_941398
_striped_scratch/

[2018-05-07T11:18:04.964] sched: Allocate JobID=941398 NodeList=nid00021 #CPUs=64 Partition=debug
[2018-05-07T11:18:06.564] _start_pre_run: dws_pre_run for JobID=941398 ran for usec=1600110

[2018-05-07T11:18:06.564] dw_wlm_cli --function pre_run --token 941398 --job /global/syscom/gerty/sc/nsg/var/gerty-slu
rm-state/hash.8/job.941398/script --nidlistfile /global/syscom/gerty/sc/nsg/var/gerty-slurm-state/hash.8/job.941398/cl
ient_nids
[2018-05-07T11:18:06.564] Activation 154 created for configuration 22 and session 215

[2018-05-07T11:18:06.564] prolog_running_decr: Configuration for JobID=941398 is complete
[2018-05-07T11:18:06.564] Extending job 941398 time limit by 2 secs for configuration
```

Creation process outputs (dwmd)



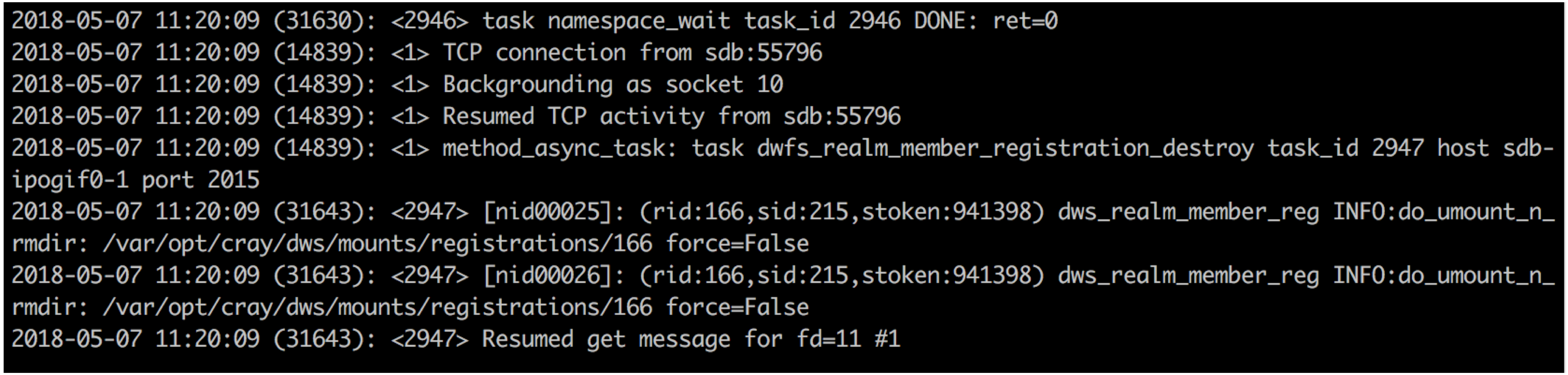
```
dwmd:
2018-05-07 11:18:01 (31530): <2942> task namespace_create task_id 2942 DONE: ret=0
2018-05-07 11:18:05 (14839): <1> TCP connection from sdb:55776
2018-05-07 11:18:05 (14839): <1> Backgrounding as socket 10
2018-05-07 11:18:05 (14839): <1> Resumed TCP activity from sdb:55776
2018-05-07 11:18:05 (14839): <1> method_async_task: task dwfs_realm_member_registration_create task_id 2943 host sdb-i
pogif0-1 port 2015
2018-05-07 11:18:05 (31544): <2943> [nid00025]: (rid:166,sid:215,stoken:941398) dws_realm_member_reg INFO:do_bind_moun
t: /var/opt/cray/dws/mounts/realm-member/33, /var/opt/cray/dws/mounts/registrations/166
2018-05-07 11:18:05 (31544): <2943> [nid00026]: (rid:166,sid:215,stoken:941398) dws_realm_member_reg INFO:do_bind_moun
t: /var/opt/cray/dws/mounts/realm-member/34, /var/opt/cray/dws/mounts/registrations/166
2018-05-07 11:18:05 (31544): <2943> Resumed get message for fd=11 #1

2018-05-07 11:18:05 (31544): <2943> task dwfs_realm_member_registration_create task_id 2943 DONE: ret=0
2018-05-07 11:18:05 (14839): <1> TCP connection from sdb:55778
2018-05-07 11:18:05 (14839): <1> Backgrounding as socket 10
2018-05-07 11:18:05 (14839): <1> Resumed TCP activity from sdb:55778
2018-05-07 11:18:05 (14839): <1> method_async_task: task node_to_registered_namespace_create task_id 2944 host sdb-ipo
gif0-1 port 2015
2018-05-07 11:18:06 (31557): <2944> [nid00021]: (aid:154,sid:215,stoken:941398) dws_n2rns INFO:>>>> mount -t dvs /var/
opt/cray/dws/mounts/registrations/166 /var/opt/cray/dws/mounts/n2rns/273 -o path=/var/opt/cray/dws/mounts/n2rns/273,no
defile=/tmp/tmpetfk_D,maxnodes=2,blksize=8388608,dwfs,deferopens,mds=c0-0c0s6n1,attrcache_timeout=3,nouserenv,multifsy
nc,parallelwrite,nocache
2018-05-07 11:18:06 (31557): <2944> [nid00021]: (aid:154,sid:215,stoken:941398) dws_n2rns INFO:do_bind_mount: /var/opt
/cray/dws/mounts/n2rns/273/22, /var/opt/cray/dws/mounts/batch/DW_Test_941398_striped_scratch
2018-05-07 11:18:06 (31557): <2944> Resumed get message for fd=11 #1
```

Creation process outputs (dwmd cont.)



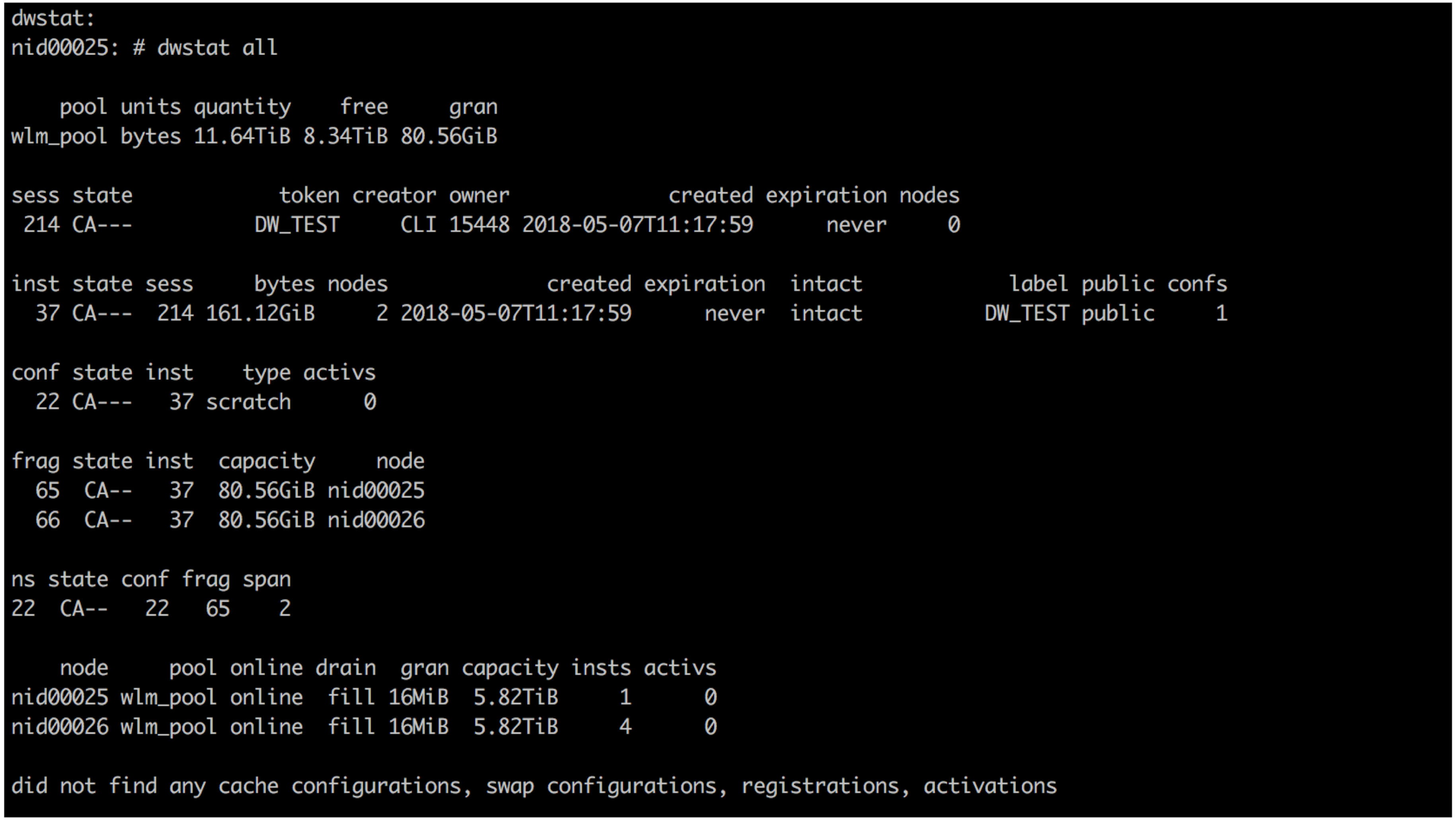
```
2018-05-07 11:18:06 (31557): <2944> task node_to_registered_namespace_create task_id 2944 DONE: ret=0
2018-05-07 11:20:07 (14839): <1> TCP connection from sdb:55792
2018-05-07 11:20:07 (14839): <1> Backgrounding as socket 10
2018-05-07 11:20:07 (14839): <1> Resumed TCP activity from sdb:55792
2018-05-07 11:20:07 (14839): <1> method_async_task: task node_to_registered_namespace_destroy task_id 2945 host sdb-ip
ogif0-1 port 2015
2018-05-07 11:20:07 (31625): <2945> [nid00021]: (aid:154,sid:215,stoken:941398) dws_n2rns INFO:do_umount_n_rmdir: /var
/opt/cray/dws/mounts/batch/DW_Test_941398_striped_scratch force=True
2018-05-07 11:20:07 (31625): <2945> [nid00021]: (aid:154,sid:215,stoken:941398) dws_n2rns INFO:do_umount_n_rmdir: /var
/opt/cray/dws/mounts/n2rns/273 force=True
2018-05-07 11:20:08 (31625): <2945> Resumed get message for fd=11 #1

2018-05-07 11:20:08 (31625): <2945> task node_to_registered_namespace_destroy task_id 2945 DONE: ret=0
2018-05-07 11:20:08 (14839): <1> TCP connection from sdb:55794
2018-05-07 11:20:08 (14839): <1> Backgrounding as socket 10
2018-05-07 11:20:08 (14839): <1> Resumed TCP activity from sdb:55794
2018-05-07 11:20:08 (14839): <1> method_async_task: task namespace_wait task_id 2946 host sdb-ipogif0-1 port 2015
2018-05-07 11:20:09 (31630): <2946> Resumed get message for fd=11 #1
```

Creation process outputs (dwmd cont.)



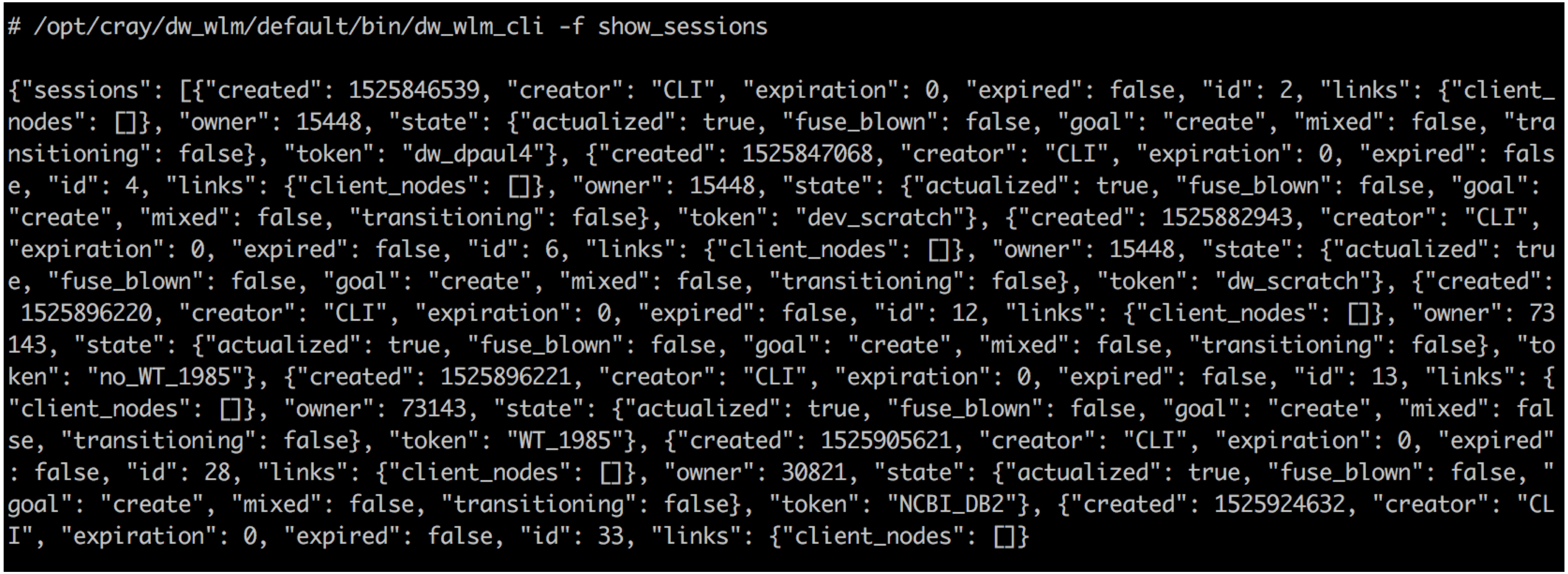
```
2018-05-07 11:20:09 (31630): <2946> task namespace_wait task_id 2946 DONE: ret=0
2018-05-07 11:20:09 (14839): <1> TCP connection from sdb:55796
2018-05-07 11:20:09 (14839): <1> Backgrounding as socket 10
2018-05-07 11:20:09 (14839): <1> Resumed TCP activity from sdb:55796
2018-05-07 11:20:09 (14839): <1> method_async_task: task dwfs_realm_member_registration_destroy task_id 2947 host sdb-
ipogif0-1 port 2015
2018-05-07 11:20:09 (31643): <2947> [nid00025]: (rid:166,sid:215,stoken:941398) dws_realm_member_reg INFO:do_umount_n_
rmdir: /var/opt/cray/dws/mounts/registrations/166 force=False
2018-05-07 11:20:09 (31643): <2947> [nid00026]: (rid:166,sid:215,stoken:941398) dws_realm_member_reg INFO:do_umount_n_
rmdir: /var/opt/cray/dws/mounts/registrations/166 force=False
2018-05-07 11:20:09 (31643): <2947> Resumed get message for fd=11 #1
```

Creation process outputs (dwstat)



```
dwstat:
nid00025: # dwstat all

    pool units quantity    free     gran
wlm_pool bytes 11.64TiB 8.34TiB 80.56GiB

sess state            token creator owner             created expiration nodes
 214 CA---          DW_TEST     CLI 15448 2018-05-07T11:17:59      never     0

inst state sess     bytes nodes             created expiration  intact           label public confs
  37 CA---  214 161.12GiB     2 2018-05-07T11:17:59      never  intact         DW_TEST public     1

conf state inst    type activs
  22 CA---   37 scratch      0

frag state inst  capacity     node
  65  CA--   37  80.56GiB nid00025
  66  CA--   37  80.56GiB nid00026

ns state conf frag span
22  CA--   22   65    2

    node     pool online drain  gran capacity insts activs
nid00025 wlm_pool online  fill 16MiB  5.82TiB     1      0
nid00026 wlm_pool online  fill 16MiB  5.82TiB     4      0

did not find any cache configurations, swap configurations, registrations, activations
```

dw_wlm_cli – command line use



```
# /opt/cray/dw_wlm/default/bin/dw_wlm_cli -f show_sessions

{"sessions": [{"created": 1525846539, "creator": "CLI", "expiration": 0, "expired": false, "id": 2, "links": {"client_
nodes": []}, "owner": 15448, "state": {"actualized": true, "fuse_blown": false, "goal": "create", "mixed": false, "tra
nsitioning": false}, "token": "dw_dpaul4"}, {"created": 1525847068, "creator": "CLI", "expiration": 0, "expired": fals
e, "id": 4, "links": {"client_nodes": []}, "owner": 15448, "state": {"actualized": true, "fuse_blown": false, "goal":
"create", "mixed": false, "transitioning": false}, "token": "dev_scratch"}, {"created": 1525882943, "creator": "CLI",
"expiration": 0, "expired": false, "id": 6, "links": {"client_nodes": []}, "owner": 15448, "state": {"actualized": tru
e, "fuse_blown": false, "goal": "create", "mixed": false, "transitioning": false}, "token": "dw_scratch"}, {"created":
 1525896220, "creator": "CLI", "expiration": 0, "expired": false, "id": 12, "links": {"client_nodes": []}, "owner": 73
143, "state": {"actualized": true, "fuse_blown": false, "goal": "create", "mixed": false, "transitioning": false}, "to
ken": "no_WT_1985"}, {"created": 1525896221, "creator": "CLI", "expiration": 0, "expired": false, "id": 13, "links": {
"client_nodes": []}, "owner": 73143, "state": {"actualized": true, "fuse_blown": false, "goal": "create", "mixed": fal
se, "transitioning": false}, "token": "WT_1985"}, {"created": 1525905621, "creator": "CLI", "expiration": 0, "expired"
: false, "id": 28, "links": {"client_nodes": []}, "owner": 30821, "state": {"actualized": true, "fuse_blown": false, "
goal": "create", "mixed": false, "transitioning": false}, "token": "NCBI_DB2"}, {"created": 1525924632, "creator": "CL
I", "expiration": 0, "expired": false, "id": 33, "links": {"client_nodes": []}
```

Common Problems & Solutions

SSD fails with DWS state on it

- Sometimes SSDs fail
- Since the DWS tries and retries to initiate and wait for stageout activity, it needs to be told when this is futile
- Find the relevant registrations and set them to --haste with dwcli
  - dwcli update registration --id 74 --haste

SSD Failure Detection

- In rare cases SSDs have failed in a way that has locked up XFS and DVS
  - This results in node health marking compute nodes admindown
- DataWarp Service now attempts to *detect* failing SSDs
- Upon detection, dwmd will *intentionally* panic a DW server node
  - This allows processes to do some cleanup so compute nodes do not go admindown
- False positives are possible. Be suspicious of hardware

```
2017-01-04T15:01:53.663992-06:00 c0-1c0s1n0 DataWarp dwmd daemon triggering a crash after
detecting a failed LVM volume group. Check for failing hardware!
```

Hardware Maintenance

- Sometimes a blade needs servicing
- Server nodes set to drain with dwcli will not be used in new instance creations
  - dwcli update node --name nid00350 --drain
- Be sure to set both nodes on a blade to drain
- Wait for instance count on nodes to hit 0 to minimize disrupting existing usages of DataWarp (dwstat nodes)
  - May need to remove persistent instances
- When maintenance completes, unset drain state
  - dwcli update node --name nid00350 --fill

The Tale of Two dwcaches

- If node A has SSDs 1 and 2 and node B has SSDs 3 and 4, after maintenance node A may end up with 1 and 3 and node B with 2 and 4
- LVM Physical Volume headers for SSD 1 has information on VG dwcache, but SSD 3 does too (but it’s a different dwcache!)
- LVM is smart enough to know that they are really different VGs, but you’ll still see two dwcaches on each node
- Swap the hardware to fix or just re-initialize the SSDs with LVM

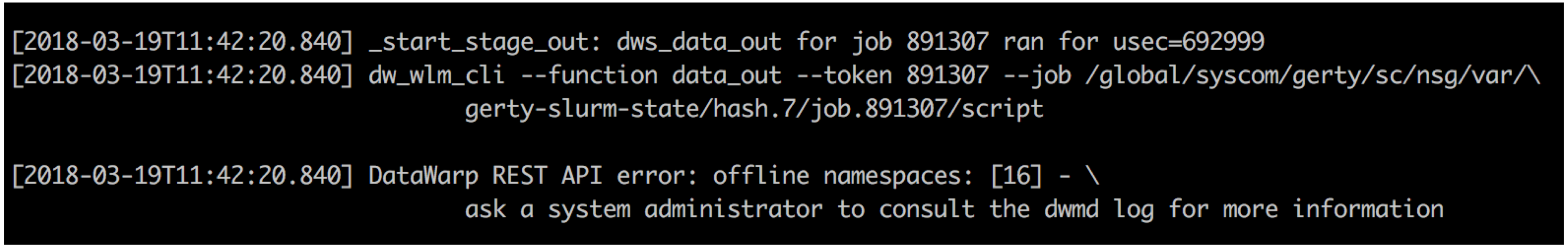
#DW stage_in/out failures with lots of files

- **#DW stage_in/out where target has thousands of files can fail due to hitting timeouts**
- **Short term: increase the timeouts (which were always way too short)**
  - DW admin guide includes instructions for using site-local ansible play to bump timeouts
  - Timeout bumps are for nginx and dwrest
- **Long term: moving to new API that removes need for increasing timeouts, improves error messages**

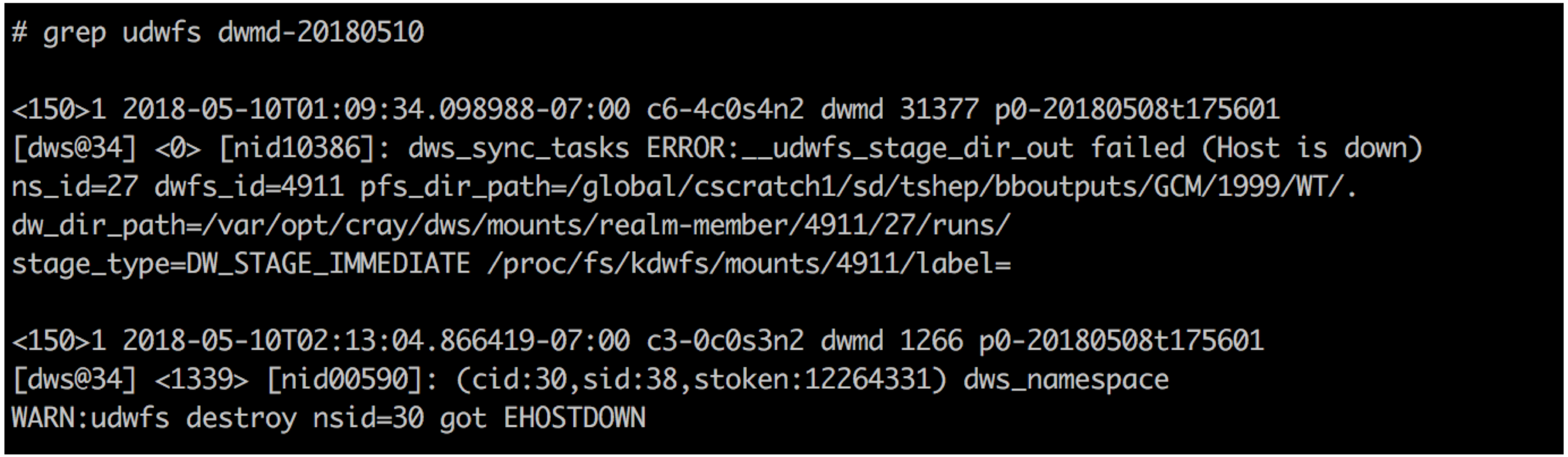
User reports of unexplained stage failures

- **Batch job #DW stage_in/out can fail**
  - System issue
    - Your PFS must be mounted on DW servers!
  - Typo in job script
- **DataWarp Service does not give good error messages today**
  - For Slurm, 'squeue -l -u username' will show an 'offline namespaces' error
- **You must look in dwmd.log for clues!**
  - Search for batch job id or udwfs_stage
- **Long term: moving to new underlying staging API that improves error messages**

Example outputs:



```
[2018-03-19T11:42:20.840] _start_stage_out: dws_data_out for job 891307 ran for usec=692999
[2018-03-19T11:42:20.840] dw_wlm_cli --function data_out --token 891307 --job /global/syscom/gerty/sc/nsg/var/\
                                gerty-slurm-state/hash.7/job.891307/script

[2018-03-19T11:42:20.840] DataWarp REST API error: offline namespaces: [16] - \
                                ask a system administrator to consult the dwmd log for more information
```

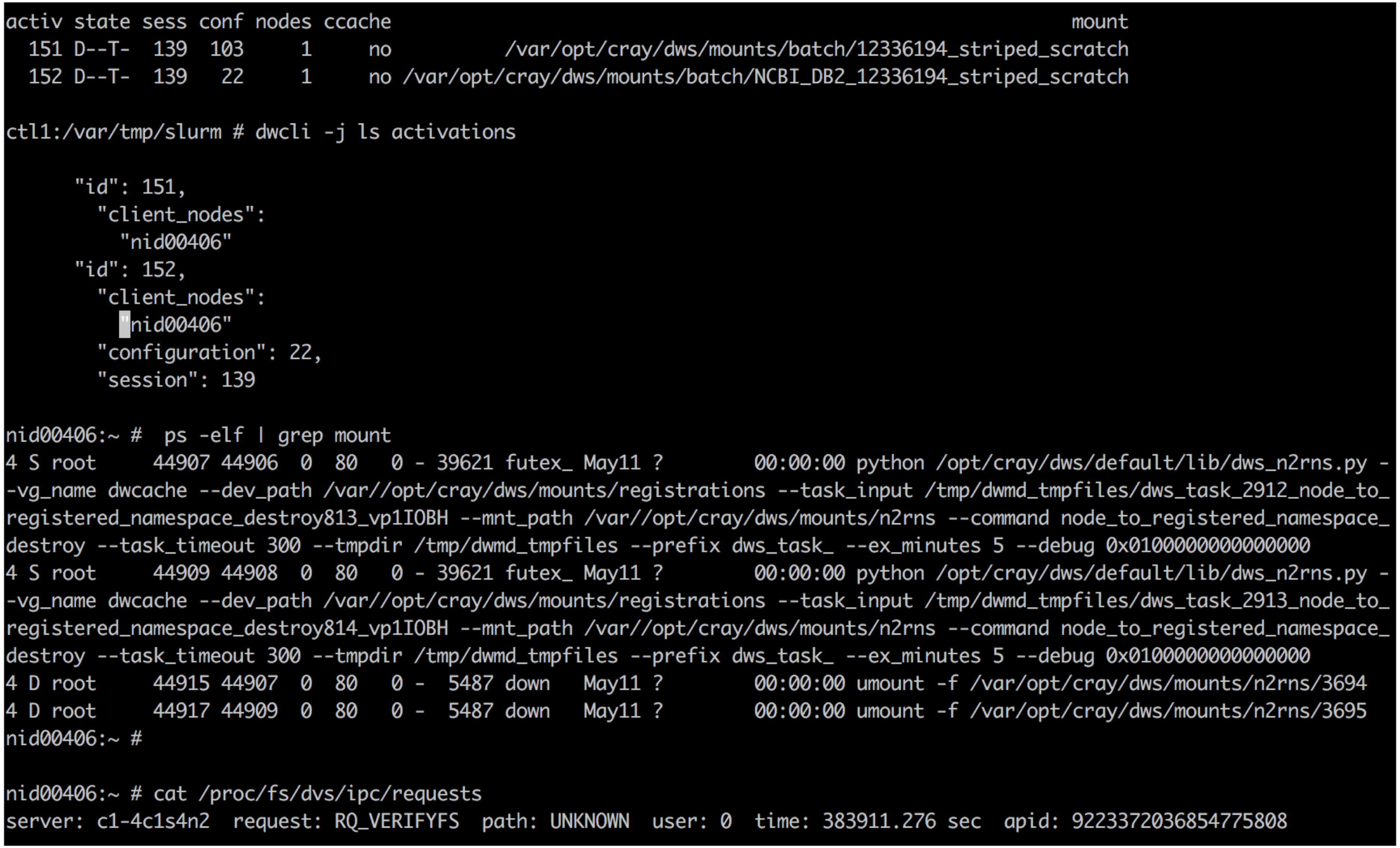


```
# grep udwfs dwmd-20180510

<150>1 2018-05-10T01:09:34.098988-07:00 c6-4c0s4n2 dwmd 31377 p0-20180508t175601
[dws@34] <0> [nid10386]: dws_sync_tasks ERROR:__udwfs_stage_dir_out failed (Host is down)
ns_id=27 dwfs_id=4911 pfs_dir_path=/global/cscratch1/sd/tshep/bboutputs/GCM/1999/WT/.
dw_dir_path=/var/opt/cray/dws/mounts/realm-member/4911/27/runs/
stage_type=DW_STAGE_IMMEDIATE /proc/fs/kdwfs/mounts/4911/label=

<150>1 2018-05-10T02:13:04.866419-07:00 c3-0c0s3n2 dwmd 1266 p0-20180508t175601
[dws@34] <1339> [nid00590]: (cid:30,sid:38,stoken:12264331) dws_namespace
WARN:udwfs destroy nsid=30 got EHOSTDOWN
```

User reports of unexplained IO errors

- **SSD write protection will return one of three errno once activated**
  - -EROFS (write window exceeded)
  - -EMFILE (maximum files created exceeded)
  - -EFBIG (maximum file size exceeded)
- **Log messages are emitted to the console log**
- **SEC rule looks for these and can take site-configured action**
- **If many users hit these, consider**
  - Educating user base on SSD write limits
  - Raising the defaults to decrease false positives
  - Turn the functionality off

Example: ‘stuck umount’



```
activ state sess conf nodes ccache                                                    mount
  151 D--T-   139  103     1     no          /var/opt/cray/dws/mounts/batch/12336194_striped_scratch
  152 D--T-   139   22     1     no /var/opt/cray/dws/mounts/batch/NCBI_DB2_12336194_striped_scratch

ctl1:/var/tmp/slurm # dwcli -j ls activations

      "id": 151,
        "client_nodes":
          "nid00406"
      "id": 152,
        "client_nodes":
          "nid00406"
        "configuration": 22,
        "session": 139

nid00406:~ #  ps -elf | grep mount
4 S root      44907 44906  0  80   0 - 39621 futex_ May11 ?        00:00:00 python /opt/cray/dws/default/lib/dws_n2rns.py -
-vg_name dwcache --dev_path /var//opt/cray/dws/mounts/registrations --task_input /tmp/dwmd_tmpfiles/dws_task_2912_node_to_
registered_namespace_destroy813_vp1IOBH --mnt_path /var//opt/cray/dws/mounts/n2rns --command node_to_registered_namespace_
destroy --task_timeout 300 --tmpdir /tmp/dwmd_tmpfiles --prefix dws_task_ --ex_minutes 5 --debug 0x0100000000000000
4 S root      44909 44908  0  80   0 - 39621 futex_ May11 ?        00:00:00 python /opt/cray/dws/default/lib/dws_n2rns.py -
-vg_name dwcache --dev_path /var//opt/cray/dws/mounts/registrations --task_input /tmp/dwmd_tmpfiles/dws_task_2913_node_to_
registered_namespace_destroy814_vp1IOBH --mnt_path /var//opt/cray/dws/mounts/n2rns --command node_to_registered_namespace_
destroy --task_timeout 300 --tmpdir /tmp/dwmd_tmpfiles --prefix dws_task_ --ex_minutes 5 --debug 0x0100000000000000
4 D root      44915 44907  0  80   0 -  5487 down   May11 ?        00:00:00 umount -f /var/opt/cray/dws/mounts/n2rns/3694
4 D root      44917 44909  0  80   0 -  5487 down   May11 ?        00:00:00 umount -f /var/opt/cray/dws/mounts/n2rns/3695
nid00406:~ #

nid00406:~ # cat /proc/fs/dvs/ipc/requests
server: c1-4c1s4n2  request: RQ_VERIFYFS  path: UNKNOWN  user: 0  time: 383911.276 sec  apid: 9223372036854775808
```

Stuck Session

- **Sometimes a session just won’t go away**
- **This USUALLY means any of:**
  - a registration cannot make forward progress; set --haste if that’s acceptable
  - a fuse has blown
  - a process is stuck
- **There is no “force remove” option in DWS because while it would clear up status displays, it wouldn’t actually fix the problem**
- **How to fix? Case-by-case basis**
  - Restart daemons (especially dwmd)
  - Reboot nodes
  - Hunt down and kill stuck processes
  - Replace fuse

Checking on DataWarp Health

- Especially after a system reboot, any of the previously mentioned hardware issues may arise
- New software updates may also introduce issues
- datawarp_check.py - basic DataWarp health check script

Back up DataWarp State

- **Some DataWarp state (pools, drain state, node-pool association) can be backed up and restored**
- **State restoration necessary when…**
  - Updating to a new release of CLE with backwards-incompatible changes
  - Rarely, dwsd database corruption
- ***dwcli config backup >/home/crayadm/dw.json* method**
  - Saves data via RESTful API
- ***dwbackup >/home/crayadm/dw.json* method**
  - Extracts data directly from dwsd database
  - Necessary if "backing up" after backwards-incompatible change

Backup examples

```
# dwcli method
crayadm@login> module load dws
crayadm@login> dwcli config backup >/home/crayadm/dw.json


# dwbackup method
sdb# module load dws
sdb# dwbackup >/home/crayadm/dw.json
```

Restore DataWarp state

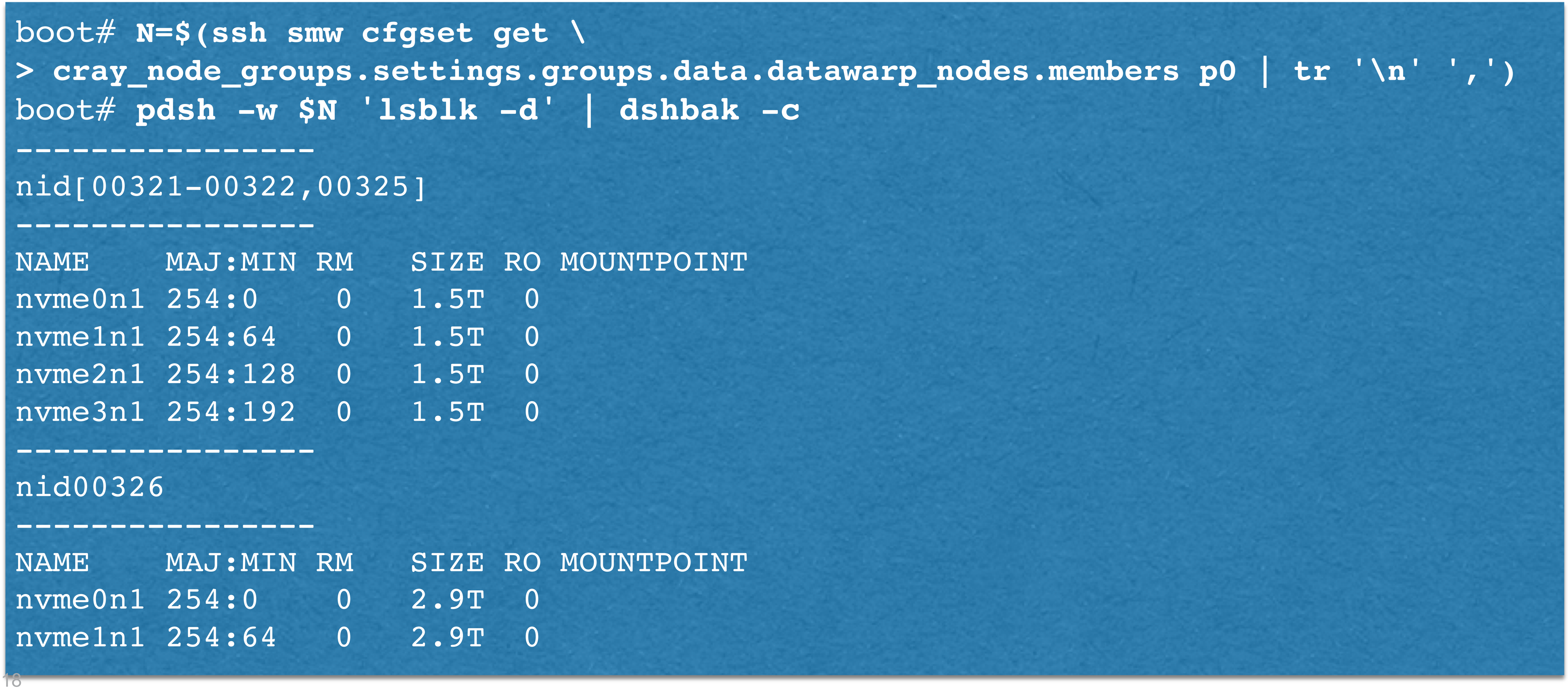
- **Saved DataWarp state can be restored at any time**
- ***dwcli config restore </home/crayadm/dw.json***
  - Can be run multiple times
  - If nodes are missing, you'll get a warning but can run the command later when the node boots

```
crayadm@login> module load dws
crayadm@login> dwcli config restore </home/crayadm/dw.json
pool check progress [===========] 1/1 100% done
node update progress [===========] 2/2 100% done
```

Tools for DataWarp System Administration

Tips and Tricks

- Use pdsh + dshbak to perform DW tasks in parallel



```
boot# N=$(ssh smw cfgset get \
> cray_node_groups.settings.groups.data.datawarp_nodes.members p0 | tr '\n' ',')
boot# pdsh -w $N 'lsblk -d' | dshbak -c
----------------
nid[00321-00322,00325]
----------------
NAME    MAJ:MIN RM   SIZE RO MOUNTPOINT
nvme0n1 254:0     0   1.5T  0
nvme1n1 254:64    0   1.5T  0
nvme2n1 254:128   0   1.5T  0
nvme3n1 254:192   0   1.5T  0
----------------
nid00326
----------------
NAME    MAJ:MIN RM   SIZE RO MOUNTPOINT
nvme0n1 254:0     0   2.9T  0
nvme1n1 254:64    0   2.9T  0
```

jq

- **In CLE as of 6.0.UP05**
- **“sed for json”**
- **DW RESTful API is stable, better for scripting**
- **Find instances with blown fuse**
  - dwcli -j ls instances | jq -rS '.instances[] | select(.state.fuse_blown == true) | .id’
- **Select server nodes**
  - dwcli -j ls nodes | jq -rS '.nodes[] | select(.online == false and .capacity > 0) | .id’
- **Can use with dwcli actions to operate on multiple objects**

datawarp_check.py

- **Simple script for checking on DataWarp health**
  - Excludes WLM layer
- **Useful to run after system boots**
- **Contact Cray support for a copy**

```
crayadm@login> ./datawarp_check.py
v3 2017-06-26
...
PASS created session 1
PASS created instance 1
PASS created configuration 1
PASS created activation 1
...
Session 1 is now deleted
```

Libhio Test Suite

- **LANL-developed parallel IO package**
- **https://github.com/hpc/libhio**
- **Includes tests that run on DataWarp through WLMs**
  - Fantastic sanity check on DataWarp and WLM integration
  - Varies DW allocation size, compute node count, IO pattern, etc
  - Each test outputs performance information
- **Supports Slurm and Moab/TORQUE as WLM**

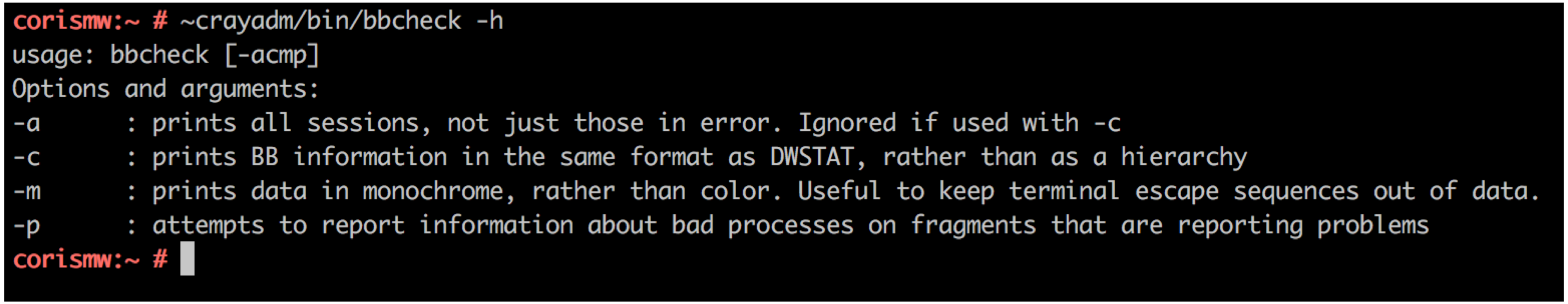
KAUST DataWarp Regression Suite

- **Written by Georgios Markomanolis at KAUST**
- **https://github.com/gmarkomanolis/datawarp_regression**
- **Test coverage**
  - IOR runs
  - Stage in, stage out
    - Files and folders
  - Persistent instances
  - libdatawarp API
- **Supports Slurm as WLM**

NERSC *bbcheck* utility

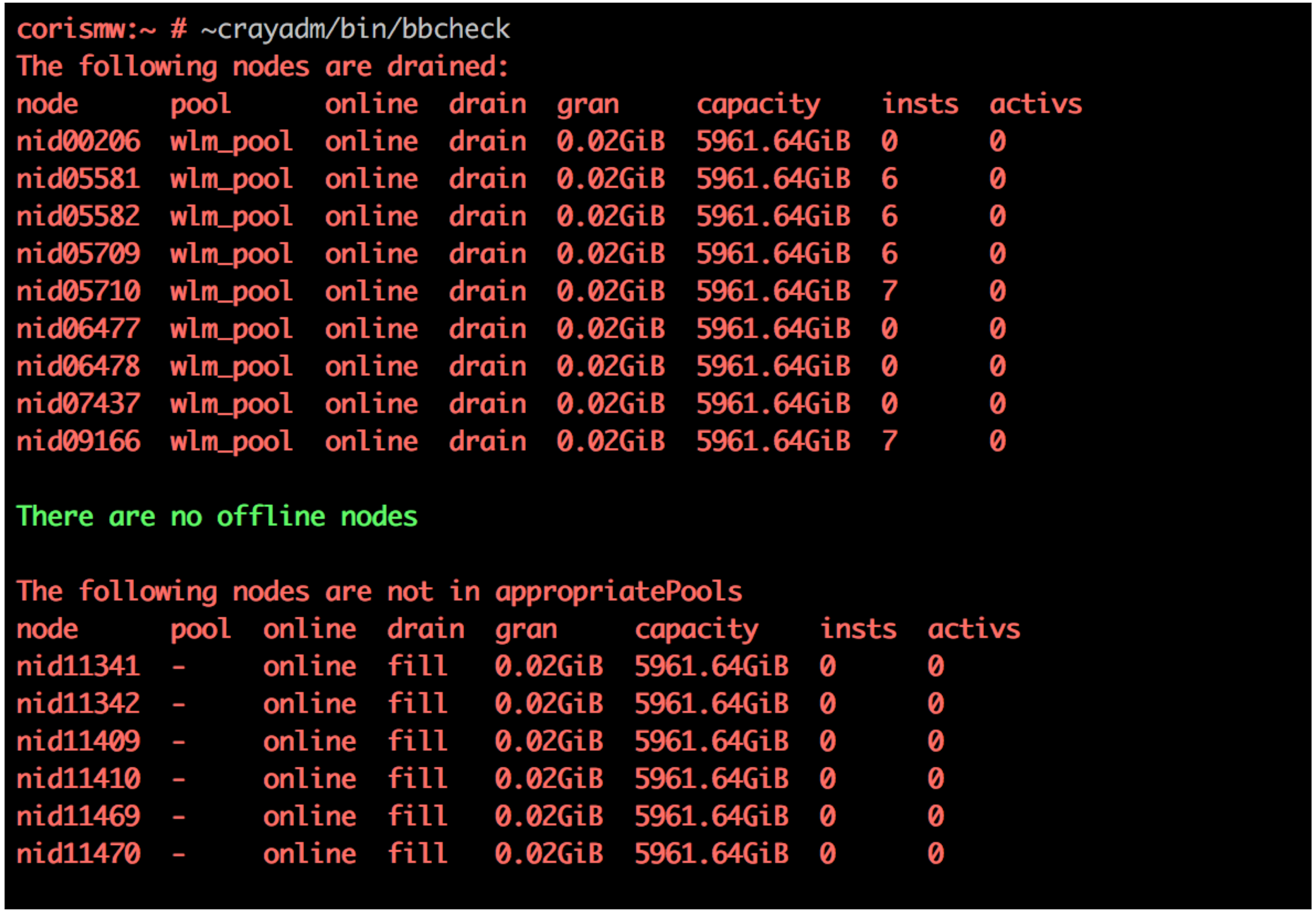
- dwstat wrapper script (python)
- Created by the Operations Technology Group
  - Basil Lalli, Tony Quan, John Gann
- Much easier to identify the pieces involved in a failure
- 30 minute *snapshots* with cron (for debugging)

NERSC *bbcheck* utility



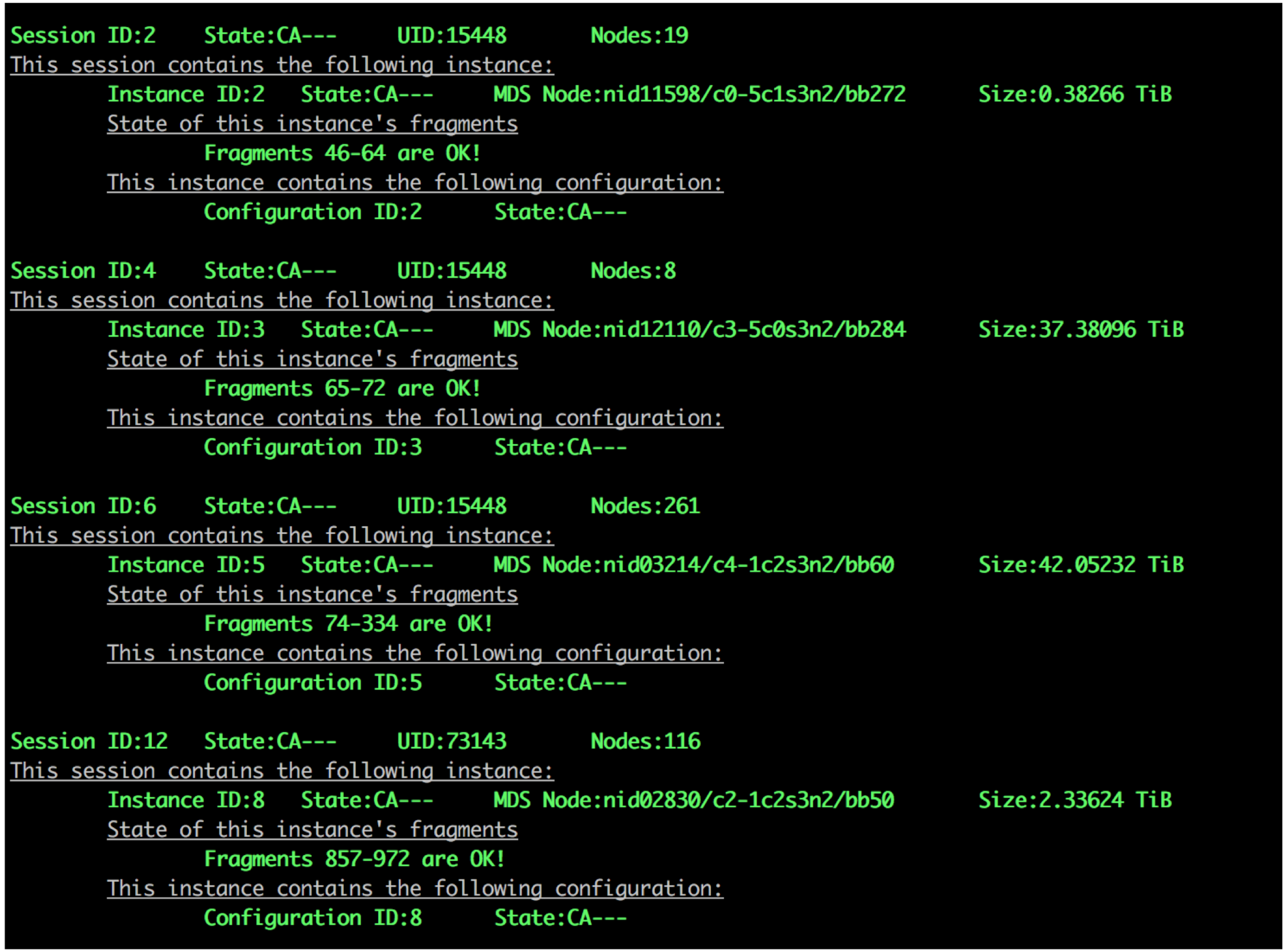
```
corismw:~ # ~crayadm/bin/bbcheck -h
usage: bbcheck [-acmp]
Options and arguments:
-a      : prints all sessions, not just those in error. Ignored if used with -c
-c      : prints BB information in the same format as DWSTAT, rather than as a hierarchy
-m      : prints data in monochrome, rather than color. Useful to keep terminal escape sequences out of data.
-p      : attempts to report information about bad processes on fragments that are reporting problems
corismw:~ #
```

# bbcheck



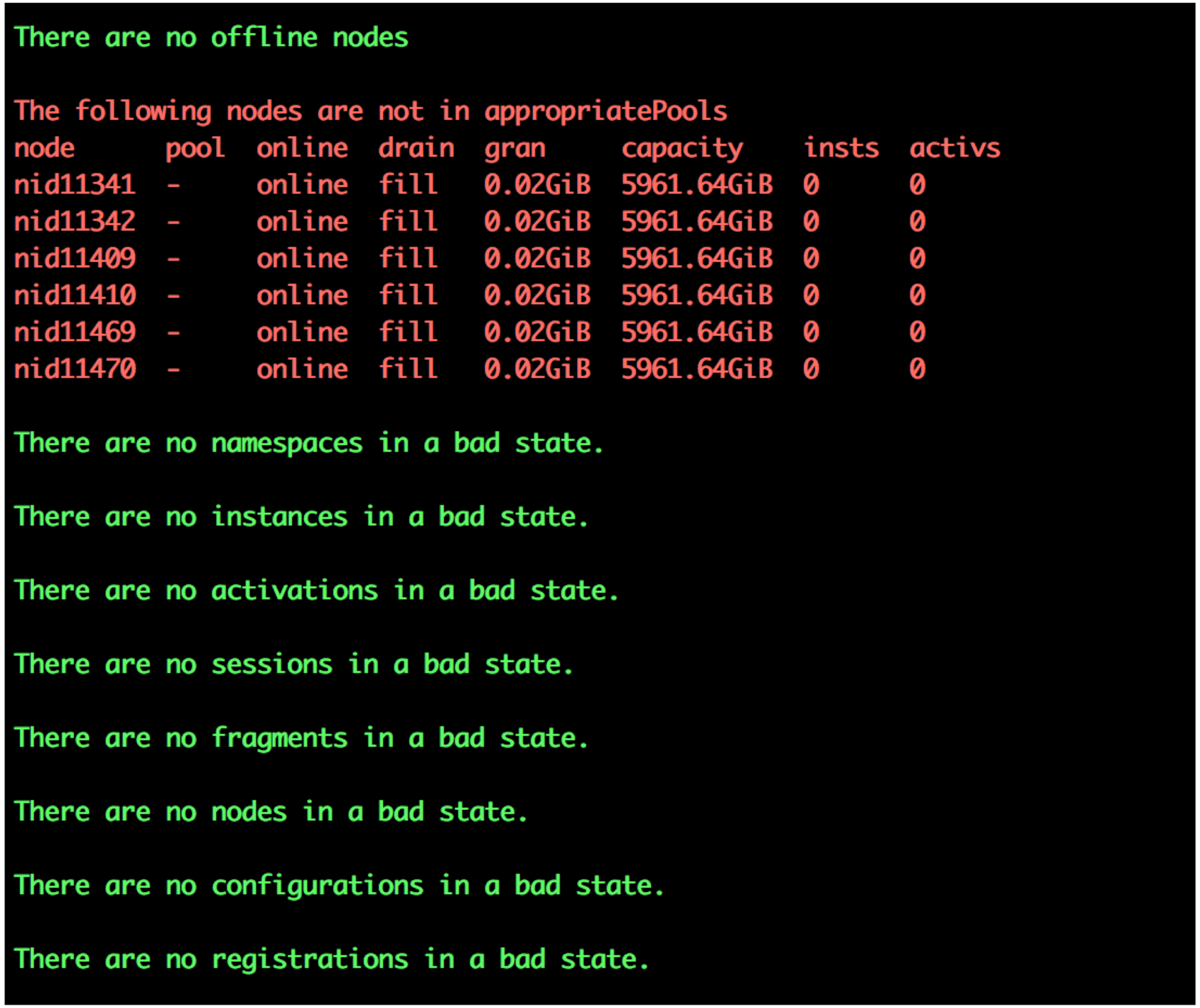
```
corismw:~ # ~crayadm/bin/bbcheck
The following nodes are drained:
node      pool      online  drain  gran     capacity    insts  activs
nid00206  wlm_pool  online  drain  0.02GiB  5961.64GiB  0      0
nid05581  wlm_pool  online  drain  0.02GiB  5961.64GiB  6      0
nid05582  wlm_pool  online  drain  0.02GiB  5961.64GiB  6      0
nid05709  wlm_pool  online  drain  0.02GiB  5961.64GiB  6      0
nid05710  wlm_pool  online  drain  0.02GiB  5961.64GiB  7      0
nid06477  wlm_pool  online  drain  0.02GiB  5961.64GiB  0      0
nid06478  wlm_pool  online  drain  0.02GiB  5961.64GiB  0      0
nid07437  wlm_pool  online  drain  0.02GiB  5961.64GiB  0      0
nid09166  wlm_pool  online  drain  0.02GiB  5961.64GiB  7      0

There are no offline nodes

The following nodes are not in appropriatePools
node      pool  online  drain  gran     capacity    insts  activs
nid11341  -     online  fill   0.02GiB  5961.64GiB  0      0
nid11342  -     online  fill   0.02GiB  5961.64GiB  0      0
nid11409  -     online  fill   0.02GiB  5961.64GiB  0      0
nid11410  -     online  fill   0.02GiB  5961.64GiB  0      0
nid11469  -     online  fill   0.02GiB  5961.64GiB  0      0
nid11470  -     online  fill   0.02GiB  5961.64GiB  0      0
```

# bbcheck -a



```
Session ID:2    State:CA---     UID:15448       Nodes:19
This session contains the following instance:
        Instance ID:2   State:CA---     MDS Node:nid11598/c0-5c1s3n2/bb272      Size:0.38266 TiB
        State of this instance's fragments
                Fragments 46-64 are OK!
        This instance contains the following configuration:
                Configuration ID:2      State:CA---

Session ID:4    State:CA---     UID:15448       Nodes:8
This session contains the following instance:
        Instance ID:3   State:CA---     MDS Node:nid12110/c3-5c0s3n2/bb284      Size:37.38096 TiB
        State of this instance's fragments
                Fragments 65-72 are OK!
        This instance contains the following configuration:
                Configuration ID:3      State:CA---

Session ID:6    State:CA---     UID:15448       Nodes:261
This session contains the following instance:
        Instance ID:5   State:CA---     MDS Node:nid03214/c4-1c2s3n2/bb60       Size:42.05232 TiB
        State of this instance's fragments
                Fragments 74-334 are OK!
        This instance contains the following configuration:
                Configuration ID:5      State:CA---

Session ID:12   State:CA---     UID:73143       Nodes:116
This session contains the following instance:
        Instance ID:8   State:CA---     MDS Node:nid02830/c2-1c2s3n2/bb50       Size:2.33624 TiB
        State of this instance's fragments
                Fragments 857-972 are OK!
        This instance contains the following configuration:
                Configuration ID:8      State:CA---
```

# bbcheck -c



```
There are no offline nodes

The following nodes are not in appropriatePools
node      pool  online  drain  gran     capacity     insts  activs
nid11341  -     online  fill   0.02GiB  5961.64GiB   0      0
nid11342  -     online  fill   0.02GiB  5961.64GiB   0      0
nid11409  -     online  fill   0.02GiB  5961.64GiB   0      0
nid11410  -     online  fill   0.02GiB  5961.64GiB   0      0
nid11469  -     online  fill   0.02GiB  5961.64GiB   0      0
nid11470  -     online  fill   0.02GiB  5961.64GiB   0      0

There are no namespaces in a bad state.

There are no instances in a bad state.

There are no activations in a bad state.

There are no sessions in a bad state.

There are no fragments in a bad state.

There are no nodes in a bad state.

There are no configurations in a bad state.

There are no registrations in a bad state.
```

Q&A

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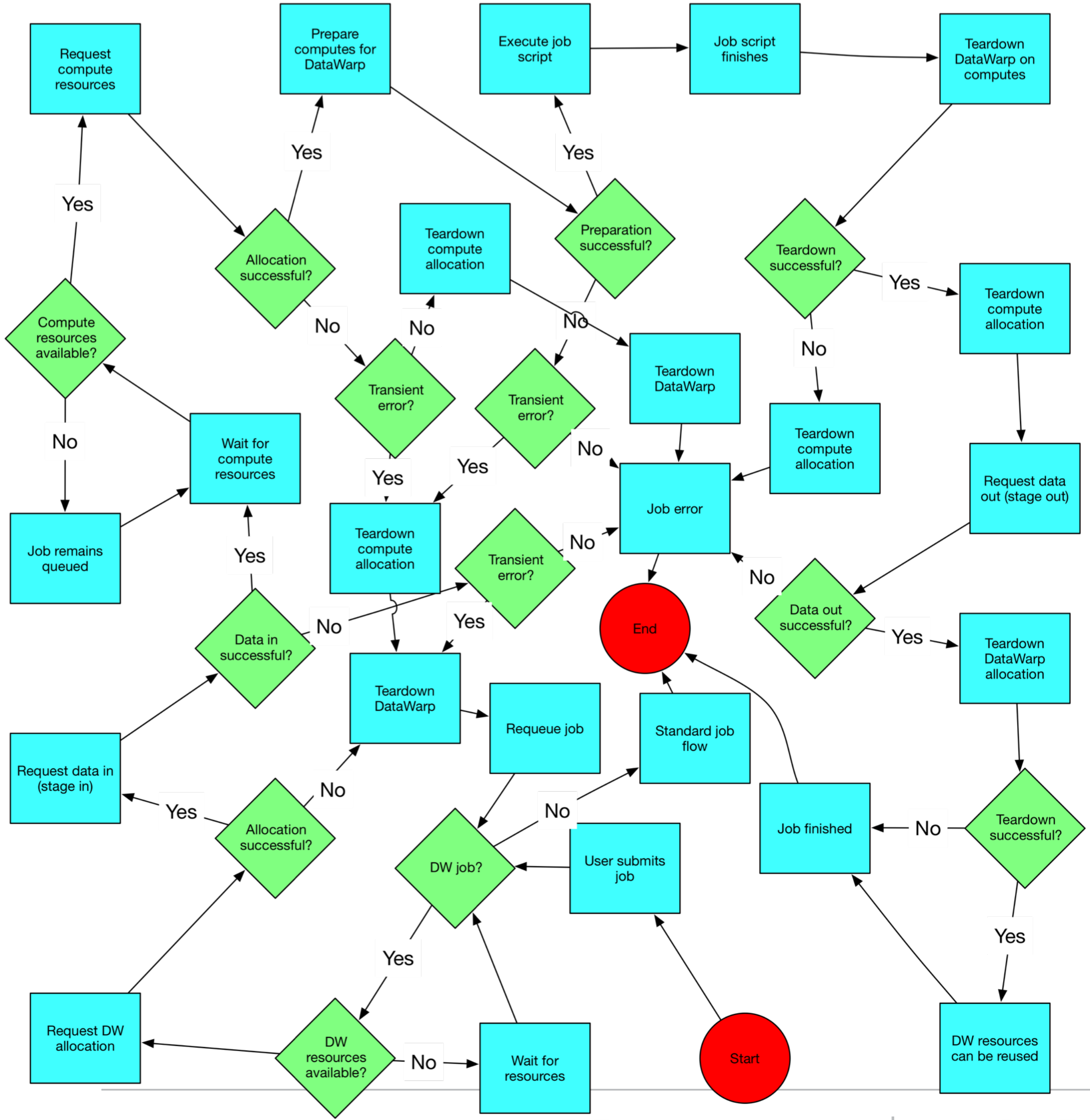

← you folks understand this now right???