Agenda – Datawarp Accounting

● **Purpose**
  - Give Administrators tools they need to manage Datawarp resources

● **Benefit/Value**
  - Administrators can bill users, educate users on best practices, and plan for the future.

● **Datawarp statistics**

● **Resource Utilization Reporting plugins for Datawarp**

● **Libdatawarp**

● **Case studies of Data and interpretation**

● **Summary**

● **Q&A**
Datawarp

- Burst Buffers on Flash drives
- Versus spinning disks: high bandwidth, lower capacity
- Limited write cycles per device
Datawarp Cache

- Flash acts as a cache for Parallel filesystem
- Datawarp cache is dedicated to an user/application
What Data Do You Want?

- Are the users getting good performance?
- Are users sharing well?
- Who is using up all the drive writes?
- Does the system have sufficient capacity?
- ??? Question unknown, but provide a lot of data
Nodes: compute, server

Compute Nodes

Datawarp Filesystem

Datawarp Server Nodes

Fragments
Compute Node Datawarp Statistics

● Inodes Created
● Files Created
● Bytes Read
● Bytes Written
● Max File Offset Read
● Max File Offset Written
Server Node Statistics

- Max offset read/written; total, per-fragment
- Bytes read/written
- Bytes Staged in/out
- Cache and pfs byte in/out
- Capacity highwater; total, per-fragment
- Maximum write window
How Do I Get the Accounting Data?

● Resource Utilization Reporting (RUR)
  ● Lightweight, low noise
  ● Simple configuration, installed as part of CLE
  ● Not a performance profiling tool for software development

● Libdatawarp library
  ● Provides user application on compute nodes access to accounting data

● Slurm
  ● Will include same metrics as does RUR
  ● Support in future version
RUR Datawarp Plugins

- **DWS plugin**
  - CLE6.0up02
  - DVS statistics from compute nodes

- **DWS_server plugin, DWS_job_server plugin**
  - CLE6.0up04
  - Statistics from server nodes
  - Per-namespace & per-fragment statistics
  - Job plugin captures statistics for stage-in and stage-out

- **RUR**
  - Output data to SMW logs, text files, user home dir, etc.
  - Configuration like other RUR plugins (see S-2393)
RUR Output

- Found in SMW log, or other files, as configured
- Includes apid, jobid, command name
- Includes user id
- Can be very verbose if there are a lot of Datawarp server nodes
- Next 3 slides are an example of the full output, but only one filesystem with only two fragments
- Later slides include only snippets for clarity
RUR Output Scratch Namespaces


...
RUR Output Scratch Fragments

"fragments": {
  "3141": {
    "fragment_id": 3141, "server_name": "nid00343", "fs_capacity": 8796093022208, "capacity_used": 3518437208883, "capacity_max": 4398046511104, "max_window_write": 1073741824, "write_high_water": 4294967296, "write_moving_avg": 536870912, "write_limit": 0},
  "3142": {
    "fragment_id": 3142, "server_name": "nid00344", "fs_capacity": 8796093022208, "capacity_used": 3518437208883, "capacity_max": 4398046511104, "max_window_write": 1073741824, "write_high_water": 4294967296, "write_moving_avg": 536870912, "write_limit": 0}
}]}
RUR Output Cache

"fragments": {
  "3144": {
    "fragment_id": 3141, "server_name": "nid00343", "capacity_highwater": 4398046511104,
    "fs_capacity": 4398046511104, "max_offset_read": 167888204, "max_offset_write": 167888204,
    "pfs_read": 41972051, "pfs_written": 41972051, "cache_read": 335776408,
    "cache_write": 335776408, "window_write_bytes": 20986024,
    "window_write_seconds": 8}
  }
}
Libdatawarp

- Same data as dws_server plugin
- Users can do periodic sampling

```
#include <datawarp.h>
buf = dw_get_accounting_data_json(dwfs_path, &retval);

#include <datawarp_cache.h>
buf = dwc_get_accounting_data_json(dwdfs_path, &retval);
```
Datawarp Accounting Use Cases

- Tracking Disk Writes
- Over-allocating Capacity
- Excess Staging
- Dissimilar Stripe Allocation
Tracking Disk Writes

- Are users writing a LOT to disks, wearing them out?
- Sometimes it needs to happen, but be careful.
- Bill users for excessive writes?

Uid: 16443, apid: 24104... {'Bytes_written': 240TB...}
Over-allocating Capacity

- Are user capacity estimates accurate?

Uid: 16771, apid: 14654, ...

{‘fs_capacity’: 32TB, ‘capacity_used’: 4.09GB...}
Excess Staging

- User preloads tons of data, then uses hardly any of it.
- Seems like a waste, though not always.

Uid: 16443, apid: 24186...

{‘bytes_read’: 2.3GB, ‘stage_bytes_read’: 415.2GB,
‘stage_bytes_written’: 0GB...}
Dissimilar Stripe Allocation

- User experienced large variability in Datawarp performance from one run to the next.
- Correlated with low available capacity, but not that low.
- Dissimilar stripe allocation
- Shows up in accounting data
- ‘Equalize Fragments’ configuration option to prevent this
Dissimilar Stripe Allocation 2

- Too much traffic going to a single storage node
- Due to fragmentation of free space
Dissimilar stripe Allocation 3

Dws_server{fragments:

‘Nid00346’: {'capacity_max': 250GB},
‘Nid00347’: {'capacity_max': 250GB},
‘Nid00221’: {'capacity_max': 750GB},
‘Nid00222’: {'capacity_max': 250GB}}

Nid00221 is serving 3 times as much space, will be hit by 3 times as much I/O traffic
Equalize Fragments

- Admin config option to Datawarp Services (See S-2393)
- Off by default, but recommended for performance
- Causes allocations from different DW server nodes to be equal in size
- Balances performance of nodes, removes bottleneck
- May cause difficulty for WLM scheduling jobs
Dissimilar stripe Allocation 4

Dws_server{fragments:
‘Nid00346’: {‘capacity_max’: 400GB},
‘Nid00347’: {‘capacity_max’: 400GB},
‘Nid00221’: {‘capacity_max’: 400GB},
‘Nid00222’: {‘capacity_max’: 400GB}}

Note that this overprovisions the allocation
(1600GB allocated > 1500GB requested)
This overprovisioning preserves balanced free space
Summary

- Datawarp offers users very fast storage, but with limited capacity, and limited write endurance of devices.
- Tracking which users utilize Datawarp, and how, allows administrators to better coordinate the resources available to the users, and plan for the future.
- RUR plugins can give basic utilization data to admins, with low overhead. Libdatawarp gives the same data to users.
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