SCR and Preparing for Burst Buffers

DOE COE Performance Portability Meeting

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Outline

Burst Buffer Technologies

SCR Overview

Burst Buffers and SCR

Additional Software Projects

Burst Buffer Technologies

Type	Technology	Location
Node Local	IBM BBAPI	LLNL (Sierra)
Machine Global	Cray Datawarp	LANL (Trinity)

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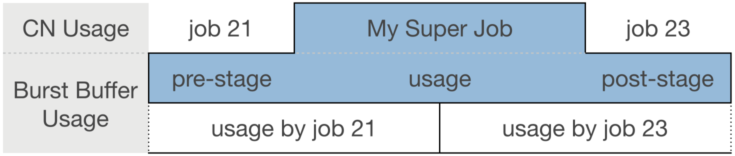
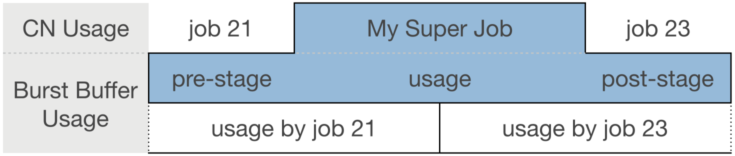
How can an application utilize this layer for I/O workloads?

Burst Buffers Use Case



- Relies on integration with resource scheduler
- Different for machine-global vs. node-local storage
- Does not address inter-job data movement

Burst Buffers Use Case



Perfect for Checkpoint/Restart

Checkpoint Restart

- a.k.a. Defensive I/O

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- Depends on resiliency of machine
  - Which may change over time
- Creating a checkpoint may not be as efficient as recomputing

SCR Goal

Enable checkpointing applications to take advantage of system storage hierarchies

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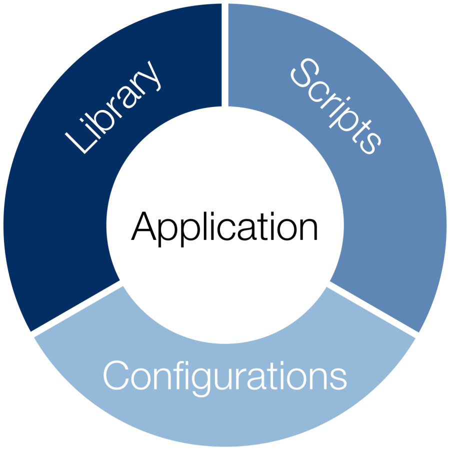
Enable checkpointing applications to take advantage of system storage hierarchies

- Efficient file movement between storage layers
- Data redundancy operations

SCR Components



SCR Component: Backend Library

- Redirect application files
- Synchronous & asynchronous flush operations
  - Hardware specific capabilities
- Data redundancy
- Support for both checkpoint & output data

SCR Component: Backend Library

```
int rc = MyApp_Checkpoint(path);
```

SCR Component: Backend Library

```
SCR_Route_file(path, newpath);
int rc = MyApp_Checkpoint(newpath);
```

SCR Component: Backend Library

```
SCR_Start_output(”dataset name”, flags);
SCR_Route_file(path, newpath);
int rc = MyApp_Checkpoint(newpath);
SCR_Complete_output(rc);
```

SCR Component: Frontend Scripts

- On Startup Locate most recent checkpoint and fetch for restart

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- Within Allocation Detect application crash or system failures and trigger restart
- During Execution Manage datasets
- Resource Scheduler Integration Pre- and post-stage data movement

SCR Component: Configurations

- Define the levels of the hierarchy
- Define modes/groups of failure
- Define checkpointing and data residency needs

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Machine Portability

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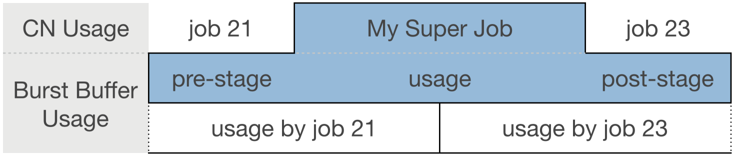

Checkpoint Restart

Burst Buffers & SCR: Prestage

- Machine Global Solved
  - Global access from CNs to storage
- Node Local Requires new softwares
  - Requires deep integration with resource scheduler
  - Most useful for DATs or half+ system jobs

Burst Buffers & SCR: Poststage

- Similar solution for both BB types
- Take advantage of vendor APIs asynchronous operations
- Decouples burst buffer usage from compute usage
  - Requires integration with resource scheduler
  - Allows for more fine-grain control of resources

Unaddressed Concerns

- Applications without checkpointing
- Shared Files
- Arbitrary data movement
  - Machine-learning use case

VELOC

- Combining two codes: FTI and SCR
- FTI: variable-based checkpointing scheme
- Will support existing FTI and SCR applications

EXASCALE COMPUTING PROJECT

UnifyCR

- User-level file system
- Shared namespace across distributed burst buffers
- I/O interception layer

EXASCALE COMPUTING PROJECT

MPI File Utils

Use parallel processes to perform file operations

- Executed within a job allocation
- `dbcast`: broadcast from PFS to node-local storage
- `dcp`: multiple file copy in parallel
- `drm`: delete files in parallel
- *many more*

`https://github.com/hpc/mpifileutils`

SCR Team

`https://github.com/llnl/scr`

- Kathryn Mohror
- Adam Moody
- Greg Becker
- Elsa Gonsiorowski

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