Argonne NATIONAL LABORATORY

Advanced Cobalt Job Submission: Ensemble Jobs

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Overview

- Definitions
- Motivations
- Types of script jobs
- Basic Script mode job
- Ensemble script jobs
- Subblock script jobs

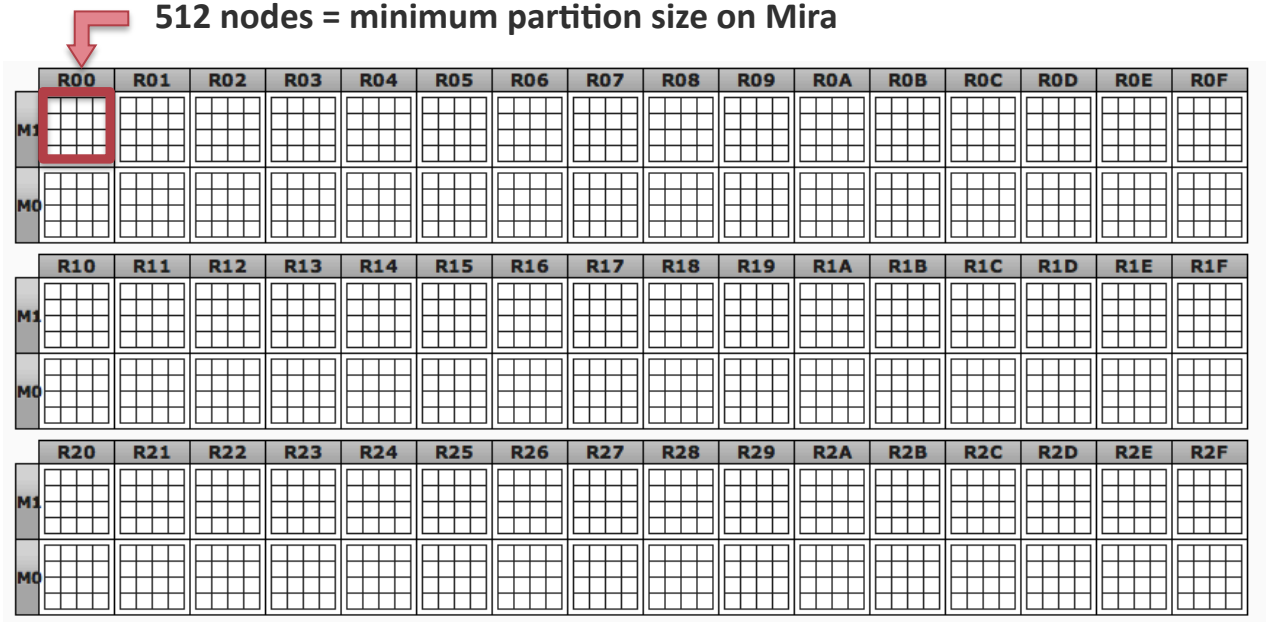
Definitions and Disambiguation

- Cobalt Job -- A job submitted to Cobalt via qsub. Shows up in qstat
- BlueGene Job -- A task run on the BlueGene compute nodes via runjob
- Script Job -- A Cobalt job submitted with the *--mode script* option
- Ensemble Jobs -- A Cobalt job that allocates a block from the scheduler and boots multiple blocks simultaneously from this allocation
- Subblock Jobs -- A runjob feature where multiple BlueGene jobs are run on the same booted block.

Minimum partition sizes on BG/Q machines

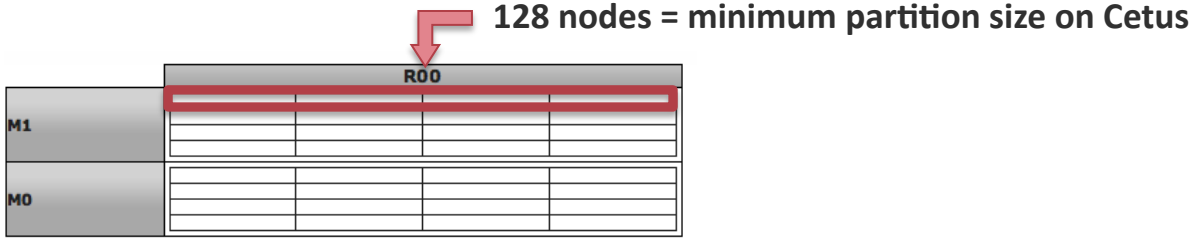
Mira

48 racks



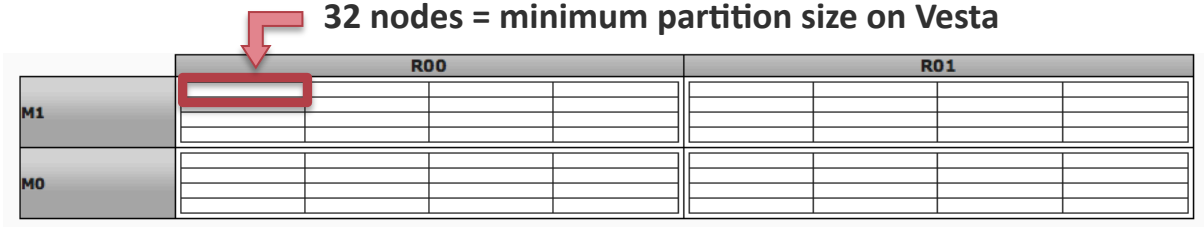
Cetus

1 rack



Vesta

2 racks

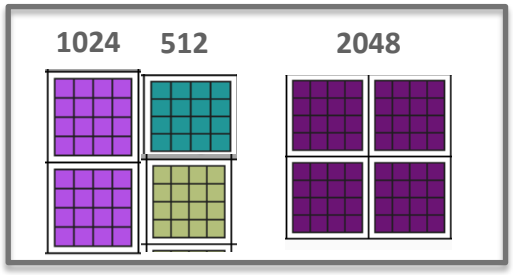


Types of script jobs and the best tool for the job

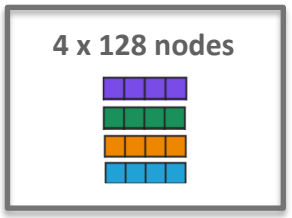
- Basic Script Jobs
  - You have a task to run and some minor staging that you wish to have occur automatically
  - You need to prompt the system to take extra actions after your run
  - You have a small series of short tasks that can run on the same hardware, and want to minimize boot time
- Ensemble Jobs
  - You want to run multiple simultaneous tasks on smaller blocks within a larger allocation
  - You want to change block size between tasks
- Subblock Jobs
  - Runjob feature provided by IBM
  - You have a number of small tasks to run
  - All tasks are smaller than the smallest block size on the system
- Neither of these are MPMD
- Ensemble Jobs and Subblock Jobs are not either-or

Examples of ensemble and subblock jobs

Example of ensemble jobs

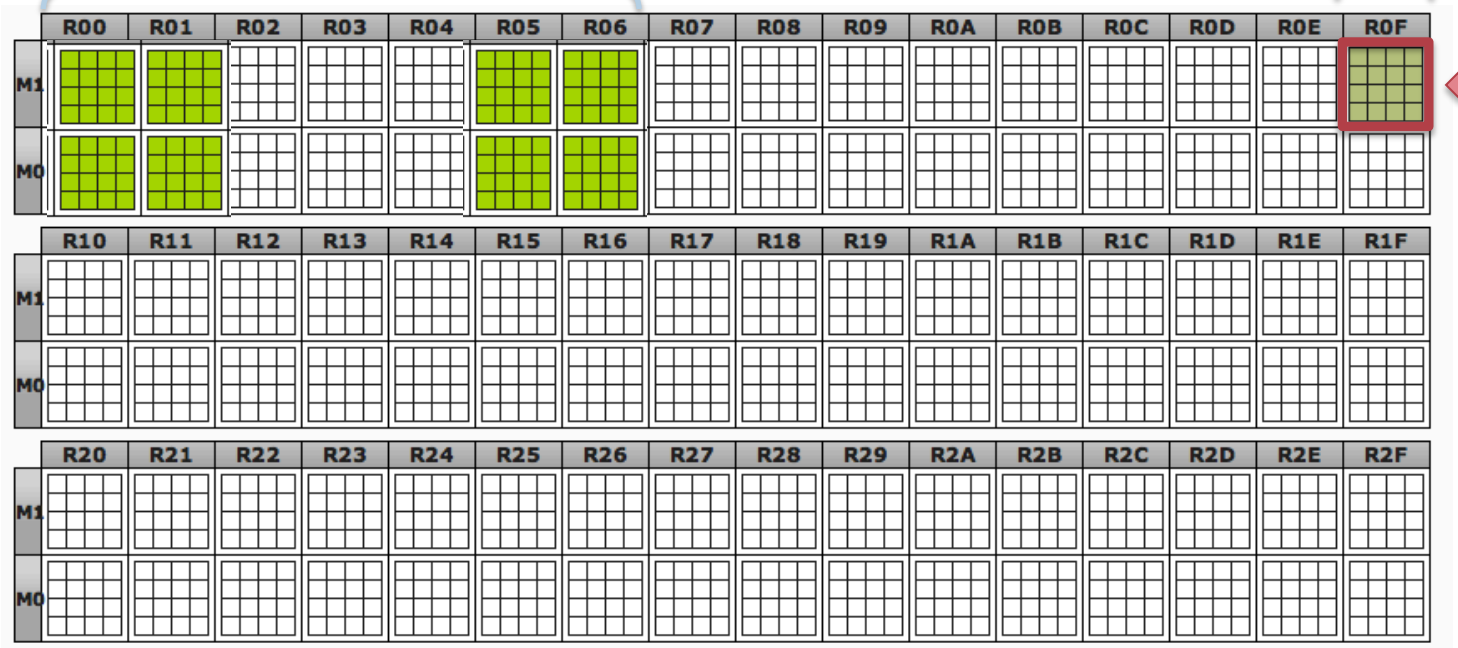


Example of subblock jobs



4K

512 nodes



Minimum partition size on Mira

For jobs with the same characteristics: higher job size = faster score increase

Setting up a basic script job

- Submit with *--mode script* on your qsub line
- Script can be anything executable on a *front end node*
- Allocated block will be booted before the start of the script
- Use Cobalt-provided variables when possible: $COBALT_JOBID, $COBALT_PARTNAME, $COBALT_PARTSIZE, etc.
- Invoke runjob from your script. You may run multiple tasks on the same block multiple times in series
- You may have to use the *boot-block --reboot* command between runs if:
  - Partlist shows your block as having a “SoftwareFailure”
  - Your program exited with a non-zero exit status
- If using BG_PERSISTMEMSIZE, remember that contents will not persist past reboots.

General Script Job Advice

- The job is charged for the set of allocated compute resources for the entire runtime.
  - Do not run expensive operations like compiles on the script host if you can help it
- When running a series of jobs, check exit statuses, and the block status.
  - Errors during a job may put a block into error, causing subsequent runs to fail
- Do not delete Cobalt-generated files as a part of the script.
  - This includes the .cobaltlog, and .error files.
  - Help us help you.
- Do be careful about what you run last during a script
  - “echo done” will cause a script to always have an exit status of 0 regardless of what else has happened!
  - Consider using the ‘-e’ flag if using a shell script
  - May interfere with dependent jobs

Advanced Script Jobs: Ensemble Jobs

- Running multiple tasks concurrently
- Block either must start off unbooted or be freed at the start of the job
  - Disable block booting by setting --disable_preboot in your qsub line
- May run on any “child” block of your allocated block
  - May be subject to wiring restrictions
- *get-bootable-blocks* utility will get all blocks that are available to boot in your allocation
  - Can constrain to particular sizes and geometries
  - Calls after a boot will not include blocked blocks
- *boot-block* boots, frees or reboots a particular location. When this utility completes the block should be ready for use
  - If a nonzero exit status is returned, a problem occurred with the boot
- Runjob works exactly the same way, just using one of the child locations per invocation

Example Ensemble Script

```
#!/bin/bash
BLOCKS=`get-bootable-blocks --size 512 $COBALT_PARTNAME`
for BLOCK in $BLOCKS
do
  boot-block --block $BLOCK &
done
wait
for BLOCK in $BLOCKS
do
  runjob --block $BLOCK : ./my_binary &
done
wait
for BLOCK in $BLOCKS
do
   boot-block --block $BLOCK --free &
Done
wait
```

From http://trac.mcs.anl.gov/projects/cobalt/wiki/BGQUserComputeBlockControl

Ensemble Script Caveats

- Some geometries may have issues running together
  - Notably a problem for 4096 node blocks and 1024 node full-torus blocks due to physical wiring
  - Make sure to hit get-bootable-blocks again if you're using these!
- Boots may fail
  - File systems may fail to mount. Hardware may die during boot.
  - Recommend a maximum of three retries
- Software errors can be cleared by rebooting
  - If running multiple jobs, partlist will show an error as blocked (SoftwareFailure)
- Can mix sizes and reboot as different sizes, but reboot required to switch
- Once a block is booted, can run multiple runjobs against it
- Some blocks may share IO resources so check ALCF system documentation
- Test your script on Cetus, if possible

Running With Subblocks

- Subblock jobs may be used within any script job
- Must target booted blocks of 512 nodes or smaller
  - Can run down to the single-node level
  - May run down to the single core level with significant restrictions
- Requires the use of the --corner and --shape flags to runjob
- Corner must be a hardware location
  - Can obtain this from a coordinate from */soft/cobalt/bgq_hardware_mapper/coord2hardware*
  - Use the first 5-tuple of the block name for the origin
- Shape are the lengths of each dimension
  - *man runjob* has a list of common shapes for valid subblock sizes
- A compute block going into error does not kill previously running jobs
- Watch out for overloading IO nodes
- A way to support multiple 128-node jobs or smaller on a midplane on Mira
- May be run in the same script as an ensemble job

Block Naming and Translation

- Block names are based on the 5D torus coordinates and imply the resources used by a given block.
- Form of LOC-XXXXX-YYYYY-[T]-[PPPP]-SIZE
- LOC is the machine identifier: Currently MIR (Mira), CET (Cetus), VST (Vesta).
- XXXXX - is the lowest leftmost corner used, equivalent to (0,0,0,0,0) locally.
- YYYYY - the highest, rightmost corner used.
- T - An optional identifier for which dimensions are Torus. Currently seen with the D-mesh 1024 blocks.
- PPPP - An optional identifier which describes which nodes should be skipped for passthrough, commonly used when skipping row 1 on a block (0010).
- SIZE -- the nodecount.
- More details in LCF documentation

Block Translation Made Easy

- */soft/cobalt/bgq_hardware_mapper* contains basic helper scripts
- hardware2coord -- take a hardware location and translate to ABCDE
- coord2hardware -- take an ABCDE location and translate to a hardware location
- get-corners.py (experimental) -- given a block name and a shape, generate every valid --corner argument for that shape on that block.
  - Must be used on a block of 512 nodes or smaller

Partition dimensions on BG/Q systems

Cetus

Nodes	A	B	C	D	E
128	2	2	4	4	2
256	4	2	4	4	2
512	4	4	4	4	2
1024	4	4	4	8	2

Vesta

Nodes	A	B	C	D	E
32	2	2	2	2	2
64	2	2	4	2	2
128	2	2	4	4	2
256	4	2	4	4	2
512	4	4	4	4	2
1024	4	4	4/8	8/4	2
2048	4	4	8	8	2

Mira

Nodes	A	B	C	D	E
512	4	4	4	4	2
1024	4	4	4	8	2
2048	4	4	4	16	2
4096	4/8	4	8/4	16	2
8192	4	4	16	16	2
12288	8	4	12	16	2
16384	4/8	8/4	16	16	2
24576	4	12	16	16	2
32768	8	8	16	16	2
49152	8	12	16	16	2

Command: partlist

http://www.alcf.anl.gov/user-guides/machine-partitions

Questions?