JSM Overview

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Presentation Goals

Give a broad overview of JSM

Present basic concepts and functionalities

Be available for assisting with complex use cases

Topics

Basic concepts of JSM

JS utilities

Resource Sets

Simple layouts

Advanced layouts

Binding and OpenMP

MIMD support

JSM is…

Launcher

– like srun, prun, mpirun, blaunch, etc

PMIx server

– MPI apps do not need to create an MPI daemon

Sub-resource manager

– LSF is the high level RM, but jsrun manages a users resources

Basic concepts

mpirun launch flow:

- Determine hosts given to you by resource manager
- Tell mpirun to use some subset of those hosts to run your job

jsrun launch flow:

- Describe the resources you want to JSM
- JSM runs your job on the resources it chooses to meet your criteria.

JSM utilities

jsrun - create a job step (or reservation)

jslist - list running, completed or killed job steps

jskill - signal a job step

jswait - wait for the completion of a job step

Resource Sets

jsrun defines bundles of resources (CPU, GPU & memory)

– called resource sets

– each resource set will result in a cgroup (unless cgroups are turned off)

– jsrun allocates CPU’s as physical cores (i.e. 44 cores per box - core isolation)

Why resource sets?

– Allows multiple jsruns to divide up resource on a node

– Simple way to describe the resources available to each rank

– Simple way to enforce locality between ranks

The basics

How many resource sets to create:

- -n, --nrs <#|ALL_HOSTS> How many resource sets to create

How many CPUs:

- -c, --cpu_per_rs <#|ALL_CPUS> How many CPU’s in each RS

How many GPUs:

- -g, --gpu_per_rs <#|ALL_GPUS> How many GPU’s in each RS

(Memory can also be assigned, but is not enforced)

Simple examples

```
jsrun -n ALL_HOSTS -c ALL_CPUS -g ALL_GPUS ….
```

– create a job step with all the resources in the entire allocation

– resources grouped by node

```
jsrun -n 64 -c 6 -g 1 …
```

– create a job step with 64 resource sets each with 6 cpus and 1 gpu

Two job steps at once

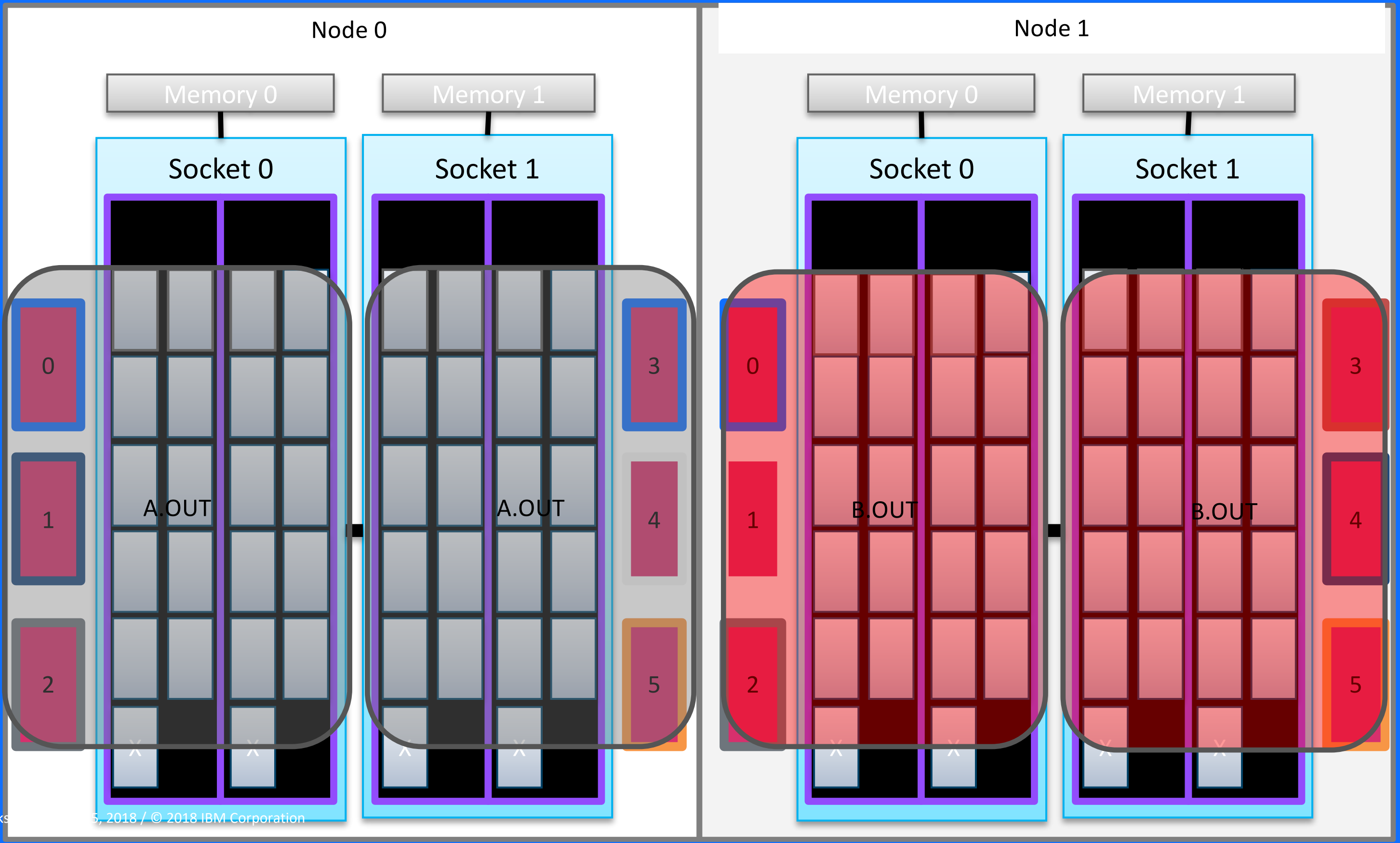
Assume 2 nodes, 40 CPU’s each (core isolation), 6 GPU each

Want to run 2 job steps at the same time that each use 1/2 the resources:

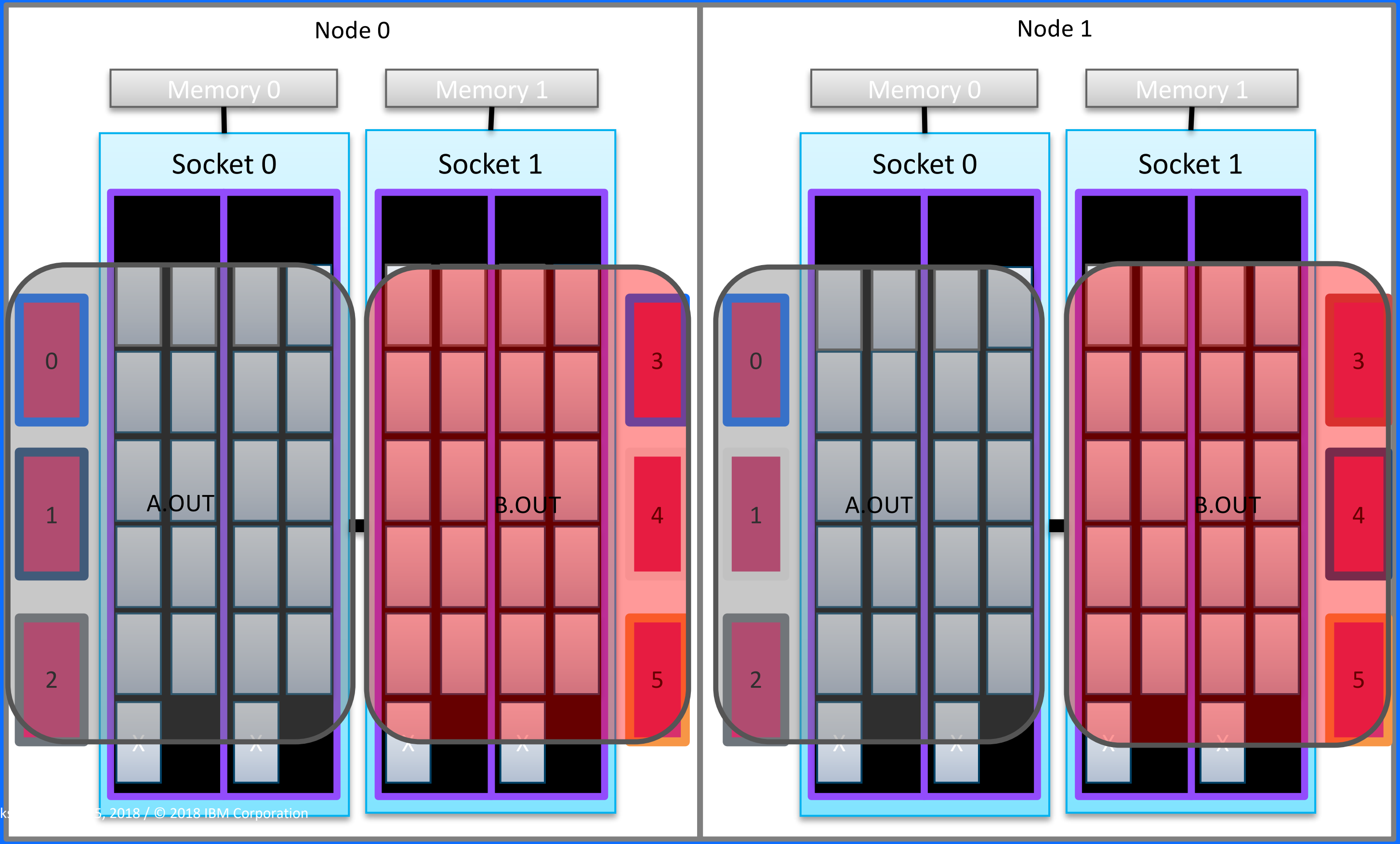
- jsrun --nrs 2 -c 20 -g 3 a.out
- jsrun --nrs 2 -c 20 -g 3 b.out

What do you expect will happen?

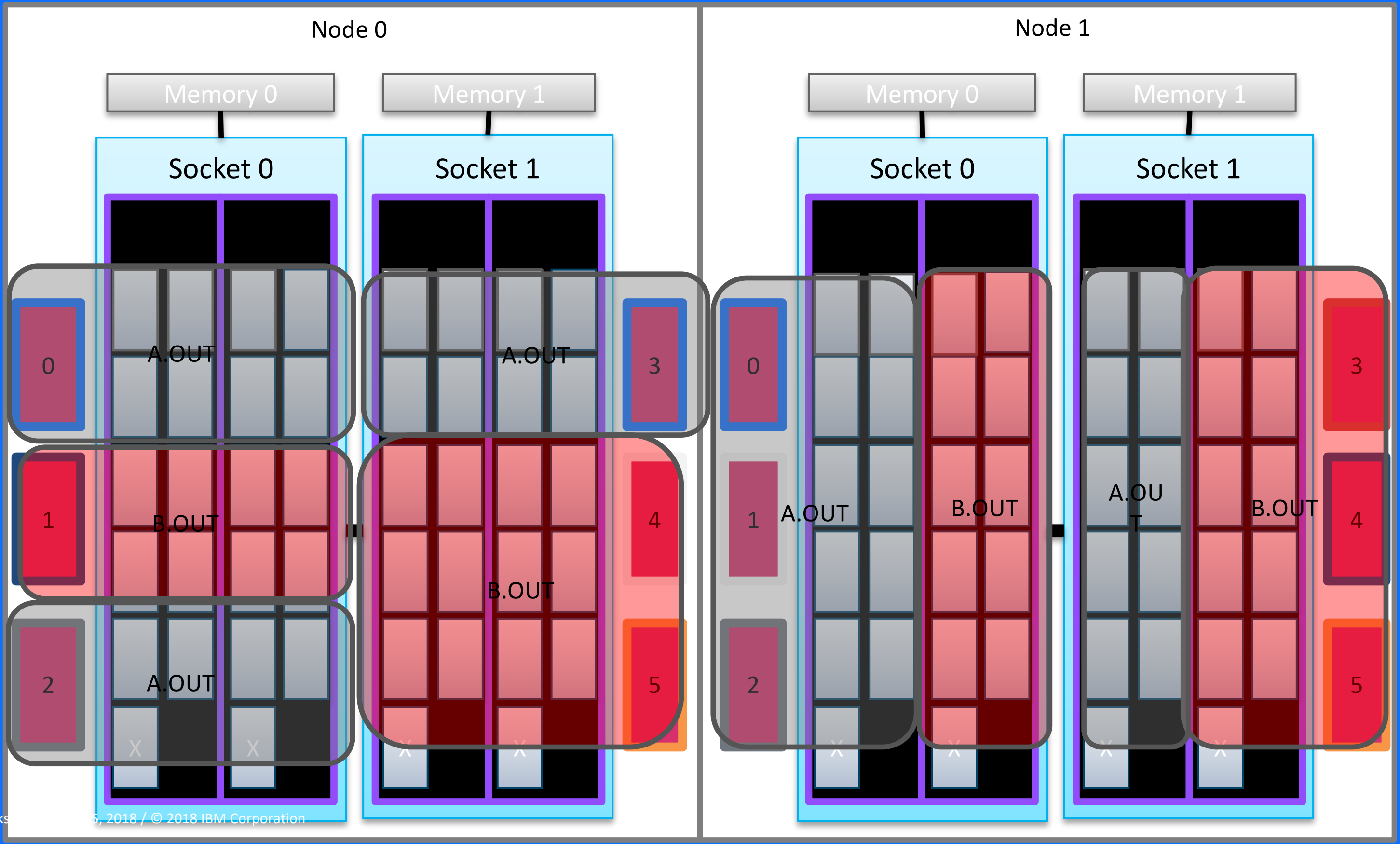
Option A:


Node 0
Memory 0
Memory 1
Socket 0
Socket 1
0
1
2
3
4
5
A.OUT
A.OUT
X
X
X
X
Node 1
Memory 0
Memory 1
Socket 0
Socket 1
0
1
2
3
4
5
B.OUT
B.OUT
X
X
X
X

Option B:


Node 0
Memory 0
Memory 1
Socket 0
Socket 1
0
1
2
A.OUT
B.OUT
3
4
5
X
X
X
X
Node 1
Memory 0
Memory 1
Socket 0
Socket 1
0
1
2
A.OUT
B.OUT
3
4
5
X
X
X
X

Option C: Chaos!



What will you get?

Option A is JSM's preferred allocation

Options B and C are possible

- but in reality would only be given if other jobs were running that had segmented the CPU/GPU space.

Option A or B can requested

Influencers of resource sets - RS per host

-r, --rs_per_host   Specifies the number of resource sets on each host

- jsrun -r 1 --nrs 2 -c 20 -g 3 a.out
- jsrun -r 1 --nrs 2 -c 20 -g 3 b.out
- Will force scenario B (-r 2 will force scenario A)

-l, --latency_priority=<comma separated list>

- priorities are cpu-cpu, gpu-gpu, mem-mem, mem-gpu, mem-cpu, gpu-cpu, CPU-CPU, GPU-GPU, MEM-MEM, MEM-GPU, MEM-CPU, GPU-CPU .

Influencers of resource sets - latency_priority

-l, --latency_priority=<comma separated list>

- priorities are cpu-cpu, gpu-gpu, mem-mem, mem-gpu, mem-cpu, gpu-cpu, CPU-CPU, GPU-GPU, MEM-MEM, MEM-GPU, MEM-CPU, GPU-CPU .
- Default set by configuration file
- Capital letters: Only resources which are optimal for the given priority will be accepted (wait for other steps to finish if necessary)
- Lower case: Use the resources which are best available at the time
- Default default is: gpu-cpu,cpu-mem,cpu-cpu

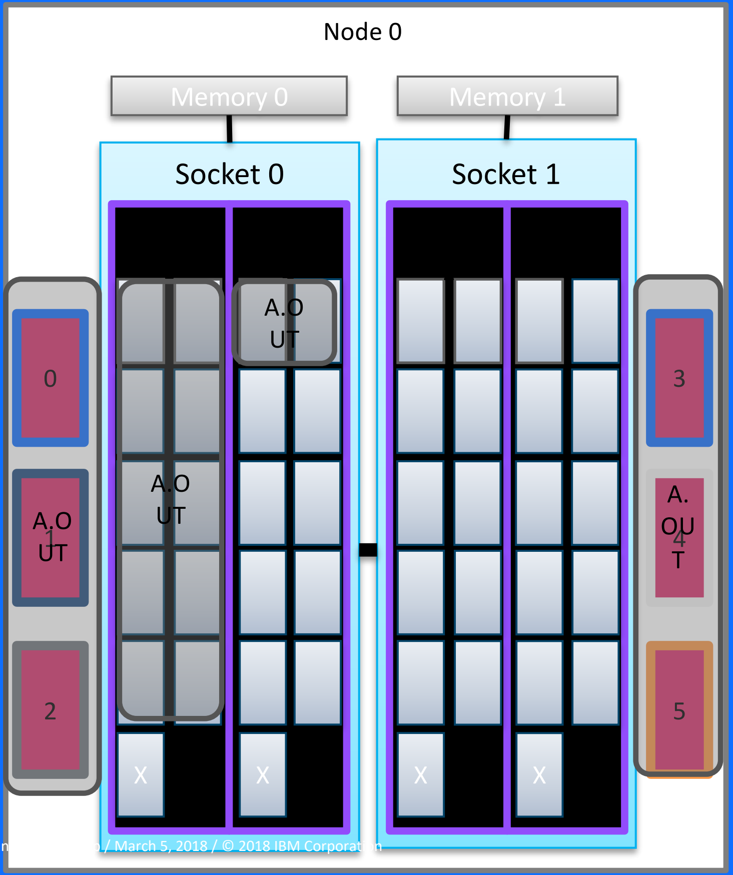
--latency_priority options

cpu-cpu - Select CPUs from the same socket
cpu-gpu - Select CPUs & GPUs from the same socket
cpu-mem - Select CPUs and memory from same NUMA
gpu-gpu - Select GPUs that are from the same socket
gpu-mem - Select GPUs & memory that are from the same socket
mem-mem - Select memory that comes from the same NUMA

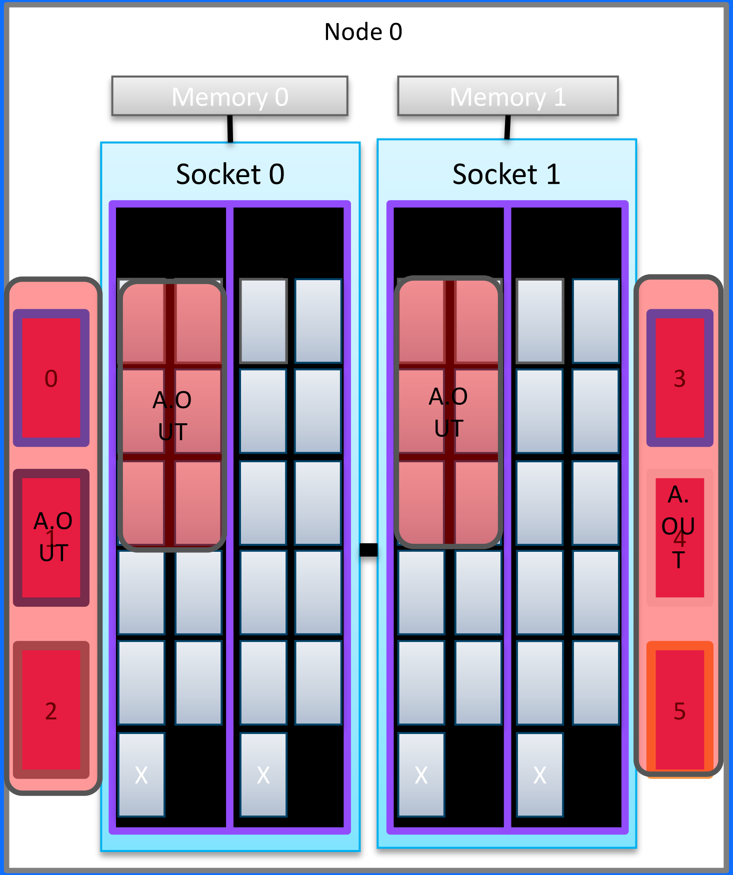
When do you actually care?

- jsrun --nrs <x> -c 12 -g 6
- Do you prefer CPU’s close or CPU’s to GPU’s close?

Option A: cpu-cpu



Option B: cpu-gpu



Save, keep or use or re-use an allocation

Allocations can be created and saved (-A, --allocate_only)

- jsrun --allocate_only --nrs 8 -c 6 -g 6 --rs_per_host 1

Allocations can be used immediately and then removed

- jsrun --nrs 8 -c 6 -g 6 --np 8 a.out

Allocations can be used/removed but saved for later recreation:

- jsrun --save_resources myoptimal16noderun.txt --nrs 8 -c 6 -g 6 --np 8 a.out
- jsrun --use_resources myoptimal16noderun.txt --np 8 a.out
- jsrun --use_resource myoptimal16noderun.txt -A

Saved allocations can be re-used (-J, --use_reservation)

- jsrun --J 1 --np 8 a.out

Creating Tasks

How many tasks to create

Where to place them

How many cores to assign to each task

How many tasks

-p, --np <x>

- Create x tasks

-a, --tasks_per_rs <x>

- Create x tasks per resource set

(Nothing)

- Get 1 task per resource set by default

Simple layouts

1 task per core on all nodes:

- jsrun a.out (with default config file)
- jsrun -c 1 --nrs X --np X a.out

1 task per 4 cores, 1 GPU each:

- jsrun -c 4 -g 1 --nrs X --np X a.out

8 tasks per core:

- jsrun -c 1 --nrs X --np $((X*8)) a.out

1 task per core, 3 GPU’s per task, 1 task per node

- jsrun -c 1 -g 3 --rs_per_node 1 --nrs X a.out

Where to place tasks

-d, --launch_distribution <packed|cyclic|plane:<x>>

- How to map tasks to resource sets.
- Do you want contiguous ranks in each resource set?
- Do you want non-contiguous ranks in each resource set?

- NOTE: In GA release, packed will pack ranks based on how many cores each rank is assigned (See --bind packed:<x>)

-H, --launch_node_tasks=<#>

- Schedule the specified task number on the launch node

How many cores to reserve for each task

Binding: how many and which cores to bind to a task

-b, --bind=<none, rs, packed[:<#>]>

– none - don’t bind

– rs - bind to the entire resource set

– packed:<n> - bind each task to at most n cores. Choose cores that are closest to each other.

OMP_PLACES

--bind option	cores bound to	OMP_PLACES
default	1 core per task	ALL SMT threads from one core
none	none (though cgroup will still limit cores if cgroups are on)	1 task per RS: All SMT threads in RS > 1 task per RS: unset
rs	all cores in the RS	All SMT threads in RS
packed:<n>	n cores from the RS	ALL SMT threads from n cores

Advanced layouts

1 task per core, each 4 tasks share 1 GPU:

```
– jsrun -c 4 -g 1 --a 4 a.out
```

1 task per core, 8 tasks communicate via shared memory and need to be close to one another:

```
– jsrun -c 8 --a 8 --latency_priority CPU-CPU  a.out
```

1 task per 4 cores, every 4 tasks share a GPU:

```
– jsrun -c 16 -g 1 --a 4 --bind packed:4 --launch_distribution packed a.out
```

Odd ranks on one host, even on another

```
– jsrun --nrs 2 -c ALL_CPUS --np X --launch_distribution cyclic a.out
```

MIMD support

```
jsrun -f <appfile>
```

Appfile:

```
<# ranks> : <reservation #> : <command>
<# ranks> : <reservation #> : <command>
<# ranks> : <reservation #> : <command>
  etc.
```

jslist

```
sh-4.2$ jsrun --nrs 2 -c 4 -g 1 /bin/true

sh-4.2$ jslist -R
     parent         cpus     gpus      exit
ID   ID      nrs    per RS   per RS    status       status
===========================================================================
1      0      2      4          1          0            Complete
----------------------------------------------------------------------------------------------------
RS 0 HOST c712f8n10:
            SOCKET 0:    cpus: 0-3 gpus: 0 mem: 4000
RS 1 HOST c712f8n10:
            SOCKET 0:    cpus: 4-7 gpus: 1 mem: 4000
----------------------------------------------------------------------------------------------------
```

jslist

```
sh-4.2$ jsrun --np 1 /bin/sleep 100 &
sh-4.2$ jswait
sh-4.2$ echo $?
 0
sh-4.2$ jsrun --np 1 /bin/false
sh-4.2$ jswait <job step id of previous jsrun>
sh-4.2$ echo $?
 1
```

Can be used to implement flow control between job steps.

Summary

JSM launching….

Define resource sets (CPU’s & GPU’s)

(Use jslist -R to see what you got)

Determine number of tasks

Determine task distribution

Determine cores per task

Environmental influencers

-h, --chdir=<path>

- Change current working directory.

-i, --immediate

- Force jsrun to return immediately.

-L, --use_spindle=<0|1>

- Should spindle be used

-M, --smpiargs=<SMPI args>

- Quoted argument list meaningful for Spectrum MPI applications

-P, --pre_post_exec=<script info>

-X, --exit_on_error=<0|1>

- Determine if a rank error should result in namespace abort

-D, --env_no_propagate=<var>

- Exclude this environment variable from being propagated

-E, --env=<var=val>

- Environment variable to be set before exec of tasks

-F, --env_eval=<var=val>

- environment variable to be evaluated and set before exec of tasks

stdio related options

-e, --stdio_mode=individual | collected | prepended

- Individual: Every rank writes to its own local file
- Collected: IO goes through jsrun
- prepended: collected + rank identification on each line

-stdin_rank=<#>

- Collected mode only. Only one rank may receive stdin in collected mode.

-k, --stdio_stderr=<filename>

- stderr filename (default: jsrun for collected, /dev/null for individual)

-o, --stdio_stdout=<filename>

- stdout filename (default: jsrun for collected, /dev/null for individual)

-t, --stdio_input=<filename>

- stdin filename (default: jsrun for collected, /dev/null for individual)