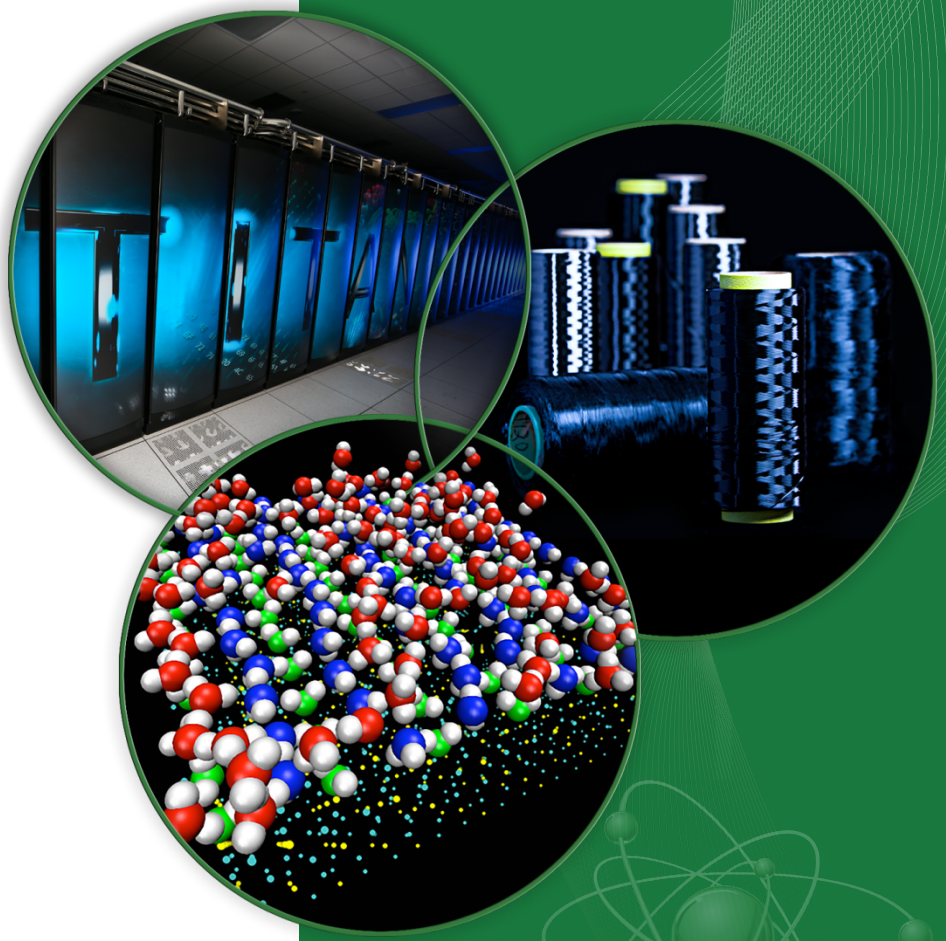
OLCF GPU Hackathon: Welcome & Introduction



Verónica G. Vergara Larrea

Adam B. Simpson

Tom Papatheodore

CSGF 2017

July 26, 2017

ORNL is managed by UT-Battelle
for the US Department of Energy

OAK RIDGE National Laboratory | OAK RIDGE LEADERSHIP COMPUTING FACILITY

Agenda

- **08:00 - 09:00** Introduction
  - What is the OLCF?
  - OLCF resources
  - Mandelbrot Problem
- **09:00 - 12:00** Hackathon
- **12:00 - 13:00** Lunch
- **13:00 - 16:00** Hackathon (cont'd)
- **16:00 - 16:10** Prepare Slides for CSGF Steering Committee
- **16:10 - 17:00** Presentations to CSGF Steering

What is the OLCF?

- **O**ak Ridge **L**eadership **C**omputing **F**acility
- Established in 2005 at ORNL
- DOE-SC user facility
  - Open to nearly everyone in the world
  - Free to use for non-proprietary work
  - Allocations are merit based
- **L**eadership **C**omputing **F**acility
  - Develop and use the most advanced computing systems in the world

OLCF Compute Resources

- Cray XK7
- #4 in the TOP500 (June 2017)
- 27 PF
- 18,688 nodes/299,008 cores
  - AMD Opteron + K20x GPU per node

- Cray XC30
- 736 nodes/11,766 cores
  - Two 8-core Intel Xeon E5-2670
- Used for pre- and post-processing

- RHEL6 Linux cluster
- 512 nodes/8,192 cores
  - Two 8-core Intel Xeon E5-2650
- 9 nodes have two K80 GPUs
- Used for pre- and post-processing

Size	18,688 Nodes	5,000 Sq. feet	
Peak Performance	27.1 PetaFLOPS	2.6 PF CPU	24.5 PF GPU
Power	8.2 MegaWatts	~7,000 homes	
Memory	710 TeraBytes	598 TB CPU	112 TB GPU
Scratch File system	32 PetaBytes	1 TB/s Bandwidth	

Image courtesy of ORNL

Summitdev System

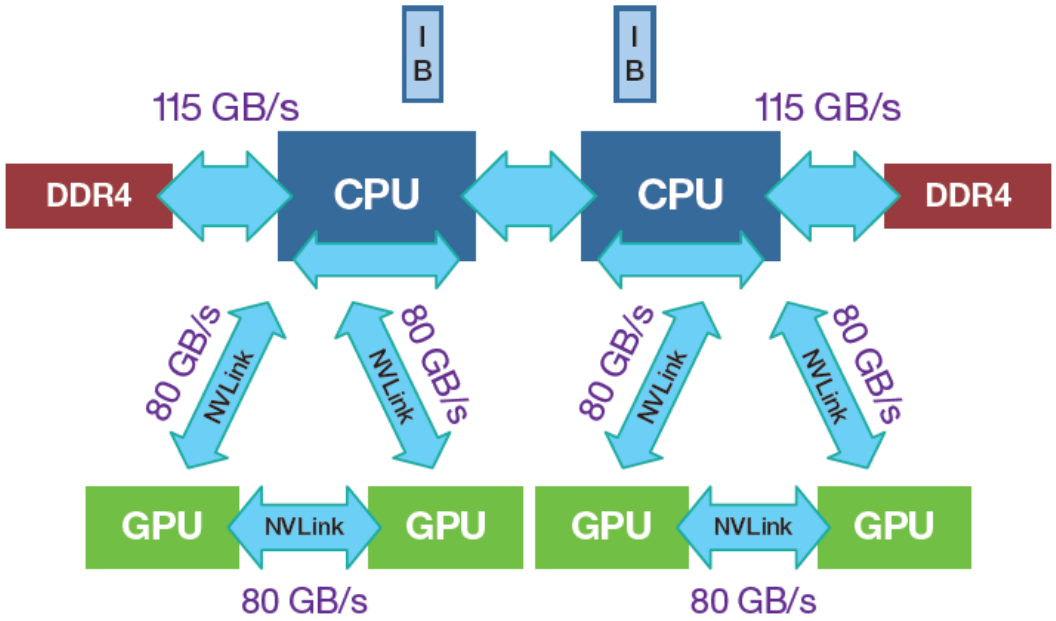
- Three racks, each with 18 IBM S822LC nodes
- One rack of login and support servers
- Nodes connected in a full fat-tree via EDR InfiniBand
- Liquid cooled w/ heat exchanger rack

Each IBM S822LC node has:

- 2x IBM POWER8 CPUs
  - 32x 8GB DDR4 memory (256 GB)
  - 10 cores per POWER8, each core with 8 HW threads
- 4x NVIDIA Tesla P100 GPUs
  - NVLink 1.0 connects GPUs at 80 GB/s
  - 16 GB HBM2 memory per GPU
- 2x Mellanox EDR InfiniBand
- 800 GB NVMe storage

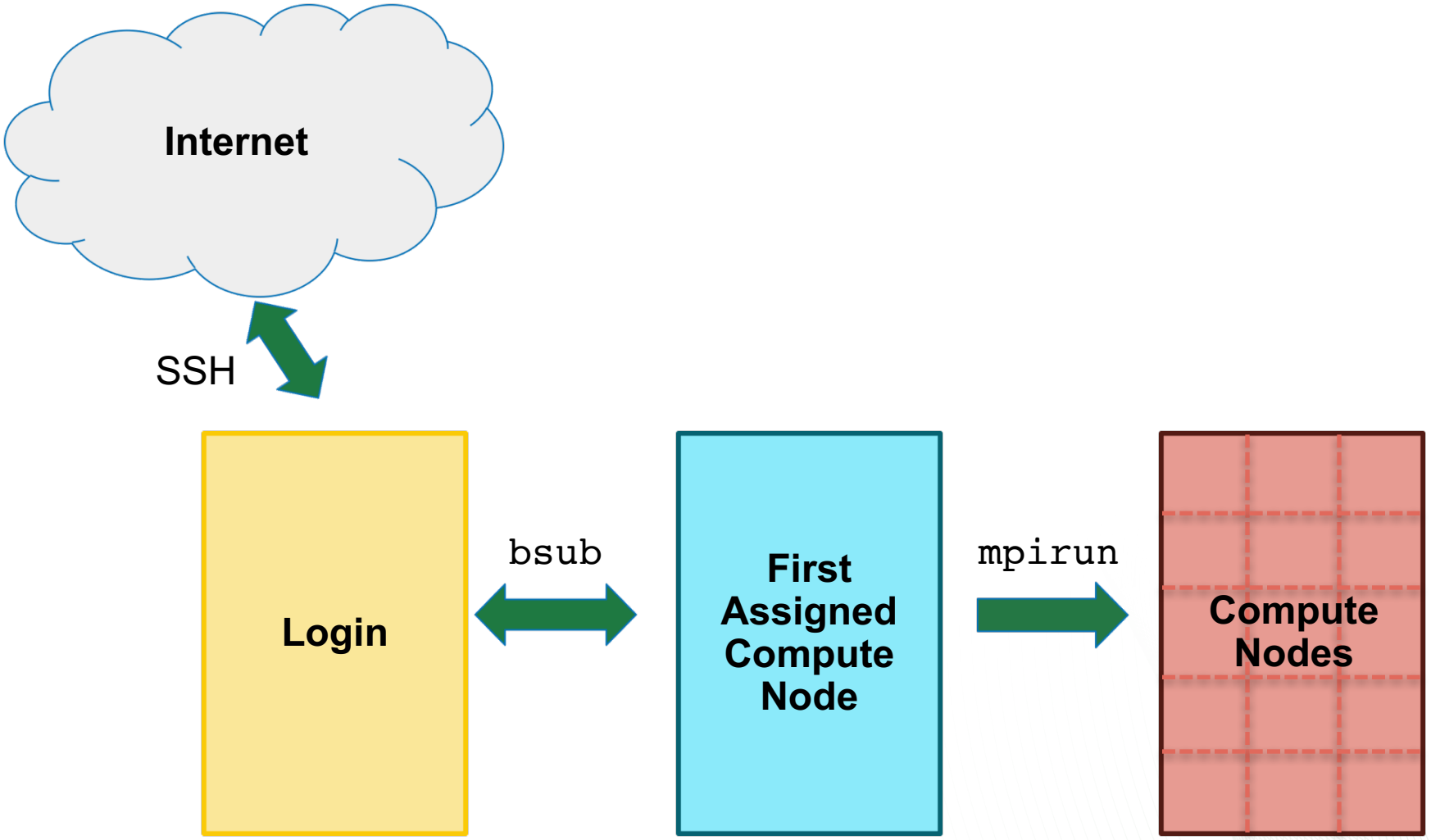
Summitdev

Summitdev Node Layout



Information and drawing from IBM Power System S822LC for High Performance Computing Data Sheet

Summitdev node structure - connectivity



Connecting to the OLCF

- The hackathon will use Summitdev
  - One generation removed from Summit's architecture
  - IBM Power8+ system with 54 compute nodes
- To login from your laptop:
  - First: `ssh <username>@home.ccs.ornl.gov`
  - Then: `ssh summitdev.ccs.ornl.gov`
- If you encounter issues:
  - Ask OLCF staff in the #csgf channel: https://olcf.slack.com/
  - Email help@olcf.ornl.gov

File systems available at the OLCF

- Home directory: `/ccs/home/<username>`
- Scratch directories:
  - User scratch: `/lustre/atlas/scratch/<username>/<projectID>`
  - Project shared: `/lustre/atlas/proj-shared/<projectID>`
  - World shared: `/lustre/atlas/world-shared/<projectID>`
- The username is the one you requested in the OLCF Account Request form.
- The project ID for this session is **`CSC261`**

LSF submission file example

```
#!/bin/bash -l
#BSUB -P csc261
#BSUB -n 20
#BSUB -W 15
#BSUB -J test
#BSUB -o test.o%J
#BSUB -e test.e%J


cd /lustre/atlas/world-shared/csc261

mkdir -p $USER

cd $USER

module list

mpirun -n 2 /bin/hostname
```

Submitting a job

- On Summitdev, check the queue:

```
username@summitdev-login1:~> bjobs -u all
```

- Then submit an interactive job:

```
bsub -n 20 -x -P CSC261 -U CSGF -W 120 -Is $SHELL
```

- If you check the queue again, you should see your job:

```
JOBID   USER        STAT   SLOTS    QUEUE        START_TIME     FINISH_TIME    JOB_NAME
121568  vgv         RUN    20       interactive Jul 10 15:47   Jul 10 17:47   /bin/bash
```

Exercise: Putting it all together

```
local:~ $ ssh <username>@home.ccs.ornl.gov
home2:~ $ ssh summitdev.ccs.ornl.gov

summitdev-login1:~ $ cd /lustre/atlas/world-shared/csc261
summitdev-login1:~ $ mkdir $USER
summitdev-login1:~ $ cd $USER
summitdev-login1:~ $ git clone https://github.com/olcf/vector_addition_tutorials.git
summitdev-login1:CPU $ cd vector_addition_tutorials/CPU
summitdev-login1:CPU $ bsub -n 20 -W 15 -x -P csc261 -Is $SHELL
Job <121654> is submitted to default queue <interactive>.
<<Waiting for dispatch ...>>
<<Starting on summitdev-r0c0n15>>

summitdev-r0c0n15:CPU $ module avail
summitdev-r0c0n15:CPU $ module load gcc
summitdev-r0c0n15:CPU $ module list
summitdev-r0c0n15:CPU $ gcc -o vecAdd_c vecAdd.c -lm
summitdev-r0c0n15:CPU $ gfortran -o vecAdd_f vecAdd.f90
summitdev-r0c0n15:CPU $ ./vecAdd_c >> ../../intro.$USER.$LSB_JOBID
summitdev-r0c0n15:CPU $ ./vecAdd_f >> ../../intro.$USER.$LSB_JOBID
summitdev-r0c0n15:CPU $ hostname >> ../../intro.$USER.$LSB_JOBID
summitdev-r0c0n15:CPU $ exit
```

Slide template

1. General observations/Interesting issues
2. Animation/movie
3. Performance results (strong and weak scaling)
4. GPU profiling

Thank you!

Questions?

Contact the OLCF at:
help@olcf.ornl.gov
(865) 241 - 6536

This research used resources of the Oak Ridge Leadership Computing Facility at the Oak Ridge National Laboratory, which is supported by the Office of Science of the U.S. Department of Energy under Contract No. DE-AC05-00OR22725.