

Exercise

Architecture of Parallel Computer Systems

SoSe 18

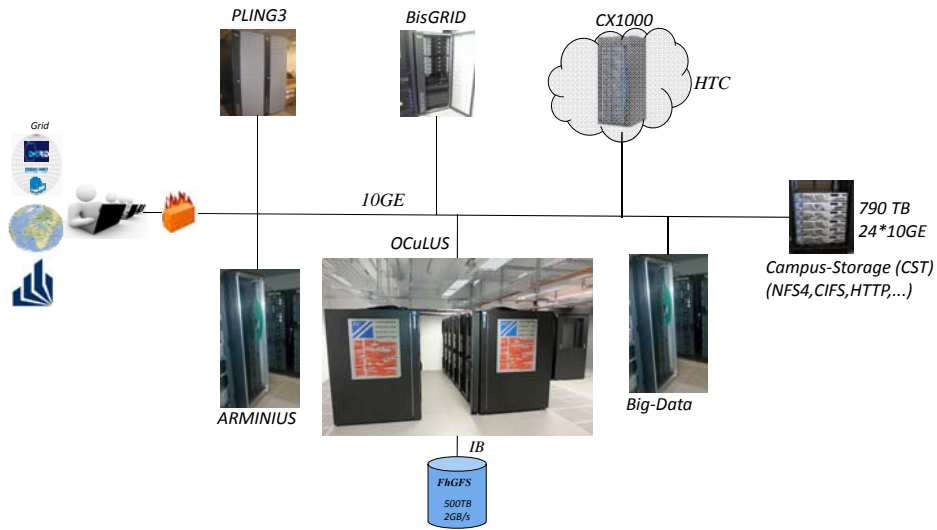
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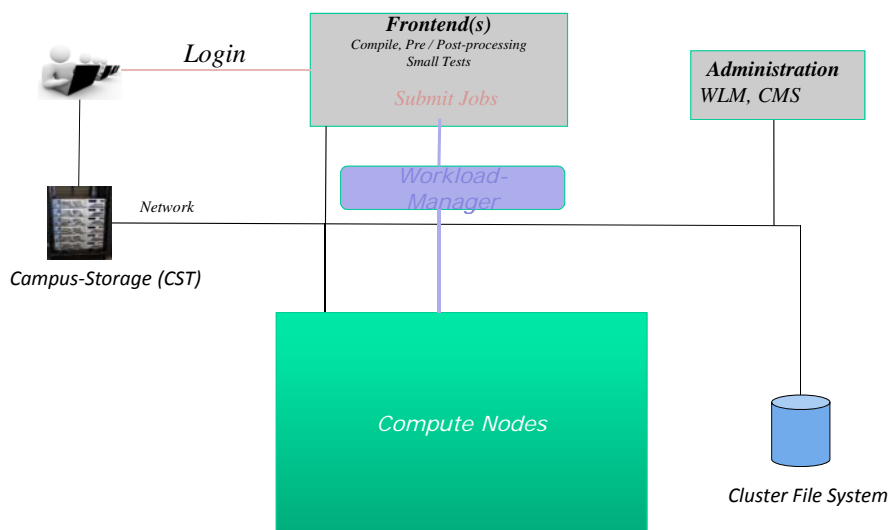
Overview Computer Systems

- Test Cluster (Arminius)
 - Multi node jobs
 - max. 60 nodes, each 36 GByte and 12 cores
- High Performance Cluster (OCuLUS)
 - Multi node jobs for “production”
 - 552 nodes, each 64 GByte and 16 cores
 - 20 nodes, each 256 GByte and 16 cores
 - 4 nodes, each 1 TByte and 32 cores
- High Through-Put Cluster (HTC)
 - Single node jobs
 - single threaded
 - shared memory multi threaded
 - Max. 16 GByte and 8 cores

PC² Infrastructure



Basic Cluster Structure



Arminius Cluster

636 processor cores, 1,8 TByte main memory

- 53 compute nodes, each
 - 2 x Intel X5650 with 2.67 GHz (2 x 6 cores)
 - 36 GByte main memory
- InfiniBand-Interconnect
 - 40 Gbit/s Mellanox HCA and switches
 - full bisectional bandwidth
- Software
 - Linux CentOS 6.6
 - openmpi 1.8.1
- Login nodes
 - fe-1.arminius.pc2.uni-paderborn.de
 - fe-2.arminius.pc2.uni-paderborn.de

Available File Systems

- The PC² provides three types of file systems:
 - A shared file system located on an external filer. This file system is available on all clusters.
 - Cluster local file systems. They provide fast access (typically realized by a parallel file system).
 - Node local disks.
- Based on this file systems, every user can access the following directories:

Environment Variable	Purpose
\$HOME	Login home, small data
\$PC2GROUPS/HPC-LCO-SIMON	Group related data
\$PC2WORK	Temporary, data center wide working data
\$PC2SCRATCH	Temporary, system local working data
\$CCS_TMPDIR	Temporary, node local data

Files needed for exercises

More details see:

<https://wikis.uni-paderborn.de/pc2doc/PC2-FileSystems>

Executing Programs on Arminius

Set Environment

- `module add intel/compiler`

Compile OpenMP program

- `icc -openmp -o pi pi.c`

Workload Management System (OpenCCS)

- `ccsinfo -a`
- `ccsinfo -s`
- `ccsinfo -s --mine`

Job Submission (example)

- `ccsalloc -I --group=HPC-LCO-SIMON -t 5m -c 1 pi 1000000000`
- `ccsalloc -I -g HPC-LCO-SIMON --res=rset=1:ncpus=6:ompthreads=6,place=free ./pi 1000000000`

Explicit Job Termination

- `ccskill <reqID>`

Executing MPI-Programs on Arminius

Set MPI-Environment

- `module add openmpi`
- `module add gcc` (optional)

Compile program

- `mpicc -o hello_mpi hello_mpi.c`

Job Submission

- `ccsalloc -I --group=HPC-LCO-SIMON -t 5m -c 2 ompi -- ./hello_mpi`
- `ccsalloc -I --group=HPC-LCO-SIMON -t 5m --res=rset=2:ncpus=1:mpiprocs=1:ompthreads=1:ib=true ompi -- ./hello_mpi`

Executing MPI-Programs

MPI-Job Submission

- 24 MPI-processes each associated with one core
`ccsalloc -l -c 24 ompi -- ./hello_mpi`
- 2 MPI-processes each placed on a separate node
`ccsalloc -l -t 4m -n 2 ompi -- ./hello_mpi`
- 8 MPI-processes each with 3 threads
`ccsalloc -l -t 5m --res=rset=8:ncpus=3:mpiprocs=1:ompthreads=3:ib=true,place=pack /
ompi -- ./hello_mpi`
`ccsalloc -l -t 5m --res=rset=2:ncpus=12:mpiprocs=4:ompthreads=3:ib=true,place=excl /
ompi -- ./hello_mpi`
`ccsalloc -l -t 5m --res=rset=4:ncpus=6:mpiprocs=2:ompthreads=3:ib=true,place=free /
ompi -- ./hello_mpi`

- First exercise
 - Login on a frontend of the Arminius Cluster
 - Execute the command
`ccsgenrcfiles HPC-LCO-SIMON`
 - Edit file `~/ccs/uirc` and set `ARMINIUS` to default machine
`CCS_UI_DEF_ISLAND ARMINIUS`
 - Copy examples from `$PC2GROUPS/HPC-LCO-SIMON` in your home directory
 - Initialize your environment for using OpenCCS
`ccsgenrcfiles HPC-LCO-SIMON`
 - Compile and execute the example programs