1. Introduction
The following best practices document is provided as courtesy of the HPC Advisory Council.

2. Application Description:
Community Earth System Model (CESM) is a coupled climate model for simulating the earth’s climate system. It is composed of four separate models simultaneously simulating: Earth’s atmosphere, ocean, land surface and sea-ice. CESM allows researchers to conduct fundamental research into the earth’s past, present and future climate states. Note that CESM1.0.3 supersedes CCSM4.0. For more information about CESM:
http://www.cesm.ucar.edu/models/cesm1.0/

3. Version Information:
Software version being used: CESM 1.0.3
Registration is required for obtaining the source code. Refer to the above URL for the registration.
To check out the source code with subversion:
$ svn co https://svn-ccsm-release.cgd.ucar.edu/model_versions/cesm1_0_3 cesm1_0_3

4. Prerequisites:
The instructions from this best practice have been tested with the following configuration:

4.1 Hardware:
- Dell PowerEdge M610 38-node cluster
- Intel Xeon X5670 CPUs @ 2.93 MHz
- Memory: 24GB per node @ 1333MHz
- Mellanox ConnectX-2 QDR InfiniBand Adapters
- Mellanox QDR InfiniBand Switch

4.2 Software:
- Intel® Cluster Ready running RHEL 5.5
- Mellanox OFED 1.5.2 InfiniBand Software Stack
- Mellanox Fabric Collectives Accelerator™ 2.1
- Compilers: Intel compilers 11.1
- MPI: Open MPI 1.5.3 with KNEM 0.9.6, Platform MPI 8.0.1
- Application: CESM 1.0.3

- Libraries: NetCDF 4.1.3
- Benchmark workload: B1850CN

5. Building CESM
After the source code has been checked out, you would need to create the case:

a. Create case
First, use this command to define the case:
$ cd ~/cesm_1.0.3/scripts
$ ./create_newcase -case /home/user/cesm1_0_3/
    B1850CN -mach generic_linux_intel -compset B_1850_CN
    -res 0.9x1.25_gx1v6 -din_loc_root_csmdata /home/user/cesm1_0_3/
    -scratchroot /home/user/cesm1_0_3/B1850CN/
    -max_tasks_per_node 12

6. Modifying the configuration files
a. Modify env_mach_pes.xml
$ cd ~/cesm_1.0.3/B1850CN
Modify env_mach_pes.xml and change all reference of 128 to the number of processes you intend to run. In my case, I will run with a job with 384 MPI processes, I replace all references of 128 to 384.
Every time you want to run a job with a different number of processes, you will need to change this and recompile at the end.

b. Modify Macros.generic_linux_intel
You will need to modify this file for the library paths:
$ vim Macros.generic_linux_intel
NETCDF_PATH := /application/netcdf-4.1.3/install-intel/
INC_NETCDF := $(NETCDF_PATH)/include
LIB_NETCDF := $(NETCDF_PATH)/lib
MOD_NETCDF := $(NETCDF_PATH)/include
MPICH_PATH := /usr/mpi/intel/openmpi-1.3.3

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8. Building the case

After the build script is generated, run this to compile.

```
$ ./B1850CN.generic_linux_intel.build
```

Sometimes, building would fail because it needs certain datasets. If the system has internet access, the dataset would be automatically. In cases when it is not, you will need to download them manually:

```
$ mdir -p ~/cesm_1.0.3/dataset-1850CN/ccsm4_init/ b40.1850.track1.1deg.006/0863-01-01
$ cd ~/cesm_1.0.3/dataset-1850CN/ccsm4_init/ b40.1850.track1.1deg.006
$ svn export --force https://svn-ccsm-inputdata. cgd.ucar.edu/trunk/inputdata/ccsm4_init/b40.1850. track1.1deg.006/0863-01-01
```

The executable is under: ~/cesm1_0_3_nfs/B1850CN/ scratchroot/B1850CN /run/ccsm.exe

9. Running the case

Before running the script to start the job, you will need to define the mpirun command line. Near the end of the run script, comment out the lines for instructions and exit, then define your mpirun command:

```
# Command for Platform MPI:
mpirun -np 384 -IBV -hostfile ~/hostfile -prot -i profile  
-e MPI_IB_MULTIRAIL=1 -srq -IBV -aff=automatic 
/home/user/cesm1_0_3/B1850CN/scratchroot/ B1850CN/run/ccsm.exe >&! outputfile
```

```
# Command for Open MPI:
mpirun -np 384 -mca btl self,sm,openib   -mca btl_  
openib_if_include mlx4_0 -mca btl_sm_use_knem 1  
-hostfile ~/hostfile --bind-to-core -mca coll_fca_en- 
able 1 ./ccsm.exe >&! outputfile
```