

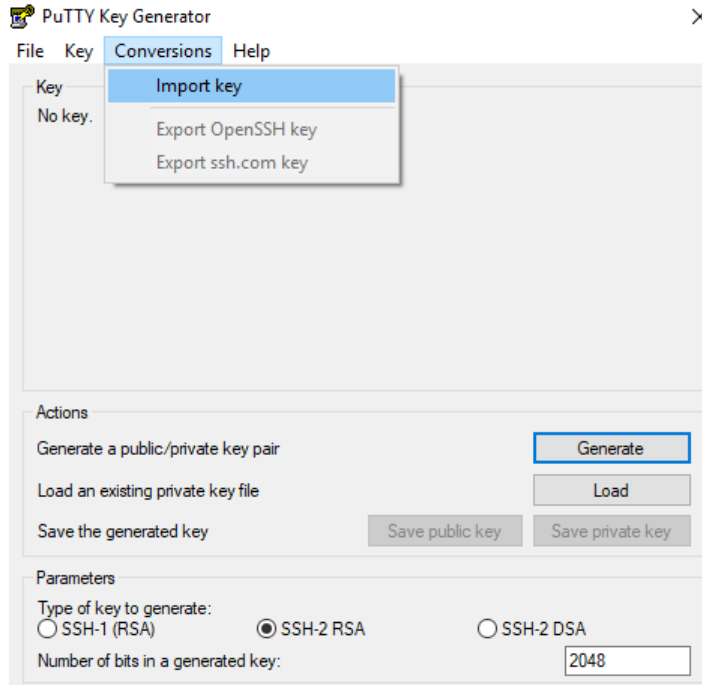
HPC Benchmarks

- By Saumya Bhatnagar

INSTALLATION STEPS:

I. Used puttygen to generate the ppk file

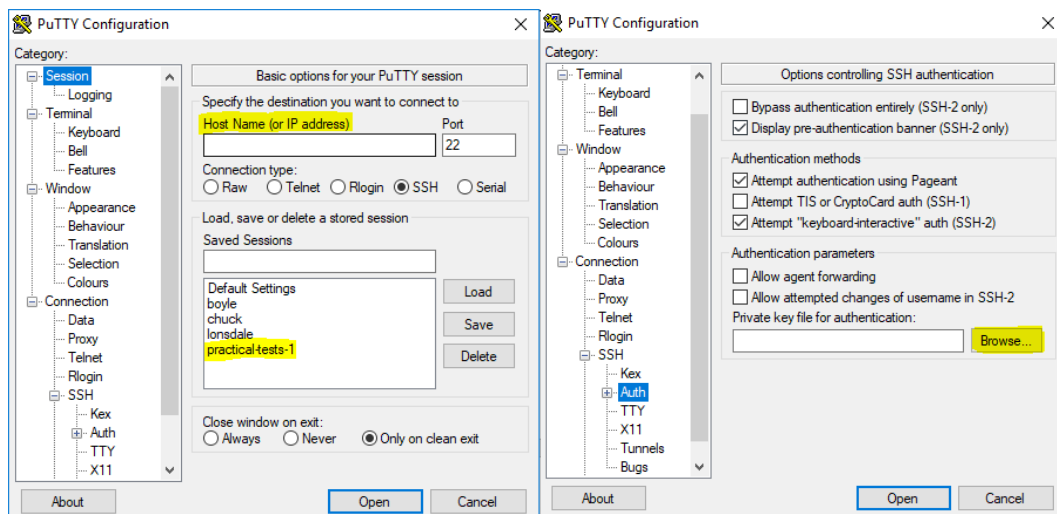
Putty Key Generator -> Conversion -> Import Key -> Browse the location -> Save private key as "key.ppk"



Save the key without the passphrase

II. Use Putty to login to practical-tests-1 (management server)

Open putty -> Create new session named "practical-tests-1" -> save IP address -> Under connection/SSH/Auth -> browse Private key -> Save session -> open session -> Login id : centos
PFA the screenshots:



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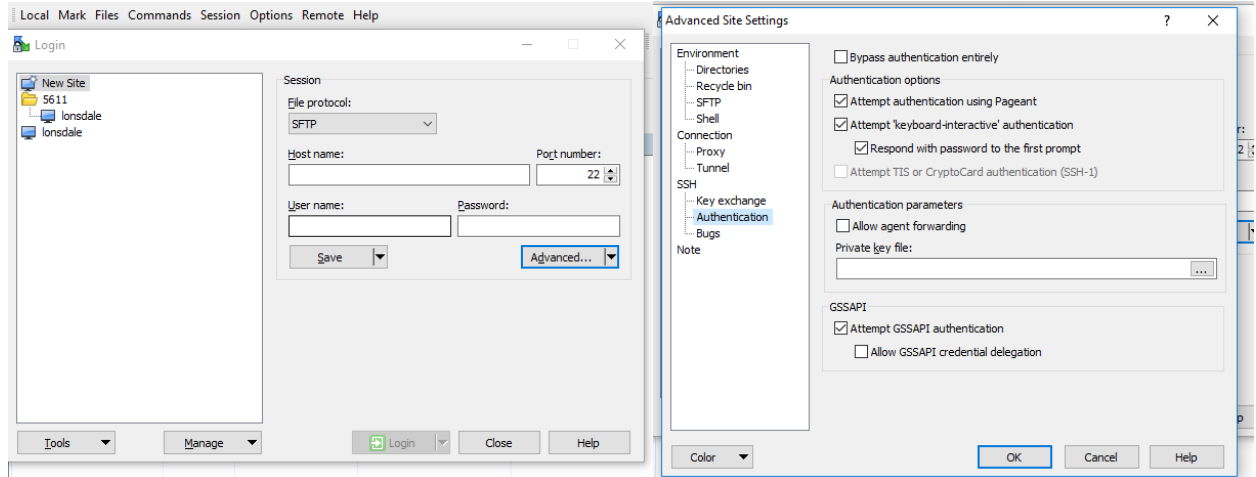
```
centos@practical-tests-1:~  
login as: centos  
Authenticating with public key "imported-openssh-key"  
Last login: Wed Sep 19 09:30:48 2018 from 77.89.144.29  
[centos@practical-tests-1 ~]$
```

III. After SSH-ing into practical-tests-1, get details of the OS/server

```
CentOS Linux release 7.4.1708 (Core)  
NAME="CentOS Linux"  
VERSION="7 (Core)"  
ID="centos"  
ID_LIKE="rhel fedora"  
VERSION_ID="7"  
PRETTY_NAME="CentOS Linux 7 (Core)"  
ANSI_COLOR="0;31"  
CPE_NAME="cpe:/o:centos:centos:7"  
HOME_URL="https://www.centos.org/"  
BUG_REPORT_URL="https://bugs.centos.org/"  
  
CENTOS_MANTISBT_PROJECT="CentOS-7"  
CENTOS_MANTISBT_PROJECT_VERSION="7"  
REDHAT_SUPPORT_PRODUCT="centos"  
REDHAT_SUPPORT_PRODUCT_VERSION="7"  
  
CentOS Linux release 7.4.1708 (Core)  
CentOS Linux release 7.4.1708 (Core)
```

IV. Open WinSCP

Give Hostname details (IP address). Then click on advanced -> Authentication -> give ppk location as shown in below figures:



Copy saumya-key from windows location to practical-tests-1 by drag and drop on WinSCP

V. Login to practical-tests-2 (1st client server)

- On practical-tests-1, copy key to .ssh directory
`cp saumya-key ~/.ssh`
- Set permissions on the .ssh directory (to 700) and the saumya-key file in that directory (to 600) on the target hosts.
`chmod 700 ~/.ssh`
`chmod 600 ~/.ssh/saumya-key`
- Now SSH into practical-tests-2
`ssh -i ~/.ssh/saumya-key practical-tests-2`

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```
[centos@practical-tests-1 ~]$ ssh -i ~/.ssh/saumya-key practical-tests-2
The authenticity of host 'practical-tests-2 ([redacted])' can't be established.
ECDSA key fingerprint is [redacted].
ECDSA key fingerprint is [redacted].
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'practical-tests-2,[redacted]' (ECDSA) to the list of
known hosts.
Last login: Tue Sep 18 14:44:54 2018 from [redacted]
```

d. Repeat Step (c) for other nodes to login

`ssh -i ~/.ssh/saumya-key practical-tests-3`

```
[centos@practical-tests-1 ~]$ ssh -i ~/.ssh/saumya-key practical-tests-3
The authenticity of host 'practical-tests-3 ([redacted])' can't be established.
ECDSA key fingerprint is [redacted].
ECDSA key fingerprint is [redacted].
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'practical-tests-3,[redacted]' (ECDSA) to the list of
known hosts.
Last login: Tue Sep 18 12:13:00 2018 from [redacted]
```

`ssh -i ~/.ssh/saumya-key practical-tests-4`

```
[centos@practical-tests-1 ~]$ ssh -i ~/.ssh/saumya-key practical-tests-4
The authenticity of host 'practical-tests-4 ([redacted])' can't be established.
ECDSA key fingerprint is [redacted].
ECDSA key fingerprint is [redacted].
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'practical-tests-4,[redacted]' (ECDSA) to the list of
known hosts.
Last login: Tue Sep 18 12:13:29 2018 from [redacted]
```

VI. Setup a user for running tests

To add user

`sudo useradd bhatnags`

To change password of user (This asks for setting password for the user bhatnags)

`sudo passwd bhatnags`

Username and password both set to bhatnags

Repeat the same for all nodes

VII. Setup password-less access between all 4 servers

a. On practical-tests-1

`ssh-keygen`

```
[centos@practical-tests-1 ~]$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/centos/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/centos/.ssh/id_rsa.
Your public key has been saved in /home/centos/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:dN/49cfS1+bU37wHJQ+QjkOje9nbwFh871H4JBWzew4 centos@practical-tests-1.nova
local
The key's randomart image is:
+---[RSA 2048]-----+
|      . o .|
|      o o  +|
|      .o.= . +|
|      ...o.+o* =|
|      S. BooE@o|
|      . + +.*B|
|      . =o%|
|      . o**|
|      .B|
+---[SHA256]-----+
```

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```
cd ~/.ssh/  
cat id_rsa.pub >> authorized_keys
```

- b. Copy on the node practical-tests-2

```
scp -i ~/.ssh/saumya-key id_rsa.pub practical-tests-2:~/.ssh/  
scp -i ~/.ssh/saumya-key authorized_keys practical-tests-2:~/.ssh/  
scp -i ~/.ssh/saumya-key id_rsa practical-tests-2:~/.ssh
```

- c. Repeat Step (b) on all nodes

```
scp -i ~/.ssh/saumya-key id_rsa.pub practical-tests-3:~/.ssh/  
scp -i ~/.ssh/saumya-key authorized_keys practical-tests-3:~/.ssh/  
scp -i ~/.ssh/saumya-key id_rsa practical-tests-3:~/.ssh
```

```
scp -i ~/.ssh/saumya-key id_rsa.pub practical-tests-4:~/.ssh/  
scp -i ~/.ssh/saumya-key authorized_keys practical-tests-4:~/.ssh/  
scp -i ~/.ssh/saumya-key id_rsa practical-tests-4:~/.ssh
```

- d. Commands to access passwordlessly

```
ssh -i ~/.ssh/id_rsa practical-tests-2 <commands you want to run>  
scp -i ~/.ssh/id_rsa <file_to_transfer> practical-tests-2:/tmp/<file_to_transfer>  
ssh -i ~/.ssh/id_rsa practical-tests-2 ls ..  
ssh -i ~/.ssh/id_rsa practical-tests-3 ls ..  
ssh -i ~/.ssh/id_rsa practical-tests-4 ls ..
```

VIII. NFS export the /home directory from the management server and then mount it on the rest of the servers

(I have shaded the address of the servers)

- a. Edit /etc/exports

```
sudo vi /etc/exports  
/home [REDACTED]24(rw,sync,no_root_squash,no_all_squash)
```

Save changes

```
sudo exportfs -ra
```

- b. Mount the directory

```
ssh -i ~/.ssh/id_rsa practical-tests-2 sudo mount -t nfs [REDACTED]24/home /home  
ssh -i ~/.ssh/id_rsa practical-tests-3 sudo mount -t nfs [REDACTED]24/home /home  
ssh -i ~/.ssh/id_rsa practical-tests-4 sudo mount -t nfs [REDACTED]24/home /home
```

- c. Make the changes permanent - add an entry to the /etc/fstab file

```
ssh -i ~/.ssh/id_rsa practical-tests-2 sudo vi /etc/fstab
```

Next step, to get it permanent:

```
ssh -i ~/.ssh/id_rsa practical-tests-2 [REDACTED]24/home / home-mount nfs defaults 0 0
```

Test mount:

```
df -h
```

IX. Setup and install MPI library across the nodes

- a. Download MPICH inside the nfs folder and extract file

```
cd /home  
sudo yum install wget  
cd /centos  
sudo wget http://www.mpich.org/static/downloads/3.1.4/mpich-3.1.4.tar.gz
```

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```
tar -xvf mpich-3.1.4.tar.gz
```

- b. Install the C compilers, Fortran compiler, and kernel build tools on all nodes.

```
sudo yum install gcc gcc-c++ gcc-fortran kernel-devel -y
```

```
[centos@practical-tests-1 ~]$ cd mpich-3.1.4
[centos@practical-tests-1 mpich-3.1.4]$ ls
aclocal.m4  configure.ac  maint      mpich-doxygen.in  src
autogen.sh  contrib      Makefile.am  mpi.def           subsys_include.m4
CHANGES    COPYRIGHT    Makefile.in  README            test
confdb      doc          man          README.envvar     www
configure   examples     mpich.def    RELEASE_NOTES
[centos@practical-tests-1 mpich-3.1.4]$ which gcc
/usr/bin/gcc
[centos@practical-tests-1 mpich-3.1.4]$
```

- c. Make directory for compilation

```
mkdir /home/centos/mpich-install
```

- d. Configure

```
cd /mpich-3.1.4
```

```
vi README
```

```
./configure --prefix=/home/centos/mpich-install/ 2>&1 | tee c.txt
```

Error: No fortran found

Assumption made: fortran codes will not be run, disable fortran and configure

```
./configure --disable-fortran --prefix=/home/centos/mpich-install/ 2>&1 | tee c.txt
```

- e. Install

```
sudo make 2>&1 | tee m.txt
```

```
sudo make install 2>&1 | tee mi.txt
```

- f. On all nodes:

```
sudo vi ~/.bashrc
```

```
export PATH=/home/centos/mpich-install/bin:$PATH
```

```
export LD_LIBRARY_PATH="/home/centos/mpich-install/lib:$LD_LIBRARY_PATH"
```

```
sudo source ~/.bashrc
```

X. Report the memory bandwidth on the systems, by downloading and compiling the STREAM benchmark.

(<https://www.cs.virginia.edu/stream/>)

- a. Download from the link (<https://github.com/jeffhammond/STREAM>) onto the local

- b. Transfer using WinSCP from local to practical-tests-1

- c. Make

Throws error due to fortran compilation

In Makefile

Commented FC commands

Changed CC=gcc-4.9 to CC=gcc

- d. Make

Make install

```
./stream_c.exe
```

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```
[centos@practical-tests-1 STREAM-master]$ ./stream_c.exe
-----
STREAM version $Revision: 5.10 $
-----
This system uses 8 bytes per array element.
-----
Array size = 10000000 (elements), Offset = 0 (elements)
Memory per array = 76.3 MiB (= 0.1 GiB).
Total memory required = 228.9 MiB (= 0.2 GiB).
Each kernel will be executed 10 times.
The *best* time for each kernel (excluding the first iteration)
will be used to compute the reported bandwidth.
-----
Number of Threads requested = 2
Number of Threads counted = 2
-----
Your clock granularity/precision appears to be 1 microseconds.
Each test below will take on the order of 8121 microseconds.
(= 8121 clock ticks)
Increase the size of the arrays if this shows that
you are not getting at least 20 clock ticks per test.
-----
WARNING -- The above is only a rough guideline.
For best results, please be sure you know the
precision of your system timer.
-----
Function      Best Rate MB/s  Avg time     Min time     Max time
Copy:         19692.1    0.008750     0.008125     0.009263
Scale:        19333.0    0.008881     0.008276     0.009412
Add:          20175.0    0.012502     0.011896     0.013294
Triad:        20562.0    0.012262     0.011672     0.013267
-----
Solution Validates: avg error less than 1.000000e-13 on all three arrays
-----
[centos@practical-tests-1 STREAM-master]$
```

Function	Best Rate (GBps)	Avg Time	Min Time	Max Time
Copy:	19.692	0.00875	0.008125	0.009263
Scale:	19.333	0.008881	0.008276	0.009412
Add:	20.175	0.012502	0.011896	0.013294
Triad:	20.562	0.012262	0.011672	0.013267

XI. Report the CPU floating point performance on the systems, using the HPL (Linpack) benchmark.

- Download from the link (<https://netlib.org/benchmark/hpl/>) onto the local
- Transfer using WinSCP from local to practical-tests-1
- Steps to be taken in command line:

Untar the file

```
tar -xzf hpl-2.2.tar.gz
```

Change directory

```
cd hpl-2.2
```

Copy the makefile in which changes are to be made for compilation

```
cp /setup/Make.Linux_Intel64 ./
```

- In the copied makefile, change the below:
 - TOPdir (Give HPL folder location),
 - MPdir (give MPI library location),
 - MPLib(specify MPI *.a files or *.so files),
 - LAdir(give BLAS location),
 - LAlib(specify BLAS *.a files or *.so files),
 - CC(=gcc),
 - CCFLAGS(flags to be used for make compilation)
- Try make

```
make arch=Linux_Intel64
```

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- f. MPI library couldn't be linked properly and was throwing below error:

```
make[1]: Leaving directory `/home/centos/hpl-2.2'
make -f Make.top build_src arch=Linux_Intel64
make[1]: Entering directory `/home/centos/hpl-2.2'
( cd src/auxil/Linux_Intel64; make )
make[2]: Entering directory `/home/centos/hpl-2.2/src/auxil/Linux_Intel64'
gcc -o HPL_dlacpy.o -c -DAdd -DF77_INTEGER=int -DStringSunStyle -DHPL_DETAILED_TIMING -DHPL_PROGRESS
_REPORT -I/home/centos/hpl-2.2/include -I/home/centos/hpl-2.2/include/Linux_Intel64 -I -I/home/centos/
mpich-install/include -O3 -W -Wall ../HPL_dlacpy.c
In file included from /home/centos/hpl-2.2/include/hpl.h:80:0,
from ../HPL_dlacpy.c:50:
/home/centos/hpl-2.2/include/hpl_misc.h:54:17: fatal error: mpi.h: No such file or directory
#include "mpi.h"
^
compilation terminated.
make[2]: *** [HPL_dlacpy.o] Error 1
make[2]: Leaving directory `/home/centos/hpl-2.2/src/auxil/Linux_Intel64'
make[1]: *** [build_src] Error 2
make[1]: Leaving directory `/home/centos/hpl-2.2'
make: *** [build] Error 2
```

So, the following changes were made:

```
sudo vi /home/centos/hpl-2.2/include/hpl_misc.h
#include "mpi.h" to
#include "/home/centos/mpich-install/include/mpi.h"
```

- g. Repeat step (e)
h. Next, it could not link BLAS properly as concluded from below error:

I installed the blas from source:

```
sudo yum install blas-devel
and linked using "-lblas" in LALib
```

```
/usr/lib64/libblas.so.3.4 -L/usr/lib64/libblas.so.3.4.2 /home/centos/mpich-install/lib/libmpi.a
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_idamax.o): In function 'HPL_idamax':
HPL_idamax.c:(.text+0x1a): undefined reference to 'idamax_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_dgemv.o): In function 'HPL_dgemv':
HPL_dgemv.c:(.text+0xba): undefined reference to 'dgemv_'
HPL_dgemv.c:(.text+0x136): undefined reference to 'dgemv_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_dcopy.o): In function 'HPL_dcopy':
HPL_dcopy.c:(.text+0x1e): undefined reference to 'dcopy_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_daxpy.o): In function 'HPL_daxpy':
HPL_daxpy.c:(.text+0x2f): undefined reference to 'daxpy_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_dscal.o): In function 'HPL_dscal':
HPL_dscal.c:(.text+0x22): undefined reference to 'dscal_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_dtrsv.o): In function 'HPL_dtrsv':
HPL_dtrsv.c:(.text+0xb8): undefined reference to 'dtrsv_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_dger.o): In function 'HPL_dger':
HPL_dger.c:(.text+0x73): undefined reference to 'dger_'
HPL_dger.c:(.text+0x9e): undefined reference to 'dger_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_dgemm.o): In function 'HPL_dgemm':
HPL_dgemm.c:(.text+0x12c): undefined reference to 'dgemm_'
HPL_dgemm.c:(.text+0x1bb): undefined reference to 'dgemm_'
/home/centos/hpl-2.2/lib/Linux_Intel64/libhpl.a(HPL_dtrsm.o): In function 'HPL_dtrsm':
HPL_dtrsm.c:(.text+0x130): undefined reference to 'dtrsm_'
collect2: error: ld returned 1 exit status
make[2]: *** [dexe.grd] Error 1
make[2]: Leaving directory `/home/centos/hpl-2.2/testing/pctest/Linux_Intel64'
make[1]: *** [build_tst] Error 2
make[1]: Leaving directory `/home/centos/hpl-2.2'
make: *** [build] Error 2
```

- i. Since, blas files were *.so files, library path is added to the environment
sudo vi ~/.bashrc
export \$LD_LIBRARY_PATH=/path to blas/lib:\$LD_LIBRARY_PATH
In my case:
export LD_LIBRARY_PATH=/usr/lib64:\$LD_LIBRARY_PATH
sudo source ~/.bashrc
- j. Repeat Step (e)
k. Check ./bin/Linux_Intel64 for HPL.dat file and .xhpl file

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```
[centos@practical-tests-1 hpl-2.2]$ ls ./bin/  
Linux_Intel64  
[centos@practical-tests-1 hpl-2.2]$ ls ./bin/Linux_Intel64/  
HPL.dat xhpl  
[centos@practical-tests-1 hpl-2.2]$ vi ./bin/Linux_Intel64/HPL.dat
```

The required files have been created (HPL.dat & xhpl)

- l. Make changes in HPL.dat file, major configuration variables are: N(the problem size), NB(the block size), P and Q (the process grids, i.e. PxQ = Num of Processes)
- m. For testing I have used N=10000, NB=16, P=Q=1, ran ./xhpl and got a 2.7Gflops, although better configuration variables can be tried for better results using the formula:

$$N = \sqrt[2]{\frac{\text{Memory Size (Gbytes)} \times 1024^3 \times \text{num nodes}}{\text{Double Precision}(8)}}$$

- n. Command ran, saving the data in res1.txt
./xhpl >> res1.txt

XII. Setup a SLURM scheduler.

a. Requirements:

i. EPEL repo:

sudo rpm -Uvh <http://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rpm>

ii. Munge DB requirements, Maria DB requirements, etc,

sudo yum install -y munge-devel munge-libs readline-devel perl-ExtUtils-MakeMaker openssl-devel pam-devel rpm-build perl-DBI perl-Switch munge mariadb-devel

iii. SLURM:

Downloaded (slurm-18.08.0.tar.bz2) from the link (<https://www.schedmd.com/downloads.php>) into local and transferred to the remote using WinSCP

b. Build and Install RMP packages:

sudo rpmbuild -ta slurm-15.08.7.tar.bz2

ls -l ~/rpmbuild/RPMS/x86_64/*.rpm

```
[centos@practical-tests-1 ~]$ ls -l ~/rpmbuild/RPMS/x86_64/*.rpm  
-rw-rw-r--. 1 centos centos 12729732 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 16564 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-contribs-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 78496 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-devel-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 5056 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-example-configs-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 140396 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-libpmi-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 8536 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-openlava-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 147400 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-pam_slurm-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 798416 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-perlapl-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 1140108 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-slurmctld-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 622516 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-slurmd-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 664020 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-slurmdbd-18.08.0-1.el7.centos.x86_64.rpm  
-rw-rw-r--. 1 centos centos 116244 Sep 20 13:27 /home/centos/rpmbuild/RPMS/x86_64/slurm-torque-18.08.0-1.el7.centos.x86_64.rpm
```

sudo rpm -Uvh ~/rpmbuild/RPMS/x86_64/*.rpm

c. Created another user "slurm":

sudo useradd slurm

sudo mkdir /var/log/slurm

sudo chown slurm. /var/log/slurm

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d. Install Maria DB

```
sudo yum install mariadb-server -y
sudo systemctl start mariadb
sudo systemctl enable mariadb
```

```
Installed:
  mariadb-server.x86_64 1:5.5.60-1.el7_5

Complete!
[centos@practical-tests-1 ~]$ sudo systemctl start mariadb
[centos@practical-tests-1 ~]$ sudo systemctl enable mariadb
Created symlink from /etc/systemd/system/multi-user.target.wants/mariadb.service to /usr/lib/systemd/system/mariadb.service.
```

```
sudo mysql_secure_installation
```

```
Setting the root password ensures that nobody can log into the MariaDB
root user without the proper authorisation.

Set root password? [Y/n] Y
New password:
Re-enter new password:
Password updated successfully!
Reloading privilege tables..
... Success!

By default, a MariaDB installation has an anonymous user, allowing anyone
to log into MariaDB without having to have a user account created for
them. This is intended only for testing, and to make the installation
go a bit smoother. You should remove them before moving into a
production environment.

Remove anonymous users? [Y/n] n
... skipping.

Normally, root should only be allowed to connect from 'localhost'. This
ensures that someone cannot guess at the root password from the network.

Disallow root login remotely? [Y/n] n
... skipping.

By default, MariaDB comes with a database named 'test' that anyone can
access. This is also intended only for testing, and should be removed
before moving into a production environment.

Remove test database and access to it? [Y/n] n
... skipping.

Reloading the privilege tables will ensure that all changes made so far
will take effect immediately.

Reload privilege tables now? [Y/n] Y
... Success!

Cleaning up...

All done! If you've completed all of the above steps, your MariaDB
installation should now be secure.

Thanks for using MariaDB!
[centos@practical-tests-1 ~]$
```

save mysql root password in root home dir

```
sudo vi ~/.my.cnf
password = some_pass
```

e. Start mysql shell

```
mysql>
grant all on slurm_acct_db.* TO 'slurm'@'████.██.██.██'
identified by 'some_pass' with grant option;
create database slurm_acct_db;
```

HPC Benchmarks

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f. Configure and enable SLURM db backend

```
sudo /etc/slurm/slurmdbd.conf
```

```
AuthType=auth/munge
DbdAddr=localhost
DbdHost=localhost
SlurmUser=slurm
DebugLevel=4
LogFile=/var/log/slurm/slurmdbd.log
PidFile=/var/run/slurmdbd.pid
StorageType=accounting_storage/mysql
StorageHost=localhost
StoragePass=some_pass
StorageUser=slurm
StorageLoc=slurm_acct_db
```

```
sudo systemctl start slurmdbd
```

```
sudo systemctl enable slurmdbd
```

```
sudo systemctl status slurmdbd -l
```

```
[centos@practical-tests-1 ~]$ sudo systemctl status slurmdbd -l
● slurmdbd.service - Slurm DBD accounting daemon
   Loaded: loaded (/usr/lib/systemd/system/slurmdbd.service; enabled; vendor preset: disabled)
   Active: active (running) since Thu 2018-09-20 13:42:57 UTC; 3lmin ago
     Main PID: 14319 (slurmdbd)
    CGroup: /system.slice/slurmdbd.service
            └─14319 /usr/sbin/slurmdbd

Sep 20 13:42:57 practical-tests-1.novalocal systemd[1]: Starting Slurm DBD accounting daemon...
Sep 20 13:42:57 practical-tests-1.novalocal systemd[1]: Started Slurm DBD accounting daemon.
```

g. Configure and enable Munge

```
sudo create-munge-key
```

```
sudo systemctl start munge
```

```
sudo systemctl status munge
```

```
sudo systemctl enable munge
```

h. Configure and enable Slurm

```
sudo vi /etc/slurm/slurm.conf
```

```
ClusterName=efg
ControlMachine=efg01
SlurmUser=slurm
SlurmctldPort=6817
SlurmdPort=6818
AuthType=auth/munge
StateSaveLocation=/home/slurm/tmp
SlurmdSpoolDir=/tmp/slurmd
SwitchType=switch/none
MpiDefault=none
SlurmctldPidFile=/var/run/slurmctld.pid
SlurmdPidFile=/var/run/slurmd.pid
Proctracktype=proctrack/linuxproc
CacheGroups=0
ReturnToService=0
```

HPC Benchmarks

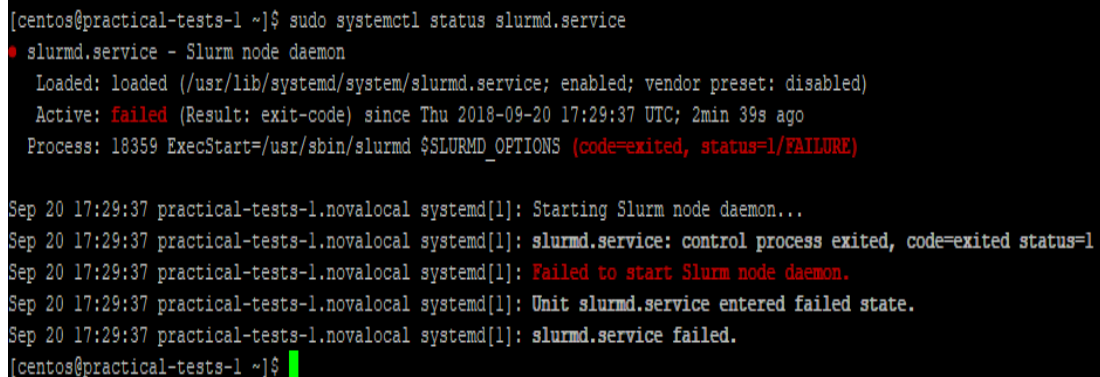
- By Saumya Bhatnagar

```
SlurmctldTimeout=300
SlurmdTimeout=300
InactiveLimit=0
MinJobAge=300
KillWait=30
Waittime=0
SchedulerType=sched/backfill
SelectType=select/linear
FastSchedule=1
SlurmctldDebug=3
SlurmdDebug=3
JobCompType=jobcomp/none
JobAcctGatherType=jobacct_gather/linux
JobAcctGatherFrequency=30
AccountingStorageType=accounting_storage/slurmdbd
NodeName=efg01 CPUs=16 State=UNKNOWN
PartitionName=debug Nodes=efg01 Default=YES MaxTime=INFINITE State=UP
```

Created some more files which were called in the “.conf” files

```
sudo touch /home/slurm/tmp
sudo touch /tmp/slurmd
sudo touch /var/run/slurmd.pid
sudo touch /home/slurm/slurmctld.pid
sudo systemctl start slurm
sudo systemctl status slurm
#Throws error
sudo systemctl status slurmd.service
```

Throws unclear error as in below screenshot: //TODO



```
[centos@practical-tests-1 ~]$ sudo systemctl status slurmd.service
● slurmd.service - Slurm node daemon
   Loaded: loaded (/usr/lib/systemd/system/slurmd.service; enabled; vendor preset: disabled)
   Active: failed (Result: exit-code) since Thu 2018-09-20 17:29:37 UTC; 2min 39s ago
   Process: 18359 ExecStart=/usr/sbin/slurmd $SLURMD_OPTIONS (code=exited, status=1/FAILURE)

Sep 20 17:29:37 practical-tests-1.novalocal systemd[1]: Starting Slurm node daemon...
Sep 20 17:29:37 practical-tests-1.novalocal systemd[1]: slurmd.service: control process exited, code=exited status=1
Sep 20 17:29:37 practical-tests-1.novalocal systemd[1]: Failed to start Slurm node daemon.
Sep 20 17:29:37 practical-tests-1.novalocal systemd[1]: Unit slurmd.service entered failed state.
Sep 20 17:29:37 practical-tests-1.novalocal systemd[1]: slurmd.service failed.
[centos@practical-tests-1 ~]$
```

XIII. Run HPL across all nodes, using SLURM, and report total system performance

//TODO