

SMARTset OpenFOAM Cluster An OpenFOAM cluster using Raspberry Pi

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What it looks like

- 10 Raspberry Pi
- Powered from a gang charger
- Connected by a simple switch
- Top one is the master
- Rest are slaves
- All have OpenFOAM 2.3.x, openMPI and SWAK4FOAM installed
- Master is also DHCP and NFS server
- Slaves auto-mount NFS and get IP address from the master DHCP server
- Pi is configured to show cpu0 activity rather than disk activity on LED0
- Master Pi has dual IP networks: WiFi to connect to outside world, Ethernet to connect to the other Pis





Network topology





Installing OpenFOAM



- Relatively straightforward use the pre-built packages from rheologic
- openMPI completely broke however
- MPI needs re-building and that isn't easy the standard Allwmake needs a helping hand with some command line options that took a long time to work out (days of Googling)
- SMARtset templates make use of SWAK4foam this is a templating toolkit. Compilation is straightforward but must be done non-parallel and with a RAMdisk tmp folder – takes several hours on the Pi

Cluster Setup



- All machines in the cluster must be able to access each other without password, using the Pi account. This is due to the way in which MPI sends jobs, it uses a tree mechanism, not master/slave
- Very wise to create a RAMdisk for the tmp folder on all Pis
- All slaves must be setup with DHCP
- The Master needs to be configured as DHCP server and with passthrough lptables rules to allow access to the outside world from the cluster devices
- The Master is the only one that runs SMARTset the Tomcat on this machine needs to be configured to run under the Pi account and include the OpenFOAM bashrc in the /etc/default/tomcat8 file





- I have a cron task on the master that runs every 15 minutes that probes the network to find all the machines plugged in (uses nmap). This is piped to the hosts file used by mpirun. The assumption is that anything that is on the private network must be a OpenFOAM/openMPI capable node
- The processor folders are copied from the master to each of the nodes before running mpirun. After it completes, the files are copied back onto the master before reconstructing the case. The system uses scp to do this.



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