A network of supercomputers, including XSEDE, PRACE, and HPCI, is an attractive HPC platform that is capable of scale out. In order to make the HPC platform practical, deployment of the applications across the platforms must be easy to do. In the proposed method, a customized development and execution environment for applications can be deployed across the HPC platforms, in a "build once, run everywhere" manner. An application environment is contained in a set of virtual machine (VM) template images, which is shared among clouds. A virtual cluster created from the template images is deployed to any number of clouds.

We are building a private cloud platform on our recently introduced supercomputer system, the AIST Super Green Cloud (ASGC), intended for High Performance Computing (HPC) users. ASGC is a 155 node-InfiniBand cluster, and the theoretical peak performance is 69.44 TFLOPS. Our HPC cloud platform is built on top of the ASGC, using the Apache CloudStack with KVM, Ceph cluster storage, and Zabbix monitoring system. Our extended CloudStack allows the user's guest OS to directly access an InfiniBand HCA by using PCI passthrough or SR-IOV.

A virtual cluster consists of a set of VMs that are built on top of a physical cluster. Our developed software, sgc-tools, creates a typical virtual HPC cluster with job scheduler, MPI library, compiler suite, NFS server, and NIS pre-installed. Users can easily set up their own application environments and instantly start their applications. Sgc-tools enables users to dynamically scale in and scale out the virtual cluster, depending on their requirements. Users can create VM template images from their virtual clusters anywhere and take them to other clouds like Amazon EC2 to deploy clones. An additional service for efficient synchronization of templates between data centers is a work in progress.

ASGC has been operated since July, 2014, and over 20 users run their applications on it. We report lessons learned from the operation during the first half of the first year. We found and dealt with several serious problems mainly related to the Apache CloudStack, and we are struggling toward the stable operation. We also report the elapsed time of construction and destruction of a virtual cluster and the several
benchmark results, including Intel Micro Benchmark, NAS Parallel Benchmark, and LAMMPS. Our experimental results show that a virtual cluster achieves competitive performance as in the case of using the same physical resources, though the performance fluctuation is getting larger. Although there is room for improvement in operations, this observation leads to our optimistic conclusions on the feasibility of HPC clouds.

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