Integration of Openstack Cloud Resources in BES III Computing Cluster

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Background: High energy physics experiments produce more and more data, and data processing system faces many problems such as low resource utilization, legacy program compatibility and so on, which needs more flexible resource scheduling and sharing. **Cloud computing** and virtualization technology provide many advantages to solve these problems in a cost-effective way.



IHEPCloud: A private IaaS cloud platform built by computing center IHEP based on Openstack, supporting user self-service virtual machine management, virtual computing cluster, and distributed computing system.



Figure 1: Virtual computing cluster architecture

BESIII experiment is a tau-charm experiment at IHEP, CAS.

Challenges of Computing Environment at IHEP:

✓ Overall resource utilization is low, but a large number job are being queued at the same time.

Resource isolation between different experiments

✓ There is no flexible policy for resource sharing



VPManger: A open source **virtual computing cluster** middleware software developed by computing center IHEP to schedule virtual machines dynamically in according with the workload of job management system. The middleware lies between resource management system (such as Torque and HTCondor) and openstack.

- Virtual job manager including VPBS and VCondor checks the status of different queue and get the available VM number and create new VMs or destroy existing VMs.
- **VM quota** checks the information of VM Pool and requirements of different applications to allocate or reserve resources.
- **VM node manager** checks and controls all the VM run environment such network status, affiliated job queue by an agent running in the virtual machine.

Figure 2: Virtual Cluster Components and Workflow

HEP users submit a job using 'qsub' or 'condor_qsub' command
Jobs come into the RMS and are captured by Virtual Job Scheduler.
Virtual Job Scheduler requests vm from VM quota management.
VM quota calculates the available vm number to reply.
Virtual Job Scheduler starts the vm according to the job queues.
Once vm starts, the client can get jobs from RMS.



Computing Resource UtJob queued,ALL Resource - Utility: 86.5automatically create





Virtual Computing Cluster middleware software has been developed and deployed, and initial test results proved the feasibility and stability of this approach. The dynamic resource scheduling policies make the resource utilization rate greatly improved. VPManager Github: https://github.com/hep-gnu/VCondor.git