Baadal: the IITD computing cloud (Beta release)

The CSC has commissioned a new cloud computing environment for *high performance computing* based on

1. 32 blade servers each with 2x6 core Intel(R) Xeon(R) CPU X5670 @ 2.93GHz and 16 GB RAM.
2. 16 blade servers each with 2x4 core Intel(R) Xeon(R) CPU E5540 @ 2.53GHz and 12 GB RAM
3. A 10Gbps ethernet backbone
4. 50 TB of virtualized storage based on a NetApp 3210V NAS and HP EVA6400 SAN with FC disks.
5. Open source virtualization technology based on KVM.
6. Baadal: an indigineously developed cloud orchestration and virtualization management software that can work with multiple virtualization technologies like KVM, Xen and VmWare

The cloud computing environment above has a raw processing capacity of around 6 TFlops. Please see here for some benchmark results. With release of the new cloud computing facility CSC will phase out the old computing cloud set up based on VmWare.

Usage

1. Please see the video at http://www.cc.iitd.ernet.in/misc/cloud/Baadal.mov or at http://www.youtube.com/watch?v=iNADlndRtMA.
2. Users can request for virtual machines by logging on to https://baadal.iitd.ernet.in/cloud.

3. While making a request users will have to specify the number of CPUs and RAM requirement from a standard set of templates. Users can also optionally request for one additional hard disk and specify its size.
4. Users will need to select from a standard set of OS templates. CSC has created standard templates based on 32 and 64 bit Linux and Windows operating systems with standard utilities like Gnu and Intel compilers, open-mpi, mpich2 and Matlab preloaded in Linux, Visual Studio and Matlab preloaded in Windows.
5. An additional virtual hard disk, if requested, will be attached to the virtual machines which the users will have to format themselves according to their requirement.
6. Requests made by students will have to be approved by their faculty supervisors through the workflow system available at https://baadal.iitd.ernet.in/cloud.
7. Once a request has been approved by a CSC cloud administrator a virtual machine will be created. The virtual machine will be owned by a faculty member who can then grant access rights to other users registered in IITD LDAP. The faculty owner will be notified about the virtual machine creation and the access password thorough an email.
8. Users can note the IP address of the commissioned virtual machine from the user interface at https://baadal.iitd.ernet.in/cloud. Users can then access their virtual machine using ssh for Linux and rdesktop for Windows as root (Linux) or Administrator (Windows) using the initial access password. Users will be required to change the root/Administrator password at first login.
9. Local users can be created on the Windows or Linux VMs using standard procedures specified by the operating systems.

10. From the user interface at https://baadal.iitd.ernet.in/cloud, users can suspend, resume, shutdown, power off and power on their virtual machines. Faculty owners can grant/delete operational privileges to other users. Users can also monitor resource utilization and indicate their resource requirements dynamically (see below).

Adjust runlevels: dynamic resource scheduling

One of the main advantanges of a private cloud is that when a VM is idle the CPU and memory resources of the host can be used effectively by other VMs which may need them. For effective resource utilization users are required to accurately indicate the resource requirement. Users can put their VMs in one of the following four resource requirement modes:

1. **Zero**: VM is shutdown. No charge.
2. **One (Gold)**: 1:1 resource will be reserved for the VM on a physical host in the cloud. This is suitable when the user is ready for computation and requires the full CPU and RAM requested.
3. **Two (Silver)**: 2:1 resource will be reserved for a VM on a physical host (resource allocation will be halved). This mode is suitable for short test runs and debugging.
4. **Three (Bronze)**: 4:1 resource will be reserved for a VM on a physical host (resource allocation will be quatered). This mode is suitable for editing and data preparation. When a VM is created it will be put in this mode by default.

Users can change the run levels at any time (from List VMs -> Settings -> Adjust runlevel), so changing runlevel even at granularity of 15 minutes will be helpful for effective scheduling of resources and for saving power by switching off unutlized hosts. It is essential that users choose an appropriate runlevel,

especially during lean periods. Users can monitor the resource utilization of their VMs from the user interface at https://baadal.iitd.ernet.in/cloud.

For our resource scheduling algorithm to be effective it is essential that the runlevel indications from users are accurate. *The cloud administrators may switch off a VM and notify the user if a VM is found to be using resources not commensurate with the indicated run level (over utlizing or under utilizing)*.

VM cost model

A VM will be notionally charged at the rate of Rs. 1 per CPU per hour + Rs. 1 per GB of RAM per hour as unit charge. For larger VMs a multiplication factor of 1.2 will be used. There will be no charge for the duration in which a VM is in a shutdown state. Charges will be halved and quartered for the durations in which a VM is in runlvel Two or Three respectively. Users can monitor the current incurred cost for their VMs from https://baadal.iitd.ernet.in/cloud.

When the cloud is ``full'' and no resources are available the VM which has incurred the highest cost will be switched off to accommodate new requests. The VM may be switched on again when demand falls or when some other VM exceeds its cost.

Error reporting

Baadal is still in a Beta phase, so there may be a few bugs and hiccups. In case of an unanticipated error in the interface at https://baadal.iitd.ernet.in/cloud, users are requested to click on ``Report to Admins'' to report a complete transcript of the error to the cloud administrators. Please report other problems, if any, to *cloudgroup@cc.iitd.ernet.in.*

Credits

CSC would like to specially thank young Abhishek Gupta and Jatin Kumar who did most of the software development over the last six months.The CSC would also like to thank Daniel J Mathew, Sorav Bansal and Huzur Saran for their help and guidance.