CREATION OF CLOUD INFRASTRUCTURE OF INP'S ASTANA BRANCH - PRIVATE ESTABLISHMENT «NULITS” AND ITS INTEGRATION WITH THE DISTRIBUTED JINR CLOUD INFRASTRUCTURE

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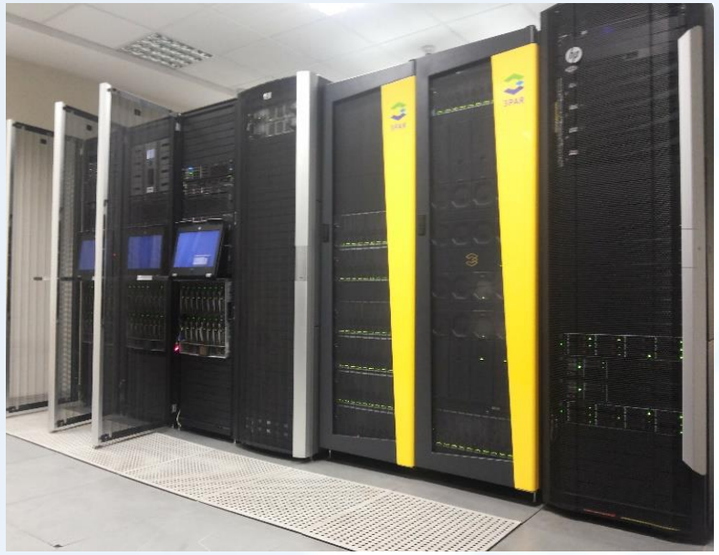
"Distributed Computing and Grid-technologies in Science and Education" (GRID 2018)
Dubna, Moscow region, Russia, September 10 - 14, 2018

Introduction

Currently, to provide the educational and business processes of the Autonomous Organization of Education "Nazarbayev University" and its subsidiaries with computing resources and data storage systems, the IT staff built an infrastructure based on the commercial product VmWare, which provides virtualization of servers and desktops of employees.



NULITS Date Center

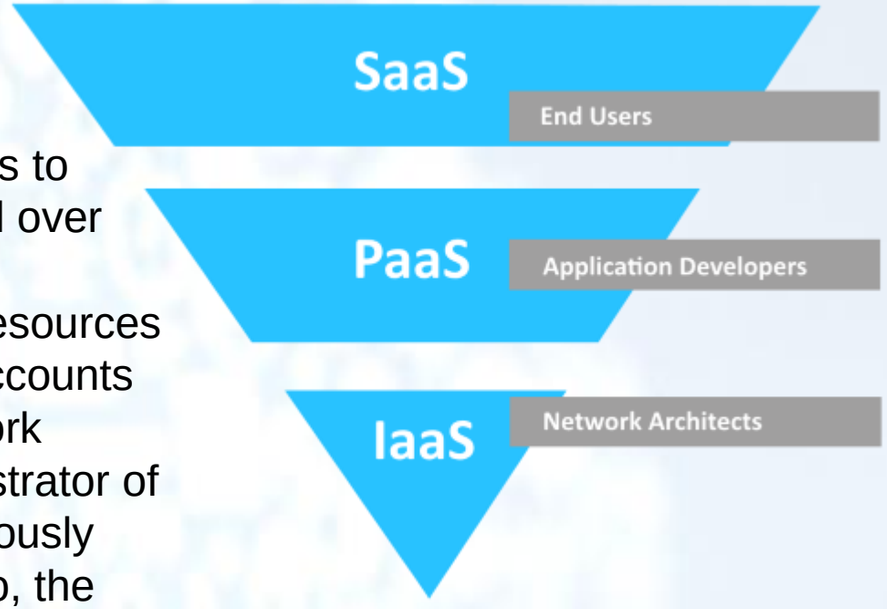
Requests for the allocation of computing resources for the implementation of scientific calculations are constantly increasing.
Further development and study of the world experience in the management of computing resources puts before us the following tasks:

- simplification of the interface / resource management mechanism. The ability to allocate a resource pool to the user, within which he himself redistributes tasks between them;
- the introduction of a billing system to record user resources;
- flexible reallocation of resources between pools / users;
- centralized use of resources of geographically dispersed data centers;

As one of the ways to solve these problems, we consider a smooth transition from a virtual to a cloud infrastructure.

Introduction

A common model of cloud technologies consists of three parts, each of which represents a separate category of services:
SaaS (Software as a Service) - applications running in the cloud, access to which end users receive via the web interface;
PaaS (Platform as a Service) - a set of tools and services that facilitate the development and deployment of cloud applications;
IaaS (Infrastructure as a Service) is a computing infrastructure (servers, data warehouses, networks, operating systems) that is provided to customers to run their own software solutions.



Cloud infrastructure IaaS compared with the virtual one gives more opportunities to deploy computing capacity "on demand", and also allows for transparent control over the allocation and use of the resources provided. In the most common virtual environments (Vmware ESXi, Citrix, Hiper-V Microsoft), monitoring the use of resources and, especially, changing quotas for the use of resources is carried out using accounts with fairly high access rights. Also, many operations (creating / upgrading network resources, changing disk quotas, etc.) require a high qualification of the administrator of the virtual data center and interaction with the customer's personnel, which seriously increases the risks of accessibility and efficiency of the virtual environment. Also, the monitoring / monitoring tools built into the basic packages, and, especially, the bilingual use of resources in the virtual environment are at the initial level.

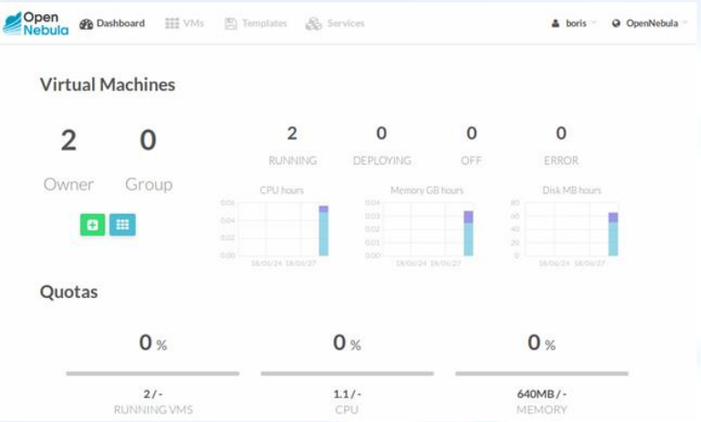
Introduction

Separately, I want to dwell on the allocation of resources "on demand." In virtual environments, this functionality is often not provided, since this is not considered to be the main task. Therefore, the means for automatic deployment of virtual machines as part of virtualization systems are either absent or have very limited capabilities. When implementing many projects to provide this functionality, you must purchase and configure additional software and licenses, which is not always possible. For example, in the case of Vmware it is necessary to purchase vCloud Director packages and separately licenses for virtual servers, for billing - vRealize packages. These products are very expensive, carry a significant additional functionality, which is often unnecessary and require separate configuration and training of maintenance personnel.

To implement the task of transition to a cloud infrastructure, we previously considered VmWare vCloud, which, due to its high cost, was not implemented. Together with the staff of the Laboratory of Information Technologies of JINR, a pilot project on the implementation of the cloud infrastructure on the basis of OpenNebula open source software was considered.

Introduction

This choice was due to the fact that in the OpenNebula product the virtual on demand and billing functionality is already built into the cloud (OneFlow and OneGate components), and the user's self-service portal is included in the software solution



When working with OpenNebula, the administrator of the entire system needs to give the user access to the self-service portal only, where he performs basic operations with his virtual machines, and the administrators of virtual data centers give access to the management interface, which dramatically increases the security of the data center as a whole. and the security of deployed virtual servers. It is possible to use both external data stores, such as SAN (Storage Area Network), NAS (Network Attached Storage), and distributed file systems (CEPH, Gluster). In the absence of separate expensive storage systems, OpenNebula makes it possible to achieve fault tolerance when accessing any disk subsystems. The advantage and convenience of this solution is the ability to simultaneously use various types of disk resources (NAS, NFS, SAN, local file systems, CEPH and others). This makes it completely transparent for virtual machine users to migrate virtual servers between different types of storage, as well as simplify the procedures for synchronizing and increasing the availability of separate virtual servers between data centers and the data center as a whole.

Would like to note that considering cloud solutions based on open source, the big advantage is the presence of large and active communities supporting this product, the availability of extensive knowledge bases and thematic forums, as well as the ability to quickly upgrade the product to the needs of the organization without losing compatibility with deployed installations.

INP’s Astana branch - PE “NULITS” cloud

Currently, the pilot project is implemented in the form of two main components:

- The primary node is a virtual server that contains the core of the system and interfaces to user / service interaction;
- Work nodes - 4 physical servers running user virtual machines;

There are two access interfaces to the OpenNebula service:

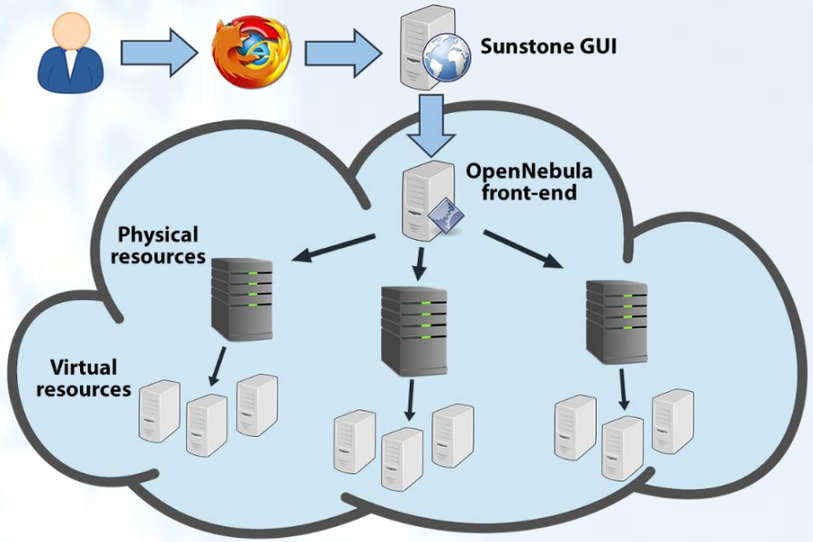
- full-featured command-line interface (CLI);
- the graphical web interface provided by the Sunstone component.

The main node is a virtual machine deployed outside the OpenNebula service. The virtual machine is deployed on its own VmWare cluster. This implementation allows fast reconfiguration during testing to minimize downtime. Allows you to quickly roll back the changes made using the proven mechanisms of VmWare.

To implement the work nodes, 4 physical servers are used with the following configuration:

- 4 x CPU E5-2660 v4 2.00GHz;
- RAM256GB;
- 2 x HDD SAS 600GB in RAID1 mode (mirroring);
- 2 x 10G + 4 x 1G + 2 x FC;

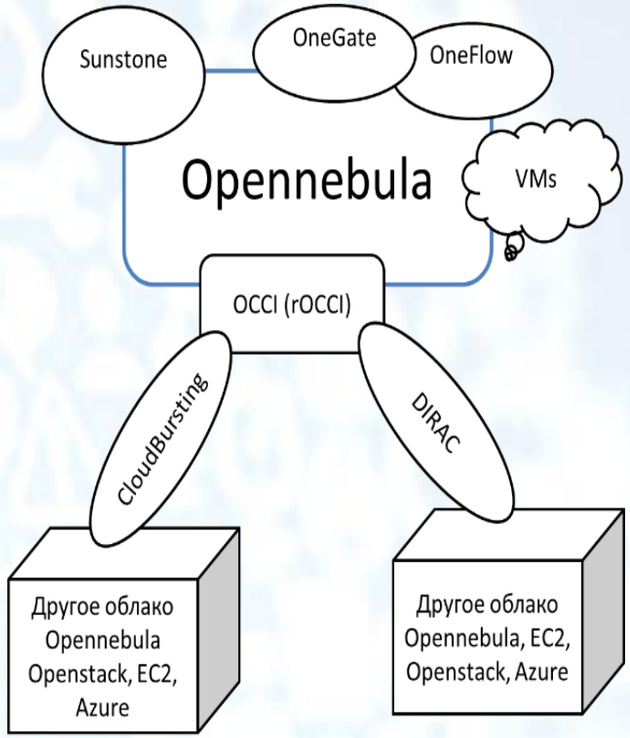
All servers of the pilot project use Linux OS - Centos 7.2 x86_64.



Integration of cloud infrastructures

The main node provides services Sunstone, Oneflow and Onegate, as well as services OCCI / rOCCI (v1) for integration with external clouds:

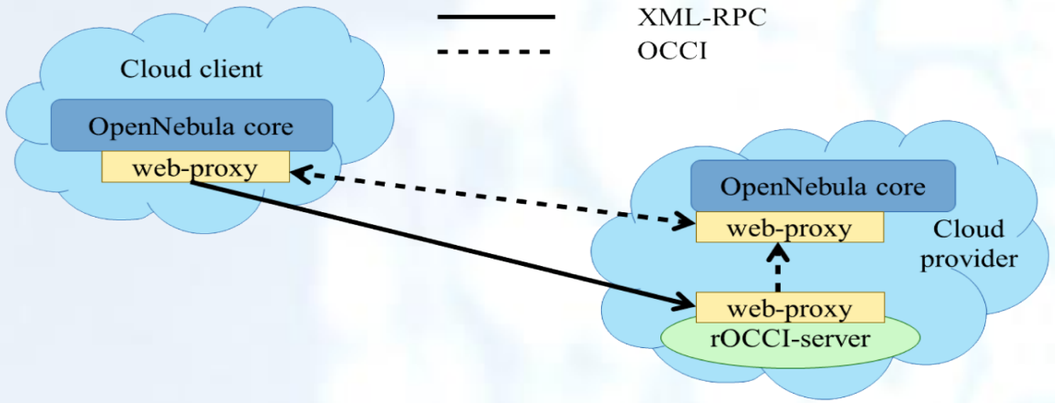
- Sunstone - web management interface OpenNebula;
- Oneflow - allocation of resources on demand;
- Onegate - configuration of virtual machines, billing;
- OCCI / rOCCI (v1) - interface with external clouds;
- CloudBursting - driver integration with the external cloud;



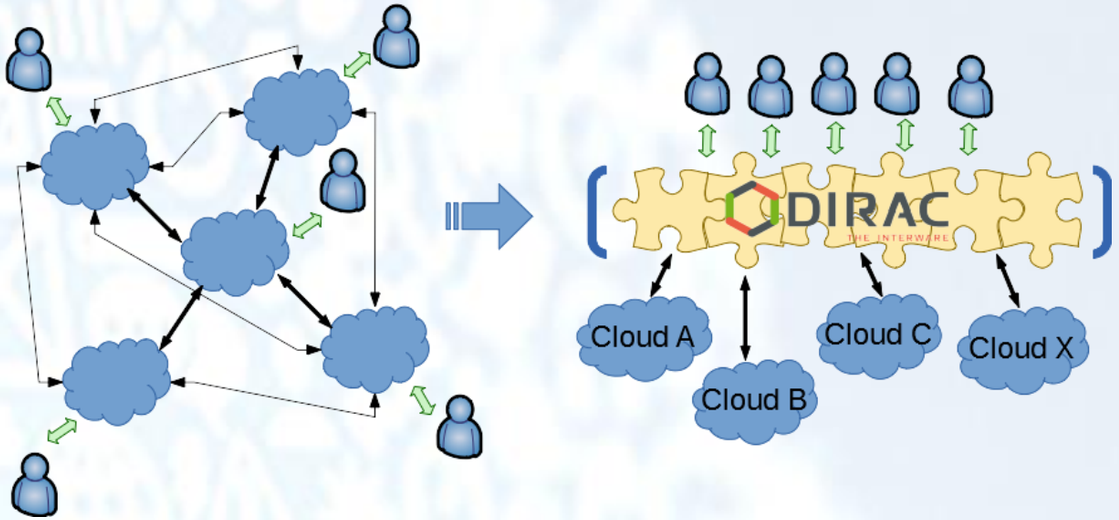
The scheme of interaction OpenNebula with external clouds

Integration of cloud infrastructures

Integration with the distributed cloud infrastructure of JINR at the moment is made using a driver based on the peering model cloud bursting.



Cloud bursting peering model



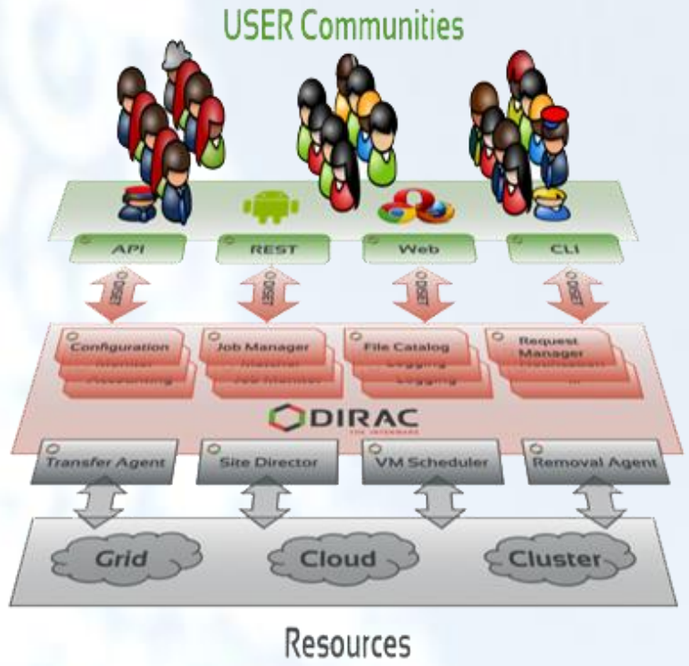
In the process of use, the instability of the driver is revealed when using new versions of OpenNebula packages, as well as its low scalability. Currently, the mechanism of cloud integration using the DIRAC grid is being considered

Integration of cloud infrastructures

DIRAC (Distributed Infrastructure with Remote Agent Control) INTERWARE is a software framework for distributed computing providing a complete solution to one (or more) user community requiring access to distributed resources. DIRAC builds a layer between the users and the resources offering a common interface to a number of heterogeneous providers, integrating them in a seamless manner, providing interoperability, at the same time as an optimized, transparent and reliable usage of the resources.

The Workload Management System with Pilot Jobs introduced by the DIRAC project is now widely used in various grid infrastructures. This concept allows to aggregate in a single system computing resources of different source and nature, such as computational grids, clouds or clusters, transparently for the end users .

Unlike the driver, the DIRAC platform allows using different computational resources with the help of pilot tasks. This method of integration is used by leading scientific data centers.
Virtual machines are stored on server disks (basic settings of OpenNebula), in addition, all working nodes have access to the shared disk space on the disk storage (LUN).



Conclusion

- The cloud infrastructure of the Astana branch of INP and the private institution "NULITS" was created on the basis of resources of both organizations based on OpenNebula open source solution.
- Its technical integration with the distributed cloud infrastructure of JINR for the peering model cloud bursting has been completed.
- Works on cloud integration using the DIRAC grid are underway.
- Within the framework of this project, it is planned to work out the interaction schemes between various components of OpenNebula and determine the list of components necessary for the minimum configuration:
  - to launch a number of research tasks of the professorial-teaching staff in order to reveal the strengths / weaknesses of this realization of the cloud;
  - compile a detailed administrator's guide to facilitate the deployment of cloud services based on OpenNebula in the future.

In conclusion, we would like to note the invaluable contribution of the leadership of LIT JINR in the person of V.V. Korenkov and staff of the cloud LIT team for the initiation of this project, constant attention and encouragement of ongoing work, without which the implementation of this pilot project is not possible.

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Thanks for attention!