

<http://ansinet.com/itj>

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

An Elastic Meteorological Cloud Platform Based on Xen

^{1,2}Fang Wei, ²Wen Xue Zhi and ²Xu jiang

¹Jiangsu Engineering Center of Network Monitoring,

Nanjing University of Information Science and Technology, 210044, Nanjing, China

²School of Computer and Software, Nanjing University of Information Science and Technology,
210044, Nanjing, China

Abstract: In the atmospheric sciences, the scales of atmospheric data are massive and growing rapidly. For complex weather forecast, such as the typhoon track prediction requires the computing of very large of computers. In order to reduce the computing cost and protect meteorological resources, we use cloud computing technologies to design an elastic meteorological cloud platform (EMCP). It can share and manage meteorological resources flexibly and efficiently. The experimental results show the EMCP has better performance and efficiency.

Key words: Virtualization technology, EMCP, xen, cloud computing, meteorological services

INTRODUCTION

Nowadays, the need for a large number of scientific computing in the meteorological science is increasing every day, in order to obtain accurate weather forecast information for the more complex the forecasting of weather forecasting system, such as typhoon track forecast (Liu and Zhou, 2011). In general, High-performance computers are required to process these data, but small organizations and units cannot afford the high price of high-performance computers. However, cloud computing can bring weather forecasting powerful, flexible and low-cost collaboration and innovation platforms. And a significant advantage of cloud computing is reducing the calculation of the cost of applications to improve the efficiency of the implementation (Dean and Ghemawat, 2008). Cloud computing platforms and users of meteorological operations can demand access to various services (such as precision computing, information storage, network services, software use, data sharing, etc.) and do not need to know what cloud computing is or how it works, because cloud computing requires the integration of a large number of resources in a virtual pool of resources (Byrne, 2010). Faced to such large scale meteorological data, high-efficient computing power (more than a trillion times) is urgently required. Therefore, establishing a cloud computing weather information processing system is very important and significant.

In addition, Xen as a virtual system platform can build an elastic meteorological cloud platform which

taking into account the strong performance of cloud computing with the security of the client and the cost of compression in the lower level (Bist *et al.*, 2013). It is suggested to fully enjoy the advantages of the virtualized cloud technology. For example, its maintenance is easier for administrators. It is also convenient for administrators to build a simple and efficient system of management. These processes of assembling, disassembling and adding components based on Cloud Computing are also simpler, securer and faster than traditional methods (Goyal and Dadizadeh, 2009).

ELASTIC METEOROLOGICAL CLOUD PLATFORM

Architecture of meteorological cloud platform: The overall architecture of Elastic Meteorological Cloud Platform (EMCP) based on Xen is shown in Fig. 1 which including three components, user, management control center and virtualization cluster. Client users can use PC to connect to the EMCP management control center and to gain a lease running state of the virtual machine, virtual machine startup, shutdown and other operations.

EMCP contains management control center, separating from the users and cloud platform inside Xen-based virtualization cluster. It is the core of the whole elastic meteorological cloud platform, including a number of modules to perform all administrative tasks, these modules are mainly functions: monitoring module, a scheduling module, a log module, a paying module and a user module. Management Control Center summarizes the use of all physical and virtual resources in the cloud

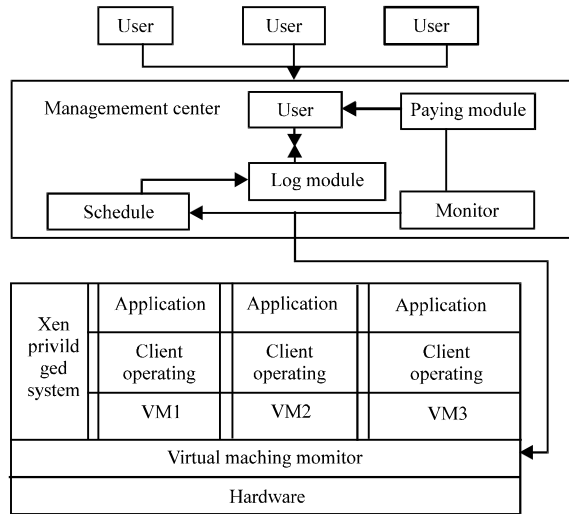


Fig. 1: Architecture of meteorological cloud platform

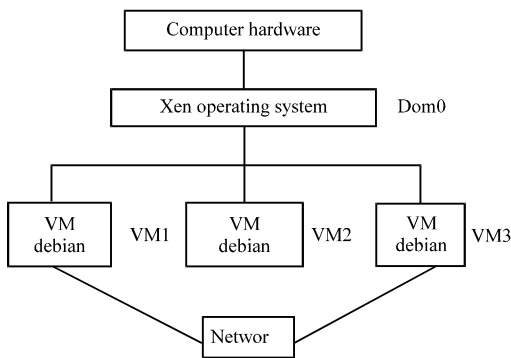


Fig. 2: Virtual cluster architecture

platform, in accordance with a pre-customized user demand dynamic scheduling of virtual machines, thus ensuring flexible scheduling features elastic meteorological cloud platform.

Design of virtual cluster architecture: Figure 2 shows a virtualization cluster architecture which contains Xen virtualization, Xen Debian system-based computer, the virtual machines and can use these virtual machines to build a virtual cluster.

Here, VM1, VM2, VM3 is the virtual cluster computing node by Xen virtualization software to create a virtual machine. These virtual machines mainly carry out a variety of complex scientific computing, in response to various requests issued by the user. Access the VM in the virtual cluster and the amount of jobs will dynamic change by the elastic scheduling module operation. If the current virtual machine node cannot handle so many submitted jobs timely, quickly and accurately than flexible

scheduling system will increase the number of virtual machine according to the scheduling policy of the virtual machine in the cluster, thus it can share the running of the amount of work; if the current amount of work is reduced, the cluster in the virtual machine is idle, the flexible scheduling system will recycle some of the virtual machine, the release of resources and space in order to improve the utilization of CPU and memory (Zhang, 2011).

ELASTIC SCHEDULING METHODS

Dynamic resources allocation: Xen virtualization technology can elastically change in term of computing resources dynamically according to the user's needs for memory and CPU bandwidth, network bandwidth increasing and decreasing. Then, if the work load is higher, Xen can allocate VM resources to these applications dynamically.

Xen virtualization technology can take virtual machines migrate from one physical server to another physical server and this operation does not need to interrupt the current service. For example, the physical server when the virtual machine crashes, in order to ensure the normal operation of the virtual machine, virtual machine management center can directly transfer this physical server within the virtual machine to another normal physical server. By contrast, if present resources and services provided by current physical servers do not meet the operational requirements of the virtual machine, then the virtual machine can also migrate to a higher level of physical server to get better service for more resources. This process is shown in Fig. 3.

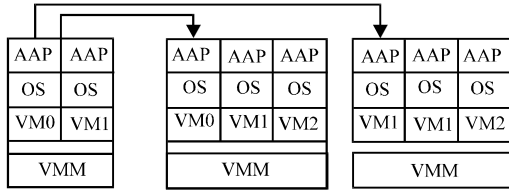


Fig. 3: Dynamic resource allocation

Virtualization: With the time growing of the demand for environmental resources, virtualization system allows dynamic resource management not to produce the downtime for increasing the allocation of resources.

Elastic scheduling method: Existing virtual cluster computing resources cannot meet the user applications of computing resources. However, computing resources of elastic scheduling module dynamic virtual machine can meet the needs of users and dynamically add new computing resources to the virtual cluster (Fang *et al.*, 2012). The work flow of elastic scheduling module is shown in Fig. 4.

According to the Fig. 4, we can see that the main function of the elasticity scheduling module include the following parts:

- Create the virtual machine (VM)
- Start VM and login in the VM
- Refresh the current computing resources
- Release the idle computing resources

The pseudo code of elasticity scheduling method is as following.

```

If (computer_resources < job_need_computer_resources)
{
    need_virtualMachine_num = job_need_computer_resources -
    computer_resources;
    searchCurrentVirtualMachineNum();
    While (currentVirtualMachineNum >= need_virtualMachine_num)
    {
        For (; currentVirtualMachineNum; currentVirtualMachineNum--)
        {
            startVirtualMachine();
        }
    }
    createVirtualMachine();
    addToVirtualCluster();
    refreshComputerResource();
    jobRun();
    releaseComputerResource();
}
else
{
    jobRun();
    releaseComputerResource();
}

```

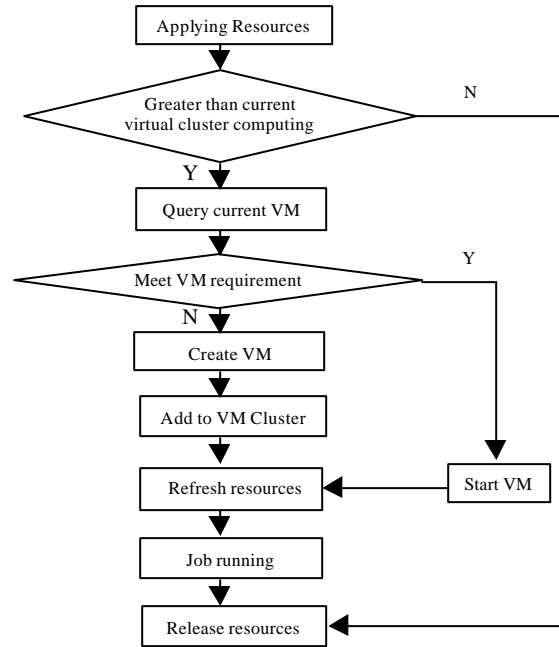


Fig. 4: Work flow of elastic scheduling module

EXPERIMENTS AND RESULT ANALYSIS

Compare the effective of jobs: This experiment is to compare performance between the physical host and elastic cloud platforms, the same amount of work from the user to complete the run to spend time different. As shown in Table 1, where physical host operating time it takes to run time and waiting time; elastic cloud platform job to spend time, including run time and create a virtual machine time.

As shown in Fig. 5, along with the job submitted by the increase in the amount of elastic weather cloud platform through elastic scheduling technique and the virtualization technology to create a new virtual machine computing node and added to the virtual cluster to meet the demand for the computing resources of the job, reduce the waiting execution time. All jobs run less than the time it takes from submission to completion of the run time spent on physical hosts. This shows that the elasticity of the cloud platform scheduling jobs caused by the lack of computing resources and technology can effectively solve queued for too long or do not run.

Testing of virtual machine display performance: VCPU number will be assigned to each virtual machine is set to be fixed, the virtual machine display performance test is shown in Fig. 6, the X-axis is assigned to the virtual

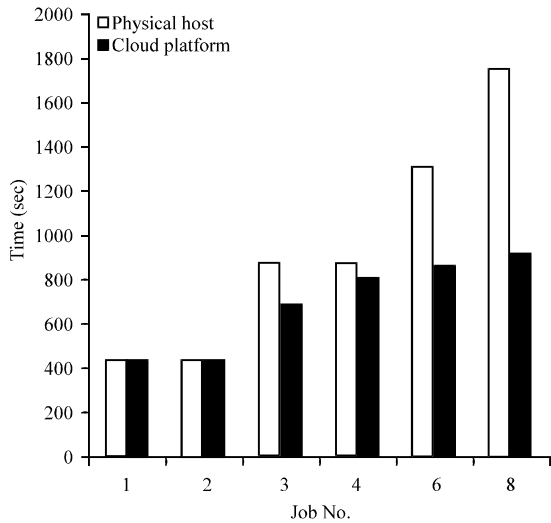


Fig. 5: Jobs running times

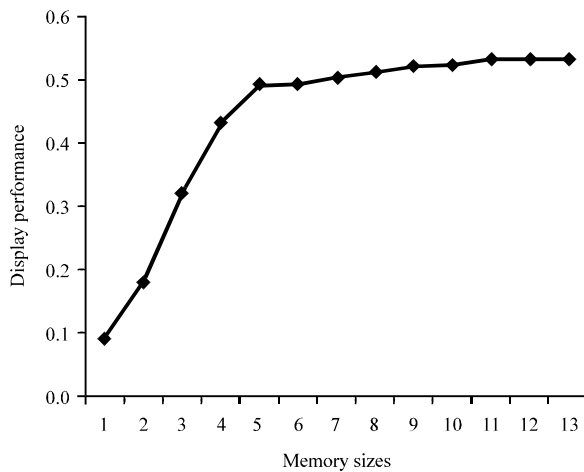


Fig. 6: Virtual machine display performance

Table 1: Jobs running time

Job No.	Running times of physical host	Waiting time (sec)	Jobs running time	Creating VM times (sec)
1	436.45	0.00	440.55	0.00
2	436.56	0.00	441.45	0.00
3	874.82	436.89	681.01	232.64
4	871.61	434.72	808.03	348.24
6	1310.41	878.05	871.54	372.16
8	1749.34	1311.90	920.40	398.28

machine’s memory size; the Y-axis represents the virtual machine display performance. It can be seen when the CPU number is fixed, the virtual machine display performance to improve with increasing allocate memory allocated to the virtual machine’s memory size significantly affects the virtual machine display performance. However, when the size of memory allocated

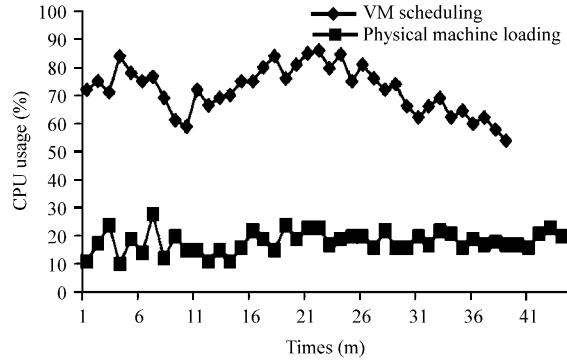


Fig. 7: ECMP scheduling under different load conditions

to the virtual machine to a fixed value, the virtual machine display performance is affected by the size of the memory allocation is very small.

Scheduling performance test: In this study, the main test scheduling performance of elastic of meteorological cloud platforms in different load cases. Shown in Fig. 7, the adoption of a flexible framework for the cloud platform virtual machine resource requests accurately responds to maximize the use of physical resources. Elastic scheduling visits, job or computation amount increases to a certain value, the virtual machine to enter the busy state module to increase physical CPU resources in a timely manner, to ensure the high availability of the CPU; enters an idle state when the virtual machine at the same time, flexible scheduling module physical CPU allocation which can be recycled CPU resources allocated to other virtual machines and to improve the utilization of physical resources.

CONCLUSION

Through Xen virtual technology research and discussion and the idea of cloud computing, an elastic weather cloud platform based on Xen is proposed. From this process a more profound understanding of the use and functionality of the Xen virtualization technology, but also appreciate the operation process and the main idea of the cloud platform, as well as flexible scheduling mechanism works. At the same time to learn more about the cloud platform to bring modern IT industry to facilitate and expand.

Meteorological industry positioning science and technology, the basis of social welfare undertakings, in modern society, its services should be close, to meet the needs of the community. With the development of IT technology, the meteorological industry will take

advantage of cloud computing technology to build a platform, better use of resources in all aspects, to provide a more comprehensive and accurate weather information.

ACKNOWLEDGMENT

This study is supported by the Project of 2011 Natural science fund for colleges and universities in Jiangsu Province (No. 11KJB520010); the Project of China Meteorological Administration Soft Science (No. SK20120151) and the Project Funded by the Priority Academic Program Development of Jiangsu Higer Education Institutions.

REFERENCES

- Bist, M., M. Wariya and A. Agarwal, 2013. A comparing delta, open stack and Xen Cloud Platforms: A survey on open source IaaS. Proceedings of the 3rd Advance Computing Conference, February 22-23, 2013, Ghaziabad, pp: 96-100.
- Dean, J. and S. Ghemawat, 2008. MapReduce: Simplified data processing on large clusters. *Commun. ACM*, 51: 107-113.
- Fang, W., W.B. Pan and Z.M. Cui, 2012. View of mapreduce: Programming model, methods and its applications. *IETE Tech. Rev.*, 29: 380-387.
- Goyal, A. and S. Dadizadeh, 2009. A survey on cloud computing: Technical report for CS 508. University of British Columbia, December 2009, pp: 55-58. <http://unbreakablecloud.com/wordpress/wp-content/uploads/2011/02/A-Survey-On-Cloud-Computing.pdf>.
- Liu, C.Q. and Y. Zhou, 2011. Meteorological information to the cloud 2011. Proceedings of the Chinese Meteorological Society Meteorological Communications and Information Technology Commission and Annual Scientific Meeting Abstracts, (CMSMCITCS'11), National Meteorological Information Center, pp: 177-179.
- Zhang, X.Z., 2011. The research and development status of key technology on cloud computing. *Network Inform.*, 9: 36-37.
- Byrne, N., 2010. Cloud computing: Is there a silver lining for accountants?. *Accountancy Ireland*, 42: 48 -51.