Feasibility of the Virtualization Based on OpenIMSCore

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Abstract. When Enterprise-level data center using virtualization technology for server consolidation is becoming more and more general, discusses and researches on virtualization for the telecommunications industry tend much fiercer. With virtualization of the system architecture, it can be saved mass time and costs, and receive better flexibility. Under this background, how to afford expected performance for each service becomes a new challenge. Combined with the ideas of virtualization and telecommunication service, this paper tests the performance of OpenIMSCore based on virtual platform to show feasibility of the virtualization for telecommunication service.

Keywords: Virtualization, OpenIMSCore, SIPp.

1 Introduction

As IT technology developing with each passing day, basic hardware with high performance is merging in large numbers. Virtualization,as an exciting architecture, which could create dynamic resource pool with limitless capacity to help users to access resource anywhere or anytime. And discussion between telecom industory becomes much fierce.

Taking advantage of virtualization,we can integrate several Operation Systems into one physical server,which can maximize the utilizaion of the hardware resource. While it can improve the flexibility and security of basic architecture, it will also reduce the cost of device, power supply of numerous servers, and cooling systems. However, overhead of virtualization must occupy some physical resource, which may have some effect on efficiency of CPU and memory. So we have to face this challenge whether virtualization could meet the demands of telcoms service system.

2 Related Technologies

2.1 Virtual Platform Vmware ESX

Many companies such as VMware, Microsoft and IBM launch virtualized products. This paper aims mainly at challenge that core network facing, and focuses on the feasibility of the virtualization based on VMware vShpere.

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VMware vShpere is composed of virtual platform ESX and management tool called vCenter Server. This virtualized technology encapsulates the whole x86 server (including driver, OS, application and configuration) into a virtual machine,and transplant it on virtual platform ESX. VMware ESX uses disk partition on virtual machine and resource subdivision to simplify the base frame, which can make certain of remote management and standardization on resource. This virtual schema provides load isolation, that means system and applications are distributed in several virtual machines which run on single physical server together. That is to say only one server can run various OS and applications independently. What's more,system resource could be assigned automatically to users on demand. In the mean time, vCenter server provides windows service to manage numbers of hosts, which use VMware HA to realize high availability.

2.2 OPENIMSCORE

The Open Source OpenIMSCore is the specific application of 3GPP, 3GPP2, ETSI TISPAN and IMS/NGN,which realize the fundamental function of IMS core network. It is an open source implementation of the Call-Session Control Functions (CSCFs) and a lightweight Home Subscriber Server (HSS) developed in compliance to the IMS architecture standards given by the 3GPP. The implementation of the CSCFs is based on SIP Express Router written in C, while the HSS developed in Java. Open IMS Core support access of kinds of UE to hold VoIP communication.

2.3 IMS BENCH SIPP

With the aim of evaluating the performance of the core components of an IMS network, the European Telecommunications Standards Institute (ETSI) developed the IMS/NGN Performance Benchmark Specification, consisting of guidelines for applying a set of tests to determine how the system behaves when the load on the system is increased. This benchmarking standard makes the benchmarking results comparable, which is an important step in taking decisions regarding the deployment of IMS systems.

The IMS Bench SIPp is a modified version of SIPp, a free open source traffic generator for the SIP protocol. The test environment meet a criterion of IMS Performance Benchmark specificaion,ETSI TS 186.008.The test system consists of one manager instance controlling the whole benchmark run, a fixed number of SIPp load generators, and a monitoring tool for the SUT collecting information about CPU load and memory consumption. At the configuration of the test, the manager assigns each SIPp instance a fixed number of users generating a predefined database containing user data as well as configuration scripts.It also generates a deployment script to deploy all needed files to each SIPp instance. Each SIPp instance then generates SIP traffic towards the SUT in accordance with the statistical distribution of each scenario ordered by the manager instance and reports the total number of generated scenarios, the number of IHS and system information of the host machine.

3 Performance Benchmark

3.1 Delay Contrast

ESX can be seen as a software tire bewteen hardware and operation system, which runs in privilege to take charge of management and isolution of virtual machine. It virtualize a hardware environment independent of physical hardware for each virtual machines and provides secure and independent condition for these virtual machines. However, virtual platform adds ESX to the physical platform, which may take some effect on IMS performance.

This experiment placed all elements of Open IMS Core including PCSCF, ICSCF, SCSCF and HSS together on one physical machine or a virtual one. The virtual machine occupies all the resource(CPU and Memory) of its physical host. To avoid numerous CPS(Call per Second) leading to signaling queuing delay,we used only 20 CPS in the test. The result of delay is shown in Tab.1, which demonstrates the introduction of ESX cause five times diference between virtual platform and physical platform.

Table 1. Delay contrast

	Session setup (ms)	INVITE arrive (ms)	Session release (ms)
Virtual platform	15.45	8.94	8.95
Physical platform	3.24	1.21	1.96

For ESX catches sensitive privilege instruction between guest OS and hardware, which can run guset OS without modification. This virtual technology use Ring Compression and Binary Translation. The former make ESX and guest OS run in different privilege, which means ESX runs in the highest privilege Ring 0, the guest OS kernel code runs in Ring 1, the application code runs in Ring 3.With this method ESX will intercept and capture some privilege instruction of guest OS.However,some instruction is not suitable for ring compress, it must scan and modify binary code of guest OS to make these instructions support virtualization. The advantage of the virtual technology is no modification of guest OS, meanwhile speed and function meet users' demand. The most disadvantage is its performance especially for I/O. So Open IMS Core running on virtual platform brings more signaling delay.

When all elements run on one virtual machine,the next experiment replaced 4 element of Open IMS Core onto the physical machine in turns, and the others still run on virtual machine. So we can know in which condition the delay is close to all elements run in one physical machine. This experiment is to find which element is the most sensitive for virtualization, and when deploy IMS core network in reality, it can choose right element runing on virtual platform.

Table 2. Delay contrast of network elements replacement

	Session setup (ms)	INVITE arrive (ms)	Session release (ms)
All on Virtual platform	15.45	8.94	8.95
All on Physical platform	3.24	1.21	1.96
Replace PCSCF on Physical platform	3.74	1.41	2.12
Replace ICSCF on Physical platform	13.87	5.51	8.52
Replace SCSCF on Physical platform	12.24	4.97	6.76
Replace HSS on Physical platform	12.9	5.35	7.62

As is shown in Tab.2 above, the delay is close to all components on physical machine when replace PCSCF onto physical machine. So PCSCF may be a bottleneck of IMS virtualization. For PCSCF is the first interface between IMS and outside environment, every service request from users must pass through PCSCF.

3.2 Maximum Call Attempts Contrast

Because of the introduction of virtual platform, there may be more difference between physical and virtual platform. This experiment tested the max number of concurrent calls on both platform, and the results can be shown in Fig.1 below. When CPS increase to 500, Open IMS Core on virtual platform can not handle these call attempts.

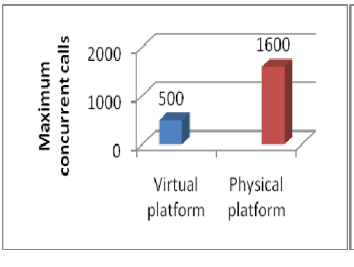

Fig. 1. Maximum concurrent calls contrast

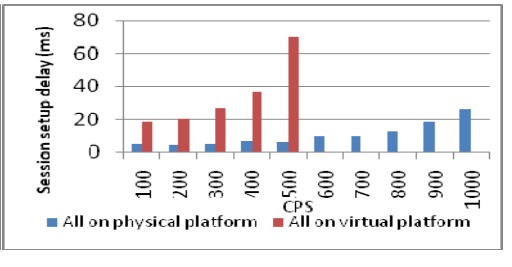

Fig. 2. Delay contrast

To find reason why different maximum calls exist in virtual and physical platform, this experiment also tested the delay. And then this experiments collected delay results using one IMS Bench SIPp test system, because more test system will cause larger delay when test same CPS. To exclude the effect as told above, we choose only one test system. The results are depicted in Fig.2. Signaling delay on virtual platform is much larger than delay on physical platform, which is the reason that call attempts failed when CPS are 500.This result also demonstrates that real-time service has high

demand on virtualization, because signaling delay leads to failure of service requests, which takes effects on the whole system performance.

3.3 CPU Utilization of ESX

As for the maximum number of concurrent calls on virtual and physical platform existing huge difference, this experiment need to test how much resource ESX used. Besides signaling delay, we tested whether hypervisor was another reason because it would take use of much CPU resource when Open IMS Core handles much call attempts. This experiment used VMware vCenter Server to real-time monitor virtual machine and physical server, and results can be seem in Fig. 3 and Fig. 4.

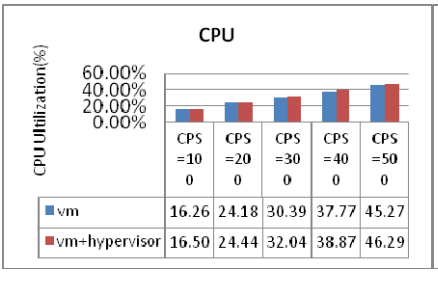

Fig. 3. CPU utilization of virtual machine and physical machine

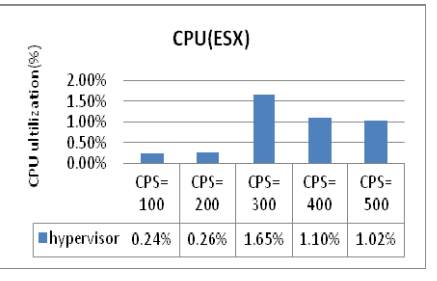

Fig. 4. CPU utilization of ESX

In Fig.3, the blue instance stands for the CPU utilization of virtual machine, the red one stands for physical server CPU utilization. Because CPU of physical server is shared by ESX and virtual machine, the red minus the blue is the ESX utilization. As Figure 4 depicted, with CPS increasing from 100 to 500, the utilization of CPU is always below 2%, which means ESX does not take huge resource that may influence the performance of Open IMS Core on virtual platform.

4 Summaries

The test results based IMS Bench SIPp demonstrate that ESX does not use huge physical resource, and when CPS increasing the resource utilization is within a fixed renge. Virtualization technology would not modify guest OS on its virtual machine, but may take some effect on performance, especially for I/O. So there may be larger signaling delay when Open IMS Core runs on virtual platform.

However the introduction of ESX takes some effect on delay and the maximum number of concurrent calls, it can integrat several physical server into only one physical server, that is to say server virtual machine runs on one physical server.If these virtual machine can handle more service than one physical server,this can increase the utilization of servers. With consolidation of server,it will reduce the number of physical servers,and increase the resource utilization,which will cut costs

on hardware and management. Some statistics shows that virtualization technology increases the average utilization of single server.After using virtualization technology,the average utilization of each server improve from 5-15% to 60-85%,meanwhile it will lower the cost on hardware and software from 30-60%.

This is the original study, and there will be more follow-up studies. As for real-time demand on telecommunication service,we will choose para-virtualization to test the delay,which may have less delay costs than full-virtualization.

References

[1] vmware official website, http://www.vmware.com/cn/
[2] OpenIMSCore Project official website, http://www.openimscore.org
[3] IMS bench SIPp official website, http://sipp.sourceforge.net/imsbench/intro.html
[4] Herpertz, R., Carlin, J.M.E.: A Performance Benchmark of a Multimedia Service Delivery Framework. In: 2009 Mexican International Conference on Computer Science (2009)
[5] Din, G.: An IMS Performance Benchmark Implementation based on the TTCN-3 Language. International Journal on Software Tools for Technology Transfer (STTT) 10(4), 359–370 (2008)
[6] European Telecommunications Standards Institute. Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IMS/NGN Performance Benchmark. ETSI TS 186 008-1 (October 2007)