Energy Efficient Virtual Machine Monitoring Architecture for Green Cloud Computing

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ABSTRACT
Nowadays Technology is growing faster; peoples started using tablets, laptops & mobile on the move. Cloud is the basic platform for everything. Using the concept of virtualization one can access others computer virtually through the cloud. As many of the users started using this virtualization, Kernel attacks and other malicious programs which invokes many malicious process are increasing day by day. In order to give security to virtual machines lots of architectures are there but those architectures are not energy efficient which means it consumes more power hence large number of cooling system is required so an energy efficient scalable architecture is necessary to monitor the process invoked by the users of the virtual machine. Virtual machine monitoring architecture which is explained in this paper is an energy efficient architecture which is implemented on virtual machines and there is a dedicated virtual machine which is used for monitoring purposes and to save the monitoring logs. All the virtual machines are installed on KVM hypervisor. This architecture monitors the process based on CPU usage. As it is light weight monitoring architecture it consumes less energy when compared to other architectures hence it enhances green cloud.

General Terms
Cloud computing, monitoring

Keywords
Virtual machine, monitoring, green cloud, kernel attacks

1. INTRODUCTION
Cloud computing[1] is a process of storing in the remote location hence it can be accessed by any device which is connected with the internet at anywhere at any time. This concept came in early 1961, there is a Professor named John McCarthy who suggested there is a computer time-sharing technology which lead to a future where computing power and even specific applications is sold through a utility based business model. The term utility based means pay per use. This idea became most popular in the late 1960s, but in 1970s the idea faded away when it became clear that the IT-related technologies of the day were unable to sustain such computing model

Some of the cloud service providers are Google, Amazon etc.., cloud provides three services they are SAAS[1], PAAS, and IAAS. SAAS[1] means software as a service where we can rent softwares as per our use some of the examples are Google drive, Microsoft's skydrive etc.., in that examples they provide office softwares which are used to create, edit documents, spread sheets, presentation etc.., these office softwares are give free of cost but some of the softwares like Photoshop, academic softwares are given on the basis of pay per use in cloud[1] environment. In order to cloud you need a browser with basic functionalities. Through the internet we are accessing higher end machine which is capable of running higher softwares not only softwares we can run operating system also through Amazon's web services.

Distributed system is the base of grid computing & grid is the base of cloud. Hence distributed systems are the base of all. Cloud is providing everything as a service for example if a user want to mail means he is not necessary to install mail app instead of that he can use that app virtually as, software as a service Gmail[1] is best example. Likewise for editing photos user doesn't have to install any software in his system instead of that he can get that software as service Photobucket[1] is an example for this type and YouTube[1] is example for video streaming cloud based app & these are the some of the examples of the cloud based services.

If a user using Microsoft's windows 8 but he needs to work on Ubuntu, he can get Ubuntu Os (Virtual machine) as a service from the internet by the concept of virtualization[2][3][4]. Likewise most of the users are started using cloud[5] platform. Sometimes the user may get the opportunity to edit the kernel hence a security/monitoring architecture is needed to monitor all the activities of the user who is using the virtual machine[6] and to stop the malicious process if he invokes. In the cloud if the service provider are introducing virtual firewall or virtual intrusion detection system consumes more cost hence host based security/monitoring architecture is needed. Some of the security architectures are explained in the related works in the coming section.
This paper is all about the energy efficient architecture which is implemented in each virtual machines of the datacenter which monitors the process based on CPU usage and instruct to the administrative virtual machine & if the administrator found a process is malicious and he will kill the process.

2. RELATED WORKS

2.1 Existing approaches
Peoples started using cloud more often so the vulnerability is also increased in order to solve such problems lots of security & monitoring architecture came. Hypervisor based Integrity Measurement Agent is also called as HIMA[7] is an approach which consists of guest VM s and management VM installed on Xen hypervisor the main disadvantage is driver problems in xen and it doesn't handle app writable executable on memory page. KvmSec[8] is the another architecture in which multiple VMs are installed in KVM hypervisor. It consists of two domains which are Dom 0 & Dom U the main disadvantage is it degrades the system overall performance. LARE[9] is an hybrid architecture installed on xen hypervisor which monitors the process by using hooks. The next architectures are Xen access [10] VMscope[11] VMInsight[12] used to monitor the process in virtual

machines. Overall most of the methods are having disadvantage like energy cost and low system performance hence energy efficient architecture is needed to monitor all the process invoked by the users of the virtual machine.

2.2 Green computing

Global warming and climate change are on top of world's list of concerns and one of the reasons is our dependence on energy extracted from fossil fuels. We all consider the transportation sector as the main pollution source of our atmosphere, but is the IT industry really exempted from the blame?

Governments around the globe usually have standards on factory or industrial facility energy consumption and emission while the energy consumption in IT laboratories and data centers are overlooked, some exception of universities and research organizations. So there are no standards or laws that are to be followed when putting up such facility, which creates a big problem. Research suggests that a huge amount of energy is being wasted during energy conversion from AC to DC and it would cost twice as much, in terms of energy consumption, to cool a server than to run it. Let's say a server is rated at 600W and it runs 24/7; that server would consume 5380KWh per year. Now let's assume that ten of those servers are running at the same time for every IT company with more than 2,000 employees. The estimated number of those companies given by the census bureau was 2917 in 2008; it could have grown exponentially within the last six years. This gives a rough value of 13,772MWh of energy consumption in 2008 alone, and twice of that value is used for cooling those servers. That is assuming all companies used the same 600W servers in the same way, but the real-world value could be even greater because there are still many old servers running. And not all of that hardware is being utilized; underutilization is the biggest waste of resource. This is a very big concern, especially since most of that energy is non-renewable.

This is where cloud computing and virtualization come in to save the day or decade. Cloud computing uses virtualization to scale resources to infinity.., Normally while using finite hardware resources. So instead of having 2,916 data centers with 10 servers spread across the U.S., theoretically 2,916 companies could be served by 10 cloud providers running 100 data centers. This means a total annual energy consumption of just 43.8MWh.

3. DESIGN OF MONITORING ARCHITECTURE

According to the survey work done by the MIT professor, for the next 50 years energy sources will be a mixture of different renewable resources hence power production unit has to be installed in the datacenters and relocate the datacenters to the coolest places so the cooling system cost can be minimized. The energy cost can not only minimized by the physical aspects but also it can be minimized by the energy efficient monitoring architecture in the datacenters.

Datacenter consists of n-number of virtual machine which can be monitored by the energy efficient architecture. The monitoring architecture is installed in all virtual machines & one dedicated virtual machine which is used by admin which is shown in figure 1. As it is energy efficient monitoring architecture it operates only the user logs in. It checks all the process which are invoked by the user and it display the process based on the CPU usage to the administrator virtual machine and a log file is also created which is used for the future use.

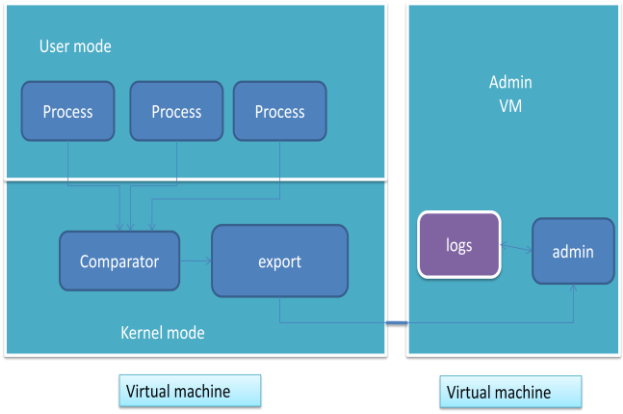

Figure 1.Monitoring architecture

This architecture consists of two blocks which are comparator & export where comparator is used to group all the similar process and export is used to create connection between the virtual machine to the administrative virtual machine & this block sort the process based on the CPU usage and sends this information to the admin. In order to install the architecture, processor which supports virtualization is needed for example in Intel's core i3 which comes with Intel's VT hence it supports virtualization.

4. RESULT AND DISCUSSION

Experimental setup: For running this architecture a processor which supports virtualization is required for example inter core i5 processor which is powered by Intel's VT. KVM hypervisor is installed on Ubuntu 12.04 OS. Above that two virtual machines are installed one is guest virtual machine and another is administrative virtual machine. First in guest machine user invokes a process then it goes to kernel mode, in this mode system calls are compared and then grouped according to their type by the comparator. Export block establish connection to the administrative virtual machine using the virtual network and this block analyze the CPU usage by the each process and sort the process according to the CPU usage and send this information to the administrative virtual machine. In the administrative virtual machine the all the data from different guest virtual machine are displayed to the administrator and a log file is also created for the future use. In the administrative virtual machine, the admin can view the live update of the process in the various virtual machines. If admin found a malicious process, he can kill such process from the administrative virtual machine itself

Process is also called as thread. There are n-number of process can be invoked by the user some of the examples of the process are copy, compress, move and decompress etc .., Process compress is taken for experimentation. When the monitoring architecture is in active monitoring mode the process compress is invoked by the user and this process goes on for one hundred and fifty seconds to complete and the corresponding power consumption is also noted, similarly the power for running only the process without monitoring architecture is noted. This experimentation has done in different trials at different time and finally the mean values are tabulated which is shown in the graph. From the graph we concluded that the energy cost of the monitoring architecture

is low when compared to the existing methods discussed in detail in the related works section.

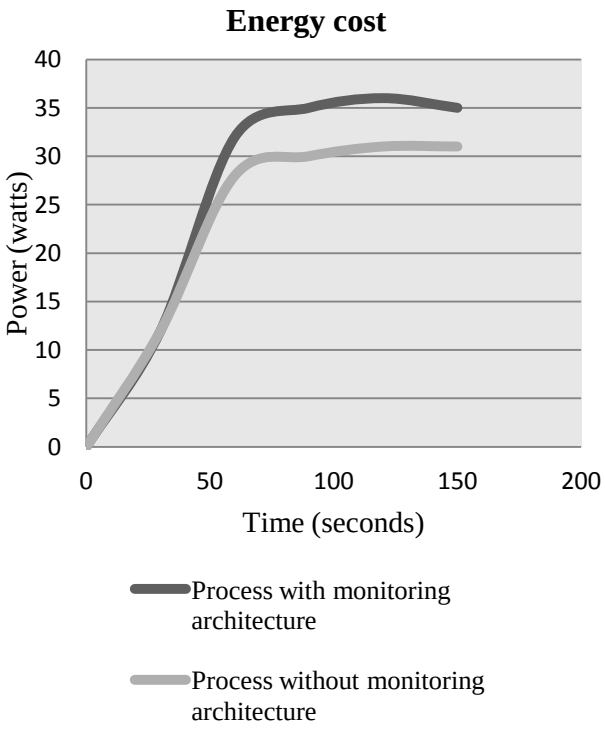

Figure 2.Energy cost

5. GREEN CLOUD IN IT FIELD

Energy cost not only reduced by the energy efficient architecture, it can be reduced by consuming energy from the renewable sources like bio, thermal, nuclear and hydro. For example, company named Apple[13] which is producing own power. The solar farm will stretch across 100 acres and generate 20 MW which is shown in the figure 3. Similarly Google started using renewable energy sources from wind, thermal[14] which results in less emission of CO2. In order to conserve energy goggle is getting power from its renewable sources. The next step to enhance the green cloud is keeping datacenter at the coolest place which means in the location which is always cool so the energy cost of the cooling system can be reduced.

Normally from the resource AC output is obtained the next step is rectification which means converting AC to DC to charge the UPS and then after charging DC is again converted into AC and it is transmitted to through the power lines to the datacenters. In datacenters again AC is converted into DC to power up the servers shown in figure 4. It is a tedious & power consuming process hence Google[14] is following a method where from the production source AC is obtained and it is then converted in DC and to charge the UPS after that DC is given to the servers which is shown in the figure 5.

Figure 3.Apple's thermal power

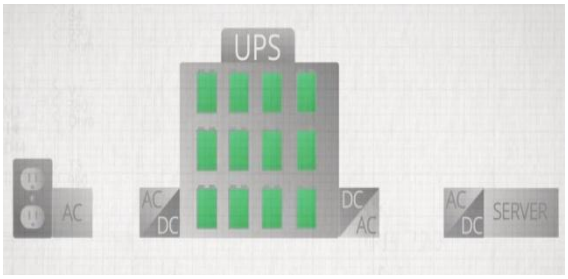

Figure 4.Conventional datacenters

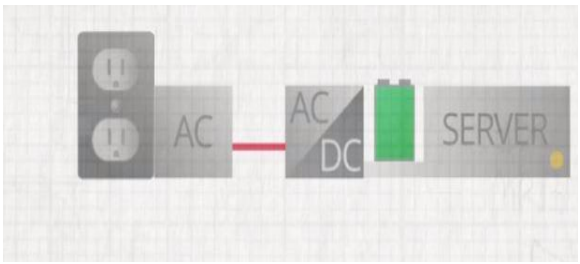

Figure 5.Google's datacenters

6. CONCLUSION & FUTURE WORKS

As virtualization becomes popular peoples started using virtual operating system from the cloud but day by day the vulnerabilities are also increases hence lots of virtual machine security architectures came but now we are in the situation to consume energy hence energy efficient architecture is needed we have studies energy efficient architecture in this paper and how it efficiently conserve energy cost is also studies. For efficient green cloud the power consumption must be reduced hence CO2 emission can be controlled, the datacenters can also produce their power for their own needs. Using recyclable hardware we can conserve green cloud.

As it is energy efficient architecture it has only monitoring part hence it won't stop the malicious process automatically only admin has to stop the process manually, in future work the energy efficient security module can be added to this architecture for the effective monitoring of the virtual machines so architecture found any malicious process which is attacking kernel of virtual machine, such malicious process will be killed by energy efficient algorithms which is

implemented in the VM security architecture in the datacenters.

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