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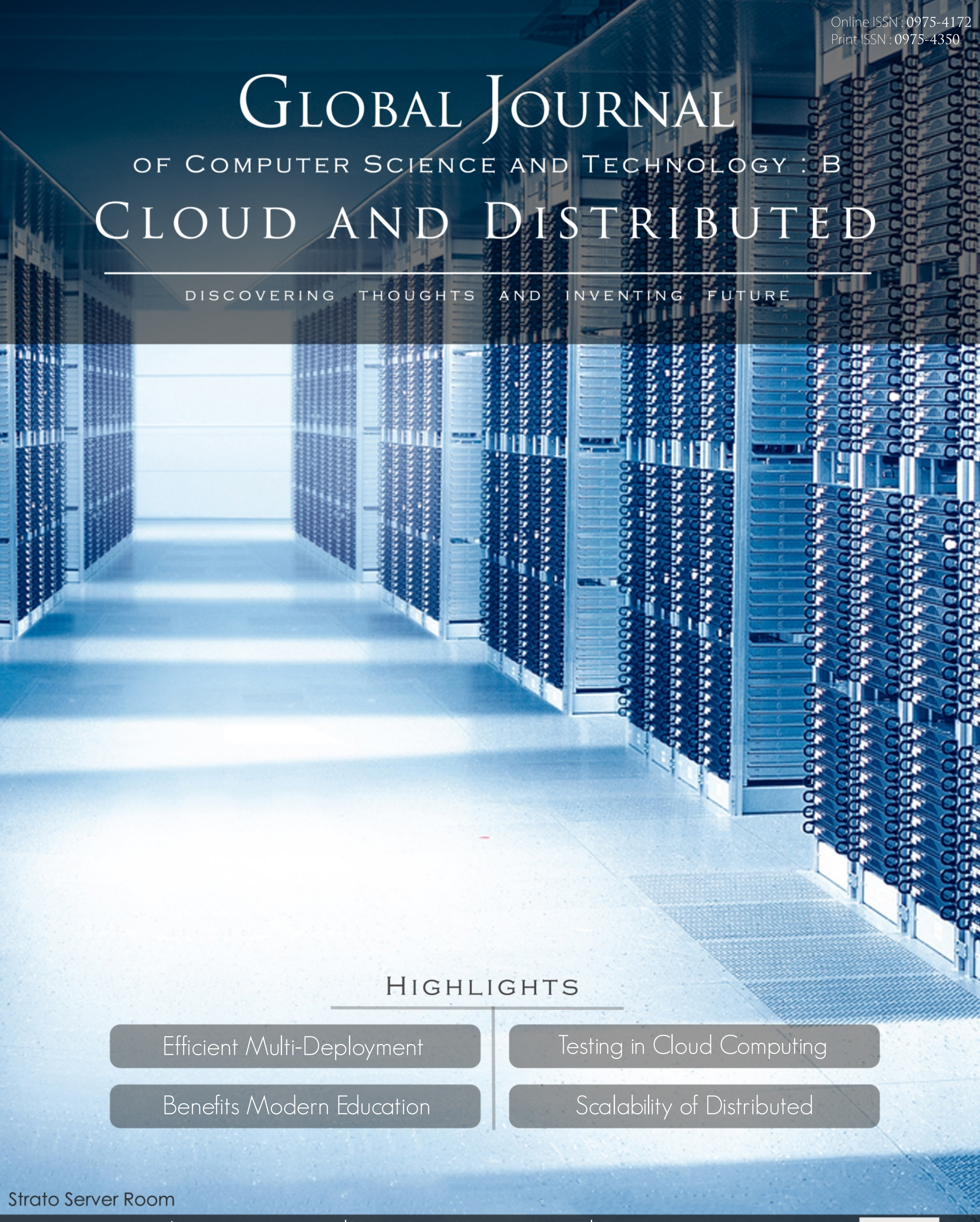
Cloud and Distributed

DISCOVERING THOUGHTS AND INVENTING FUTURE



Strato Server Room

Highlights

- Efficient Multi-Deployment
- Testing in Cloud Computing
- Benefits Modern Education
- Scalability of Distributed

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Going Back and Forth: Efficient Multi-Deployment and Multi-Snapshotting on Clouds

By Syeda Farhath Begum, Dr. Kahalid Mohiuddin & Ashiquee Rasool Mohammad
Osmania University, Hydrabad, India

Abstract - Cloud computing has changed the way people think of using resources. Especially, the IaaS (Infrastructure as a Service) allows users to make use of unlimited resources in pay per use fashion. Virtualization is the technology based on which the cloud service providers are able to provide or share computational resources and data centers to users. Though this approach is practical, it throws certain challenges in terms of designing and development of IaaS middleware. One such challenge is the need for deploying thousands of VM instances to meet the requirements of growing number of users. In the process another challenge is to snapshot multiple images and persisting them towards management tasks like stopping VMs temporarily and resuming them as and when required. The presence of data centers in different configurations enables the simultaneous deployment and snapshotting is important. This capability should be coupled with another feature that is the whole mechanism should be hypervisor independent. To achieve this, a new virtual file system is proposed in this paper. This is basing on lazy transfer scheme with VM optimization and object versioning that takes care of multi-snapshotting and multi-deployment simultaneously and effectively. The experiments have shown that the new filing system and related techniques have improved performance, and bandwidth utilization is reduced by 90%.

Keywords : Cloud Design, Cloud Storage Performance, Empirical Study, Multi-snapshotting, versioning, VM images, lazy propagation, cloning, multi-deployment.

GJCST-B Classification: *C.2.1*

GOING BACK AND FORTH EFFICIENT MULTI-DEPLOYMENT AND MULTI-SNAPSHOTTING ON CLOUDS

Strictly as per the compliance and regulations of:

Going Back and Forth: Efficient Multi-Deployment and Multi-Snapshotting on Clouds

Syeda Farhath Begum [α], Dr. Kahalid Mohiuddin [σ] & Ashiquee Rasool Mohammad [ρ]

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Keywords : Cloud Design, Cloud Storage Performance, Empirical Study, Multi-snapshotting, versioning, VM images, lazy propagation, cloning, multi-deployment.

I. Introduction

Nowadays, the emergence of Infrastructure as a Service (IaaS) cloud computing is a feasible substitute to the acquisition as well as physical resources management. With the help of IaaS, users can be able to lease storage and time of computation from datacenters that are very large. Leasing of computation time can be achieved by enabling users to deploy virtual machines (VMs) on the resources of the datacenter. As the user possess overall control on the configuration regarding Virtual Machines by making use of on-demand deployments, IaaS leasing is simply similar to purchase of hardware that is dedicated but with no long-term commitment as well as cost. The IaaS on-demand nature is complex to make such kind of leases more attractive, as it allows users for expanding or shrinking their resources with respect to their needs of computation, by making use of external resources for complementing their local resource base [15].

This emerging model results in new challenges with respect to the design as well as development of systems providing IaaS. One among frequently resulting patterns in the operation of IaaS is the necessity for deploying a huge number of VMs on most of the nodes relative to a datacenter at the same instant of time, starting from a collection of VM images that are stored previously in a fashion that is persistent. For instance, this pattern is occurred when the user needs the deployment of a virtual cluster that is used to execute a distributed application or a group of environments for supporting a workflow. This pattern is referred as multi deployment. Such kind of large deployment of most of the VMs at a time can take a longer time. This problem is in particular acute for VM images that are used in scientific computing in which image are large in size (from small number of gigabytes up to greater than 10 GB). A conventional deployment contains hundreds or else thousands of such kind of images. Before starting the instances of VM, conventional techniques of deployment [23] broadcast the images to the nodes , a process which could take time ranging from tens of minutes to approximately hours, not taking into account the time for booting the operating system alone. This could make the time of response of the IaaS installation very longer than that is acceptable and remove the on-demand benefits obtained from cloud computing. Once the instances of the Virtual Machines are being run, a same kind of challenge is applied to snapshotting the deployment. Most of the VM images which were changed locally need to be transferred in a concurrent manner for making storage stable with the reason to capture the VM state for using later (for instance in check pointing or online migration to another cluster or cloud). This pattern is referred to as multisnapshotting. The technique of conventional snapshotting works definitely on custom VM image file formats [9] for storage of only incremental differences in a new file which rely on the original VM image similar to backing file. When taking regular snapshots for a huge number of VMs, such kind of approaches form a huge number of files as well as interdependencies among them, that are difficult for managing and that get in the way with the ease-of-use basis behind clouds. Moreover, with emerging datacenter trends as well as tendencies for

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federating clouds [12], configurations have become more and more varied. Custom image formats are not standardized and might be used with particular hypervisors alone that limits the ability for easily migrating VMs among various hypervisors. Hence, multisnapshotting should be handled in a transparent and portable style which hides the interdependencies of additionaldifferences and exposes VM images that are standalone, by greater portability in various hypervisor configurations.

Along with incurring delays that are significant and raising issues of manageability, these patterns can also form huge network traffic which comes in the way through the execution of applications on resources that are leased and results in greater costs of utilization for the user.

In this paper a virtual file system that is distributed specifically that is optimized for patterns of multideployment as well as multi- snapshotting. As the patterns are considered complementary, they are investigated in conjunction. Our proposal provides a proper balance between performance, storage space, and finally consumption of network traffic, while treating snapshotting in a transparent manner and revealing standalone and even raw image files (understood by many hypervisors) to the outside.

The summary of our contributions are as follows:

- We present a flow of design principles which optimize patterns of multideployment as well as multisnapshotting and describe in which manner our design can be integrated with the resources of IaaS (Sections 2 and 3).
- We illustrate how to comprehend these principles of design by building a virtual file system which leverages distributed storage services that are versioning-based. To clear this point, we describe an implementation over BlobSeer, a service related to versioning storage particularly designed for maximum throughput under concurrency [17, 24].

Our approach is evaluated in a sequence of experiments each of which is conducted over hundreds of nodes that are provisioned on the Grid'5000 testbed, by making use of synthetic traces as well as real-life applications.

II. Related Work

Multideployment which depends on complete broadcast-dependent pre- propagation is a commonly utilized technique [28, 23, 11]. While this technique prevents read contention to the repository, it can incur great overhead in network traffic as well as execution time, as mentioned in Section 5.2. Moreover, as the VM images are completely copied on the compute nodes locally, multisnapshotting will not be feasible: greater amounts of data have been duplicated unnecessarily and can cause transfer delays that are not acceptable, without mentioning huge space of storage and utilization of network traffic.

For alleviating this problem, most of the hypervisors offer support of native copy-on-write by giving definition of formats of custom VM image file [12, 20] particularly designed for efficiently storing additional differences. Similar to our approach, this makes base images to be usable in the form of templates that are read-only for multiple logical instances that store modifications per instance. Moreover, deficiency of standardization and also the generation of more number of new files that are interdependent restrict the portability as well as manageability of the snapshots of VM image that result. Another approach that is different in nature for instantiating a huge number of VMs from the identical initial state has been proposed in [13]. The authors present a latest cloud abstraction: VM FORK. Basically this is considered as the equivalent of the fork call on operating systems like UNIX, cloning a VM at every instant into multiple replicas which are running on various hosts. While this is simply equal to CLONE followed by COMMIT in our method ,the main concern is on reducing the time as well as traffic of the network for spawning and running, on the fly, new remote instances of VM that share the identical state of a VM that is already running. Local modifications have been assumed tobe ephemeral, and no support is provided for storing the state persistently.

A similar one to our approach is Lithium [10], a replication system that is fork-consistent for virtual disks. Lithium supports instantaneous volume creation along with lazy space allocation and creation of writable snapshots instantaneously. Not similar to our approach is the one which is dependent on segment trees, Lithium is dependent on log structuring [22], that can potentially humiliate read performance when increasing the number of successive snapshots for the same image: the log of incremental differences is started growing, making it more costly for reconstructing the image.

Cluster volume managers for virtual disks like Parallel ax [16] allow compute nodes for sharing access to a block device that is single and globally visible, which in a collaborative manner managed for presenting individual virtual disk images to the Virtual Machines. While this allows frequent snapshotting that is not efficient like our approach, image sharing is intentionally not encouraged so as to remove the requirement for a distributed lock manager that is claimed for dramatically simplifying the design. Most of the storage systems, like Amazon S3 [5] (backed by Dynamo [8]), are particularly designed as highly accessible key-value repositories for infrastructures of cloud. They may be building blocks that are valuable for block level storage volumes [1] which host images of virtual machine; moreover, they have not been optimized for snapshotting. The intention of our approach is to complement existing platforms of cloud computing, from industry (Amazon Elastic Compute Cloud: EC2 [4]) as well as from academia (Nimbus [2, 12, 24], Open Nebula [3]). While the particulars for EC2 are not available publicly, it has been widely accepted that all of these platforms depend on many of the techniques mentioned above. Claims for instantiating multiple VMs in ―minutes,‖ moreover, are not sufficient to meet our objectives of performance; So, our work is believed to be a welcome addition in this circumstance.

III. Description of Infrastructure and Other Components

a) About Cloud Infrastructure

Clusters are used in building IaaS cloud platforms. They are made up of hardware that makes use of less power and reduces cost per unit and provides high speed [4]. Many machines are interconnected and each machine is attached a disc storage. Virtualization technology is used in order to share physical resources well. The machines are able to run multiple VMs. Many nodes are dedicated for storage that is responsible for persistence. They might be having either distributed [5] or centralized [2] storage service. Such storage service is responsible to store VM instance images reliably. The manipulations of VMs include deleting, downloading, uploading and so on.

b) State of the Application

VM deployment state has two parts namely the state of all VM instances at any given point of time and the state of the channels between them meant for communications. They include sockets which have been open, network state and virtual topology. In order to make the sate persistent for future reuse and maintenance, it is essential that the VM instances are to be persisted and at the same time hundreds of VM instances are to be created to meet increasing demands of cloud users. However capturing the global state of such channels is difficult [14]. To avoid this problem, the second model is to get sum of all VM instances. This model discards any in-transit traffic in the network and assumes that fault tolerant network is used.

Model 3, which is simplified version of model 2 is that the VM state is represented only by the virtual disk attached to it. It stores only minimal information pertaining to state and such information is reused later. It has the benefits like reduction in size and portability across systems. Model 3 is widely used mechanism in practice and the same is considered in this work.

c) Application Phases

Any VM may not access the whole image. Some utilities and applications are never used. To model this behavior the VM life cycle has been divided into three phases namely boot phase, application phase and shutdown phase. The boot phase reads configuration files, launches processes that represent initial state of VM. The application phase is in either negligible virtual disk access that need not be persisted or data–intensive which needs dedicated storage. The shutdown phase generates very negligible disk access and this phase is not there when VM instance terminates prematurely due to some hardware failure.

IV. Our Methodology and Architecture

In order to optimize the process of multisnapshotting and multideployment, a new filing system is proposed. The following sub sections describe it.

a) Overview of Design

The design of the proposed approach depends on the principles like optimizing multisnapshotting, reducing contention, optimizing VM disk access, and aggregating storage space.

i. Aggregating local Storage

The existing approaches [5, 2, 3] are not capable of making use of storage space available in local hard discs of nodes. To overcome this shortcoming, the proposed approach aggregates storage space from local hard disks and forms a common pool which is used in a distributed fashion. Its advantages are high scalability and freeing memory for reducing overhead in managing VMs.

ii. Optimizing VM access and Reducing Contention

On demand VM image mirroring facilitates to make use of locally available VM image for output. However, it can get from global VM instance the required information in the form of mirroring. It improves performance. Moreover our approach supports reduction of contention as the VM image is split into number of equal sized pieces. While reading values if any piece is not available in the local disk, it is obtained from remote disk thus reducing contention.

iii. Optimizing Multi-Deployment and Snapshotting

When full VM image is saved every time, it consumes lot of resources even though small changes are made. To avoid this certain file formats can be used to incrementally save to other virtual machine. Its drawbacks include limitation of migration capabilities and also the risk of ending up with so many VM instances. By using shadowing and cloning these problems are overcome by the proposed approach.

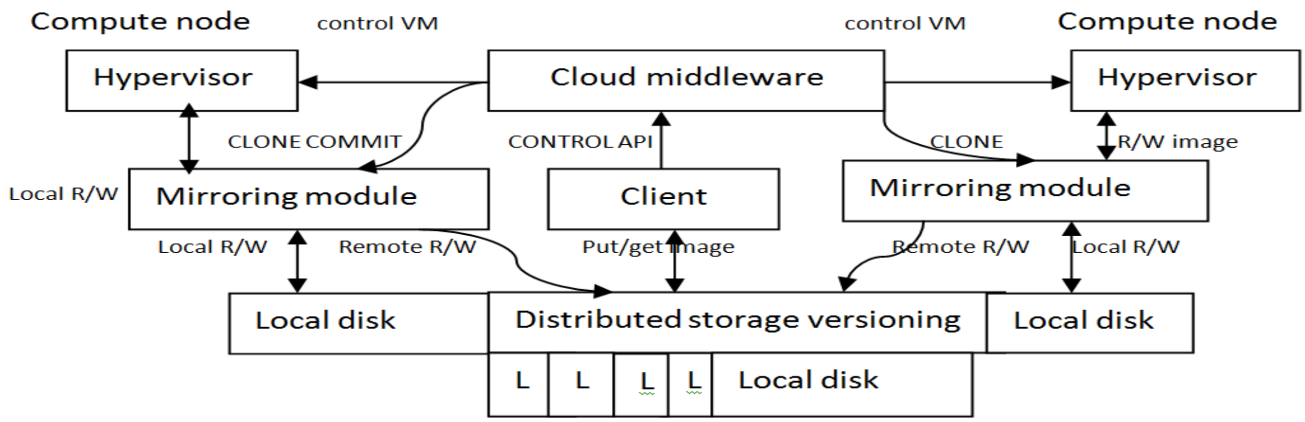

Fig. 1: Shows proposed architecture

V. Proposed Cloud Architecture

Fig. 1 shows the architecture of the proposed system. It has cloud middleware, compute nodes or hypervisors, clients mirroring modules. The cloud middleware facilitates communication to mirroring modules and also hypervisor concurrently. COMMIT is used to save changes permanently while CLONE is used to make another copy. Local disks are involved to form a distributed file system which improves the overall performance of multisnapshotting.

VI. Implimentation Details

The proposed system implementation mainly has two modules namely distributed versioning storage service and mirroring module. The former is meant for improving management of repository while the latter for trapping IO access and runs in each compute node.

a) Software Reused

Some of the components are reused in the proposed system. For instance BlobSheer [17, 18, 19] and FUSE are reused. The BlobSheer is meant for working with LOB objects while the FUSE is meant for implementing mirroring module.

As can be seen in figure 2, the fuse module is made up of many components like hypervisor, cloud middleware, BlobSheer etc.

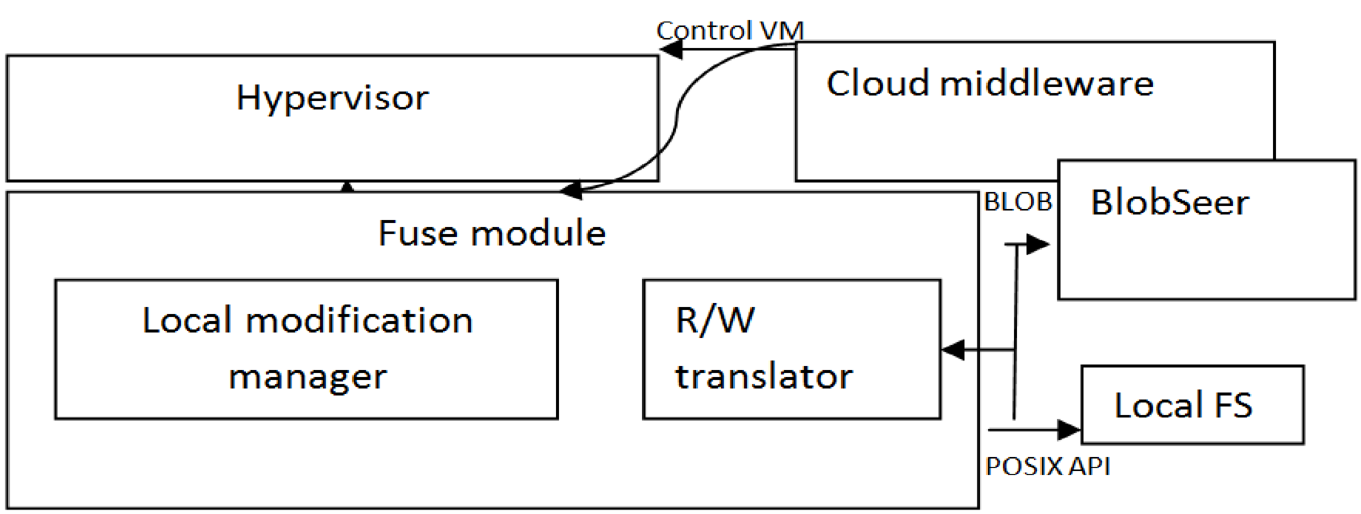

Fig. 2: Fuse Model

b) The Approach

Figure 2 presents FUSE module. Its sub modules are local modification manager and R/W translator. The former is for tracking local content while the latter is meant for translating original requests into remote read and write requests. On opening VM first time, the local disk has an empty file created in order to mirror BLOB image. The storage has been optimized. The local file gets closed after unmapping when VM image is closed. For remote access of VM image through POSIX the commands like COMMIT and CLONE have been implemented as part of FUSE module. COMMIT save local changes into BLOB image permanently. CLONE is meant for cloning VM image. Finally these are integrated with Nimbus cloud.

VII. Evaluations

Experiments and results on multi-deployment and multi-snapshotting are described in the following sub sections.

a) Emperical Setup

Grid'5000 was used to perform experiments. iNancy with 120 clusters was used. Each one is with x86 64 CPU with virtualization support, local HDD worth 250 GB and 8GB of RAM with Internet connection. KVM 0.12.5 was the hypervisor and the OS is Red Hot Linux.

b) Multideployment Performance

The following sub sections throw light into the experimental results. The observations are done in a multideployment pattern when a single VM is used to have ―n number of VM instances.

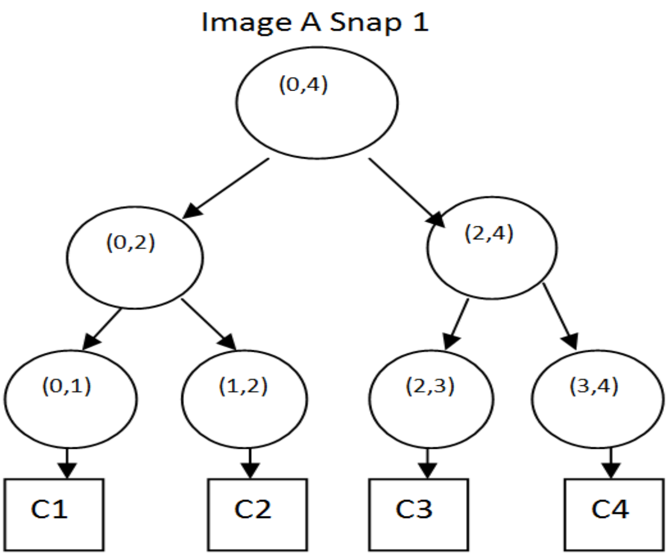

Fig. 3 : Segmentation of chunk details of VM image A

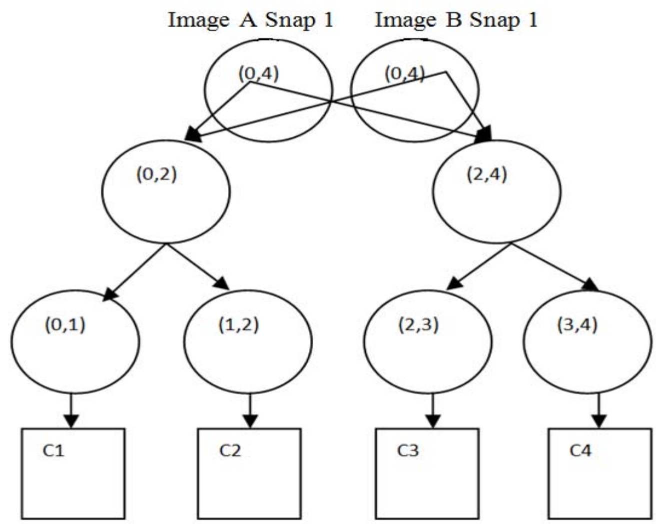

Fig. 4 : Segmentation of chunk details of VM image A

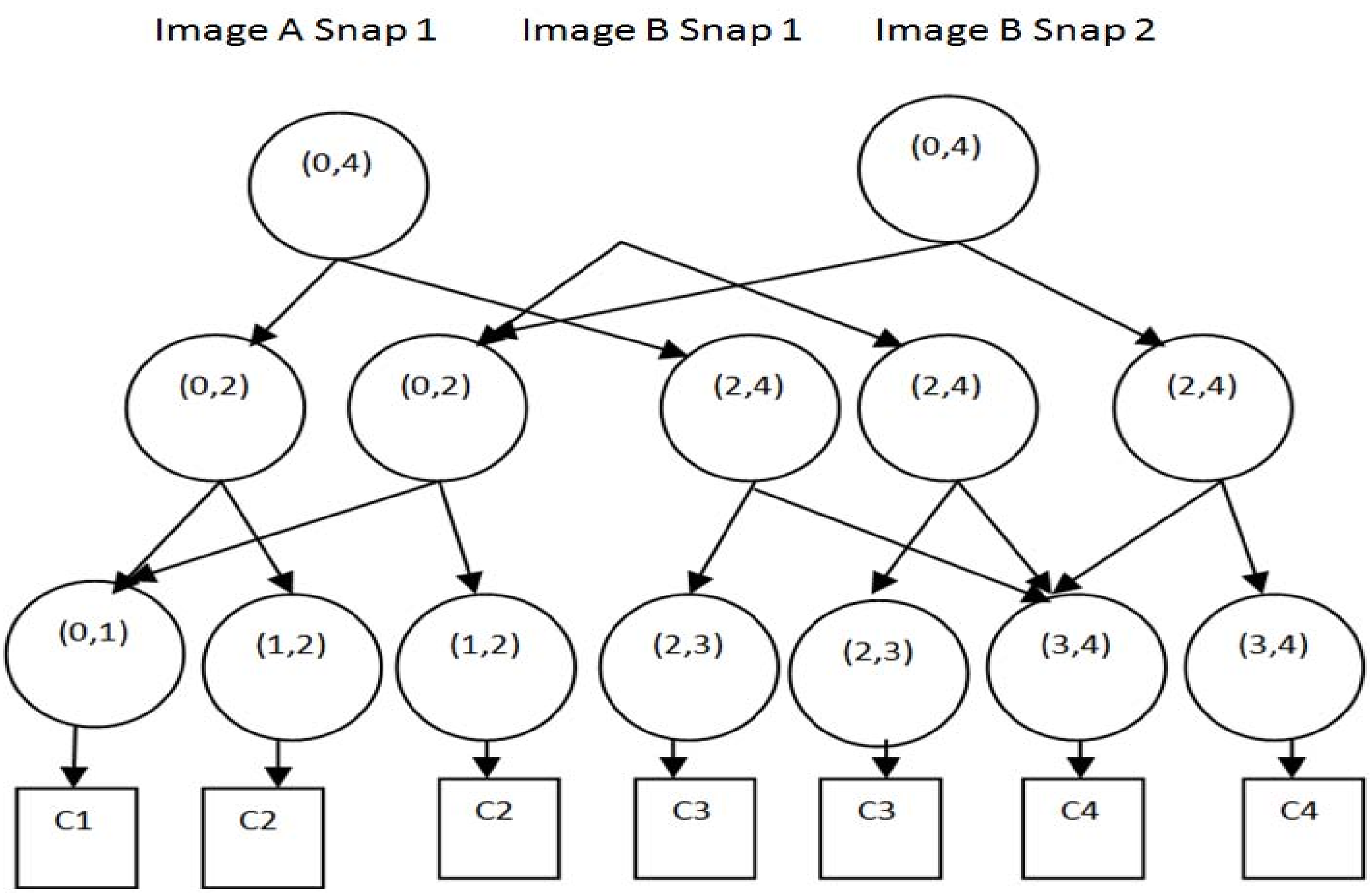

Fig. 5: Segmentation and chunk composition of consecutive snaps

i. *Propogation*

As given in [21, 23], it is part of cloud and has phases like broadcasting of VM image, and launching of VM instances concurrently. The drawback in the propagation approach is the overhead incurred in the initialization phase. Taktuk [7] has been used to overcome this downside. Taktuk is a broadcasting tool which is highly scalable. NFS server is used to store VM images.

ii. *Comparing Qcow2 Over PVFS*

PVFS [6] is used to compare our work. This tool is meant for metadata management with high performance. For comparison it was deployed in compute nodes. In order to initialize VM instances qcow2[9] images are created in the compute node in the local system while PVFS is used as backup image. The performance is measured on average time take to boot each instance and total network traffic.

Figure 6, 7, 8 and 9 shows the results of comparison of other works and our approach.

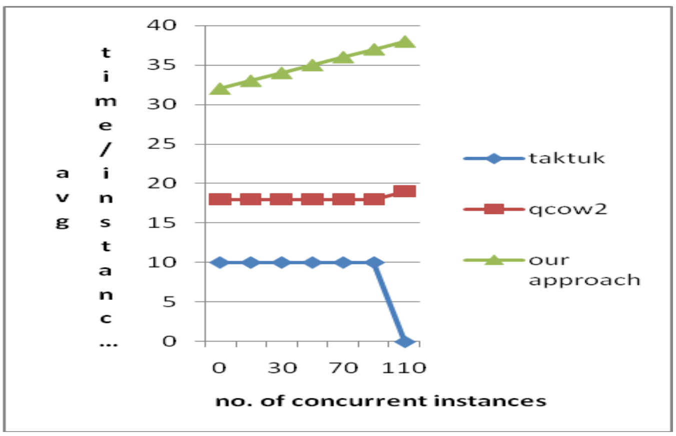

Fig. 6: Performance in terms of no. of concurrent instances

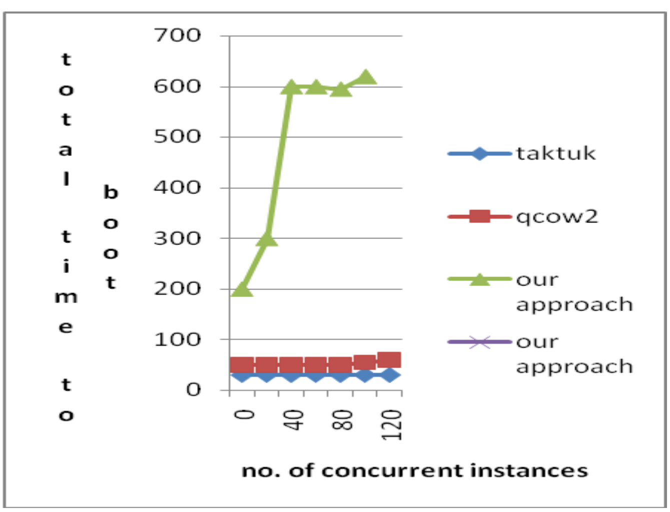

Fig. 7: Performance in terms of no. of concurrent instances

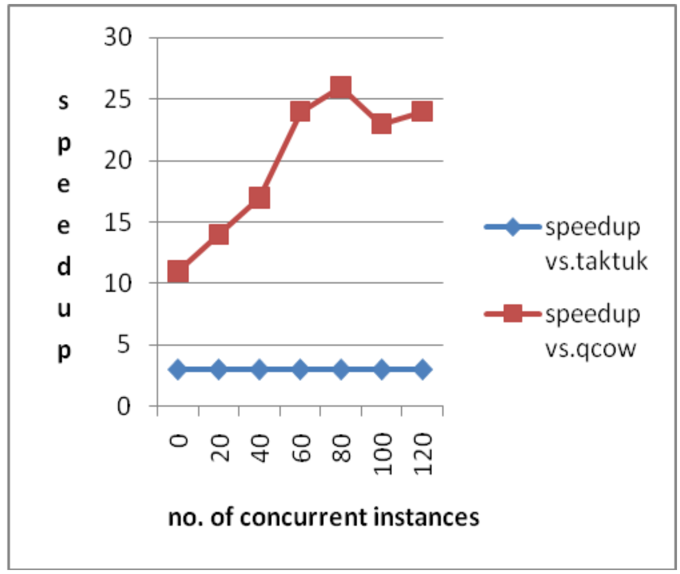

Fig. 8: Performance in terms of no. of concurrent instances

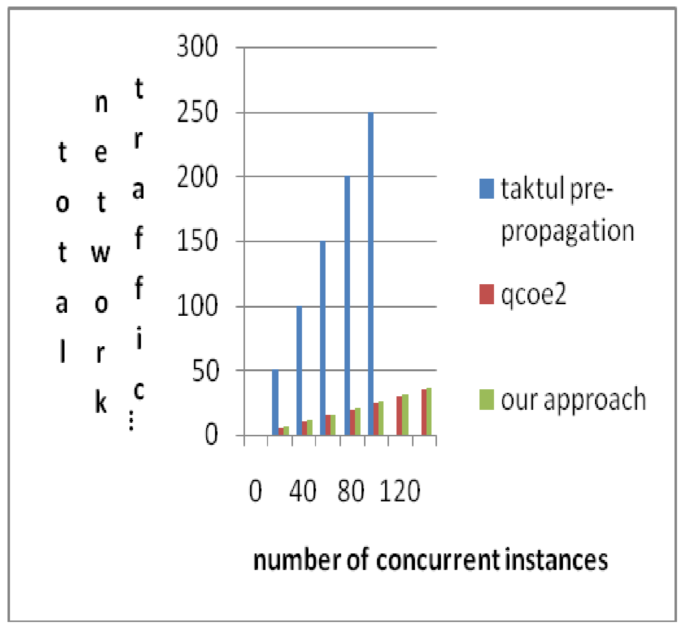

Fig. 9: Shows performance in terms of no. of concurrent instances

iii. *Multi-Snapshotting Performance*

The performance of our approach in case of multisnapshotting is described in this section. The comparison is made between qcow2 over PVFS and our approach. Fig. 10 and 11 show the performance of multi-snapshotting of our approach and qcow2 over PVFS. When overall performance is considered, our approach is taking relatively less time for instance creation and completion.

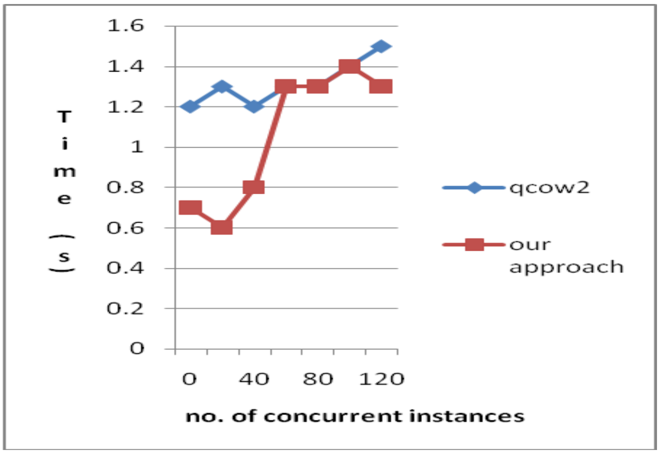

Fig. 10: Shows average time snapshot an instance

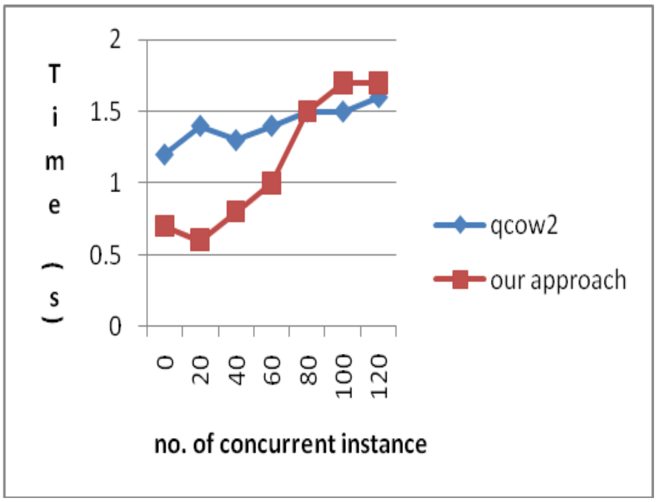

Fig. 11: Shows completion time to snapshot all instances

Figure 12 (a), (b) and (c) show the performance of access pattern, operation type and setting of local and our approach. The access patterns compared are Read, Write and Overwrite in block of 8 KB. The operation types considered are random seeks, file creation, and file deletion. The Fig. 12 (c) shows the time taken to finish simulation using 100 VM instances.

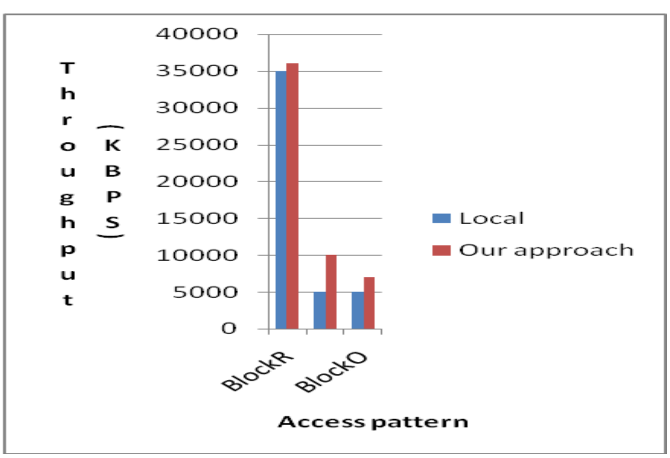

Fig. 12: (a) Access pattern in terms of throughput

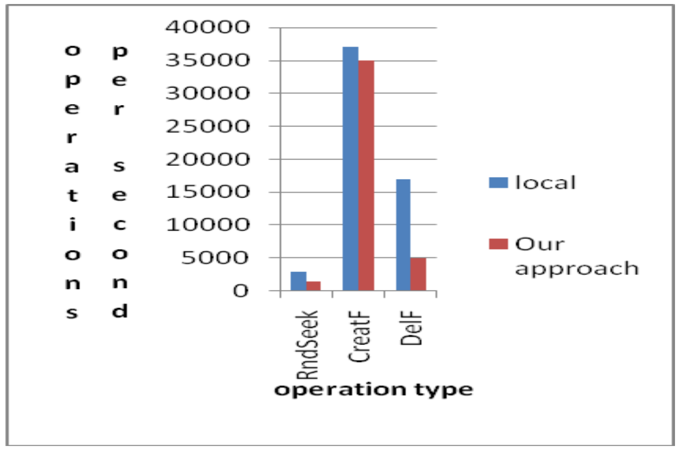

Fig. 12: (b) Shows operation type and operations per second

Our approach is showing better results and it is intended to help cloud platforms such as EC2, Nimbus etc. We believe that our work can be used in any existing cloud platform in order to improve its performance in terms of managing virtual machines and improving performance by using our techniques pertaining to multi-snapshotting and multi-deployment. Figure12 (c) shows time taken to finish simulation using 100 VM instances

VIII. Conclusion and Future Work

Since cloud computing is becoming more popular and efficient management of VM images, like image propagation for computing nodes and image snapshotting for the purpose of check- pointing or migration is difficult. The performance of these kind of operations affects in a direct manner the usability of the benefits provided by systems of cloud computing. This paper presented various techniques which integrate with middleware of the cloud for handling two patterns efficiently. They are multideployment and multi-snapshotting.

A lazy VM deployment scheme which fetches content of the VM image as required by the application that is executed inthe VM, thereby minimizing the pressure on the storage service of VM for deployment requests that are heavily concurrent. Moreover, we leverage object versioning for saving local VM image differences alone back to persistent storage when a snap-shot is generated, yet offer the illusion that the snapshot is a different, completely independent image. This has two crucial benefits. First, it does the management of updates of the hypervisor in an independent manner, thus greatly enhancing the portability of VM images and providing compensation for the deficiency of standardization of the VM image format. Second, it manages snapshotting in a transparent manner at the level of the repository of the VM image, simplifying to a great extent the snapshots management. We have given the demonstration of the advantages of our approach via experiments on number of nodes by making use of benchmarks as well as applications of real-life. When compared with simpler approaches depending on pre-propagation, our approach gives a best improvement in execution time as well as resource usage: the total time for performing a multi-deployment got reduced approximately to a factor of 25, and the storage and bandwidth usage got reduced by approximately 90%. When compared with approaches which make use of copy-on-write images (i.e., qcow2) depending on raw backing images that are stored in a distributed file system (i.e., PVFS), a speedup of multideployment by a factor of 2 and multi-snapshotting performance that is comparable are shown, each with the extra benefits of transparency as well as portability.

Depending on these results that are supported, we plan for exploring the multi-deployment as well as multi-snapshotting patterns in a more extensive manner. According to multideployment, one optimization that is possible is to build a scheme that is perfecting depending on last experience through the access pattern. According to multi-snapshotting, reductions that are interesting in time as well as storage space can be achieved by presenting deduplication schemes. We also intend for fully integrating the present work with Nimbus [2] and thereby explore its advantages for more critical applications of HPC in the real world.

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Analysis and Strategy for the Performance Testing in Cloud Computing

By Eljona Proko & Ilia Ninka
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Abstract - The aim of this study is the analysis and presentation of some ideas on performance testing in Cloud Computing. Performance is an important factor in testing a web application. Performance testing in cloud computing is different from that of traditional applications. Our research methodology in this article includes an overview of existing works on testing performance in Cloud Computing, focusing on discussion that the traditional benchmarks are not sufficient to analyze performance testing in Cloud Computing. In this study we are focused mainly on analysis performance metrics in Cloud Computing, based on their characteristics such as elasticity, scalability, pay-per-use and fault tolerance, and then we discuss why needed new strategies for performance testing in Cloud Computing and creation of new benchmarks. From this study we conclude that the performance testing and evaluation should be performed using new models testing, which are created according to Cloud Computing characteristics and metrics.

Keywords : Cloud computing, characteristics, performance, testing, benchmarks, strategy.

GJCST-B Classification: C.2.1

ANALYSIS AND STRATEGY FOR THE PERFORMANCE TESTING IN CLOUD COMPUTING

Strictly as per the compliance and regulations of:

Analysis and Strategy for the Performance Testing in Cloud Computing

Eljona Proko [α] & Ilia Ninka [σ]

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Keywords : Cloud computing, characteristics, performance, testing, benchmarks, strategy.

I. Introduction

Modern computer system is becoming more complex and this depends on the network technologies on the internet. Performance testing [1] intended to measure system throughput and latency with varying number of concurrent users, over extended periods of times, and with different load profiles. Performance testing in cloud computing is different from that of traditional applications. The traditional performance testing focused on the performance metrics for applications that are under a particular workload for a fixed configuration. Cloud test need to measure the performance metrics related to the workloads that run in a distributed fashion on multiple virtual and real machines. The growth of cloud computing created a demand for new strategy that can measure the performance characteristics of cloud applications.

This paper begins by describing Cloud Computing definition. Section III describes cloud computing characteristics. Section IV discusses traditional benchmarks problems regarding performance testing in Cloud Computing. Section V discusses ideas for new strategies and creation of new models in testing cloud computing. In Section V we conclude this study.

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II. Cloud Computing

Cloud Computing is a model that offers the vision of a virtually infinite pool of computing, storage and networking resources where applications can be scalable deployed [2]. Fig.1 illustrates cloud computing scheme. This cloud model promotes availability and is composed of five essential characteristics, four deployment models, and three service models [3].

a) Essential Characteristics

i. *On-demand self-service based usage model*

A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.

ii. *Multi Tenancy with resource pooling*

The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

iii. *Broad network access for distributed resources*

Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

iv. *Elasticity to provision capabilities quickly*

Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

v. *Measured Service*

Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts).

Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

b) Deployment Models

i. *Private cloud*

The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

ii. *Public cloud*

The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

iii. *Community cloud*

The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.

iv. *Hybrid cloud*

The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds)

c) Service Models

i. *Cloud Software as a Service (SaaS)*

The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

ii. *Cloud Platform as a Service (PaaS)*

The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

iii. *Cloud Infrastructure as a Service (IaaS)*

The capability provided to the consumer is to provide processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating system; storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

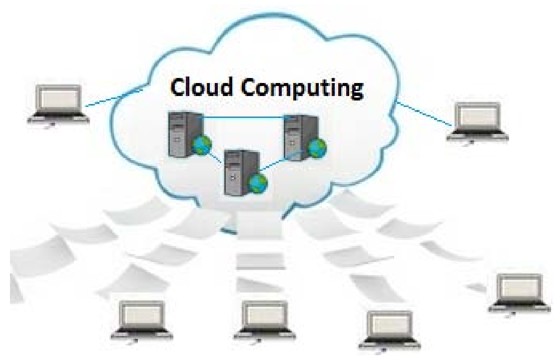

Fig. 1: Cloud Computing

III. Cloud Computing Characteristics

A metric is used to measure and understand the behavior of software. Cloud metrics can be used to measure the behavior of cloud which utilizes the resources from the computers as a collective virtual computer, where the applications can run independently from particular computer or server configurations [10]. Cloud delivers its services through internet and provides the full user functionality of a software application by the web sites which provide Software as a Service. Dynamic web sites provide regularly changing information to users and utilize dynamically generated pages and maintain data for display in a database [9]. Cloud uses the dynamic web sites to deliver the web applications on demand. Cloud metrics should follow some characteristics which help to evaluate cloud on each and every parameter which is necessary for a good quality cloud, so that a client can rely on it to choose the best cloud.

The main advantages of cloud computing are scalability, pay-per-use and fault-tolerance [4].

a) Elasticity [8] is one of the major factors for the success of the cloud as an IT infrastructure. For a DBMS deployed on a pay-per-use cloud infrastructure, an added goal is to optimize the system's operating cost. Elasticity, i.e. the ability to deal with load variations by adding more resources during high load or consolidating the tenants to fewer nodes when the load decreases, all in a live system without service disruption, is therefore critical for these systems. Even though elasticity is often associated with the scale of the system, a subtle difference exists between elasticity and scalability when used to express a system's behavior.

b) Scalability is a desirable property of a system, which indicates its ability to either handle growing amounts of work in a graceful manner or its ability to improve throughput when additional resources (typically hardware) are added. A system, whose performance improves after adding hardware, proportionally to the capacity added, is said to be a scalable system.

c) Reliability is the probability that a product or part will operate properly for a specified period of time (design life) under the design operating conditions (such as temperature, volt, etc.) without failure [6]. The outcome of the measurement process is reproducible that is similar to results over time for some different inputs and across many different situations. Cloud gets many requests simultaneously and will also give the similar results for some requests in a period of time so clouds have to be reliable.

d) Availability Cloud Services should be available maximum time [7]. The on demand, elastic, scalable, and customizable nature of the cloud must be considered when deploying cloud architectures. Many different clients might be accessing the same back-end applications, and many provider are providing the cloud services has the expectation that only their application will be properly delivered to users. In cloud computing it is essentially required to gather the information instantly without making a user to wait and the gathered information should be related to each other.

e) Cost Cloud Computing allows an organization to pay by the hour of computing resources, potentially leading to cost savings even if the hourly rate to rent a machine from a cloud provider is higher than the rate to own one. This is essentially preferable when demand for a service that varies over time.

f) Fault Tolerance is one of the key issues of cloud computing. There are many fault tolerance techniques in parallel computing [11]. Fault tolerance is concerned with all the techniques necessary to enable a system to tolerate software faults. These software faults may or may not Manifest themselves during systems operations, but when they do, software fault tolerant techniques should provide the necessary mechanisms of the software system to prevent system failure occurrences.

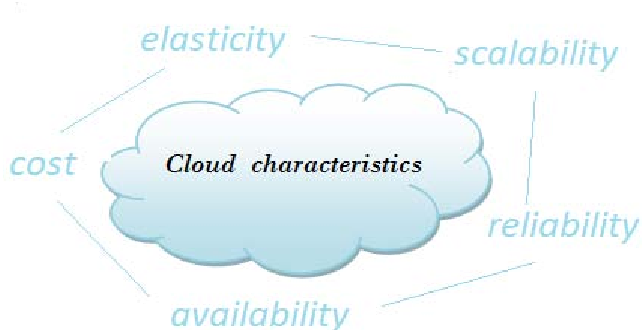

Fig. 2: Some of the cloud computing characteristics

IV. Traditional Benchmarks Are Not Sufficient to Analyze Performance Testing in Cloud Computing

The goal of benchmarking a software system is to evaluate its average performance under a particular workload. TPC-W [14] has been designed for transactional database systems. Cloud systems usually do not offers strong consistency constraints because most web-based applications only require lower levels of consistency. As a consequence existing TPC-W implementations for the cloud are not conforming to the specification. The primary metric used by the TPC-W [13] is WIPS that the system under test can handle. By scaling the number of emulated browsers, the number of requests and the load on the system can be increased. WIPS is useful in the context of a static system it is not for adaptable and scalable systems. The second metric of the TPC-W is $/WIPS, is based on the total cost of ownership of the system under test including software, hardware, maintenance and administration expenses. These overall costs are then divided by the maximum number of WIPS to calculate the $/WIPS. In the context of cloud computing does not exists maximum number of WIPS. Thus, there exists no fixed load for which the overall cost can be calculated. TPC-W became outdated in front the evolution of web applications and does not reflect modern access-paths. TPC-W benchmark has not the adequate metrics for measuring the characteristics of cloud systems, such as pay-per use scalability and fault tolerance.

V. Idea for Testing Performance in Cloud Computing

Performance is generally tied to an application's capabilities within the cloud infrastructure itself. Testing is a periodic activity and requires new environments to be set up for each project [12]. Web applications must be tested for multiple operating systems and updates, multiple browser platforms and versions, different types of hardware and a large number of concurrent users to understand their performance in real-time [5]. Cloud Computing is growing at a rapid pace. With the advent of this technology, there is bound to be an increase in demand for Cloud Testing. New cloud test should be based on an e-commerce scenario (i.e., a web-shop) and define web interactions as test drivers. Thus, the test should allow the evaluation of the complete application stack. A new cloud test should analyze the ability of a dynamic system to adapt to a changing load

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(including peaks) in terms of scalability and costs. Moreover, another goal is to test to the assumption of infinite scalability of an application in the cloud. Cloud providers often replicate data over different data centers for availability but also performance reasons. In order to get a fair comparison of the test results, the emulated browsers should run in different locations (worldwide). By doing this, we can achieve that the test results are not biased due to the location where the test driver is running. A solution to this problem is to run the test drivers on a cloud infrastructure of a provider which supports location based installations. A new test should comprise web interactions that resemble the access patterns of Web 2.0 like applications. One example is to add web interactions that allow users to write and read reviews of individual products or to add web interactions that allow user communities to exchange the latest news about certain products. Web 2.0 applications often include multimedia content (audio files, video files, pictures) which can be accessed by users. This content produces heavy load on the servers which host that content. Cloud makes it cost-effective for creating separate test regions for system testing. The test strategy should answer what is intended to be achieved by moving testing to the cloud, including cost savings, easy access to infrastructure, reduction in cycle times, etc. The strategy should define the type of tests to be performed in the cloud, the risks associated and the duration of the tests. We need to define the infrastructure requirements necessary for building a test environment by selecting the required testing tools and applications, hardware and software, bandwidth, etc. The next step is selection of a service provider for security, quality, reliability and any discrepancies in the terms and conditions. Executing the test is the critical phase where applications are tested according to the defined test strategy. Monitor and analyze test results is the last step. It is advised that test results be monitored in real-time to understand and react to capacity- or performance-related issues. Also, analyze cloud usage against chargeback costs to understand the financial performance of cloud services.

VI. Conclusion

The growth of cloud computing created a demand for benchmarks that can measure the performance characteristics of cloud applications.

The traditional performance benchmarking focused on the performance metrics for applications that run on single node systems. Cloud benchmarks need to measure the performance metrics related to the workloads that run in a distributed fashion on multiple virtual and real machines. Metrics are the necessary and important elements for evaluation the quality enabling the identification of a good Cloud Computing. The performance metrics for the distributed workloads need to be defined based on the cloud application characteristics.

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Cloud Computing Issues and Benefits Modern Education

By D.Kasi Viswanath, S.Kusuma & Saroj Kumar Gupta
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Abstract - Cloud computing, a rapidly developing information technology has brought new change & opportunities to IT industry and in the field of education. E-learning platform brings a brand new concept & is a kind of network information learning mode & also known as online learning to guide education. E-learning emphasizes on the technology to transform & guide education. E-learning system will use the cloud computing that introduces efficient scale mechanism. In this paper we proposed cloud computing to e-learning from the following aspects: its work mode, services, business model, benefits & issues. Our results suggest that the introduction of cloud computing to e-learning is feasible & to bring greater clarity landscape about cloud computing benefits.

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GJCST-B Classification: *C.2.1*

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I. Introduction

Since 2007, cloud computing has become hot issue, many companies began to attempt to use cloud computing services. With the convenience, economy, high scalability and other advantages, cloud computing enables the enterprise liberation from the heavy pressure of the IT infrastructure management and maintenance. Cloud computing change the Internet into a new computing platform, is a business model that achieve purchase on-demand and pay-per-use in network, has a broad development prospects [1].E-learning is an Internet-based learning process, using Internet technology to design, implement, select, manage, support and extend learning, which will not replace traditional education methods, but will greatly improve the efficiency of education. As e-learning has a lot of advantages like flexibility, diversity, measurement, opening and so on, it will become a primary way for learning in the new century[2]. In traditional web-based e-learning mode, system construction and maintenance are located in interior of educational institutions or enterprises, there left a lot of problems such as significant investment needed but without capital gains for them, which leads lack of development potential. In contrast, cloud-based e-learning model introduces scale efficiency mechanism, i.e. construction of e-learning system is entrusted to cloud computing suppliers, which can make providers and users to achieve a win-win situation: on the one hand, the supply companies can use their own technological advantages to build an e-learning system with more stable performance, more comprehensive functions, and more secure features. Meanwhile, suppliers can take charge in some way so as to earn a reasonable profit to return funds. On the other hand, users can be free from the building and maintenance for e-learning system and specifically focus on the application of e-learning system in order to improve teaching quality and management level. In this model, the construction of cloud computing systems is separated from their usage, and through economic leverage there are sufficient back-up and maintenance funds to build and feed an e-learning system, which can make e-learning system development into a virtuous circle. Thus, emergence of cloud computing opens a new idea to further development for e-learning.[3] But the development of cloud computing is facing many critical issues, the most prominent is the security issue, with the growing popularity of cloud computing, the importance of security show gradual upward trend, become an important factor in the development of cloud computing. The purpose of this paper is attempted to bring greater clarity landscape about cloud computing security.

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II. Cloud Computing

a) Definitions

Cloud computing is such a type of computing where you don't have to spend any money to build and maintain your IT infrastructure. When you need to use computing resources like application software, you just borrow that facility from a third party organization, and access that service via Internet. In return you pay the service provider as you use the computing power. In short, in cloud environment, you don't need to buy any hardware and software to run your business applications thus it helps you minimize your investment on hardware resources and IT maintenance team. [4]

b) Types of Cloud Computing Service

Currently, cloud computing customers can expect to get three types of services from cloud service providers and those three are:

1. Cloud infrastructure as a service- All the required hardware to run a business is provided

by cloud service providers and the customers manage their own application software.[4]

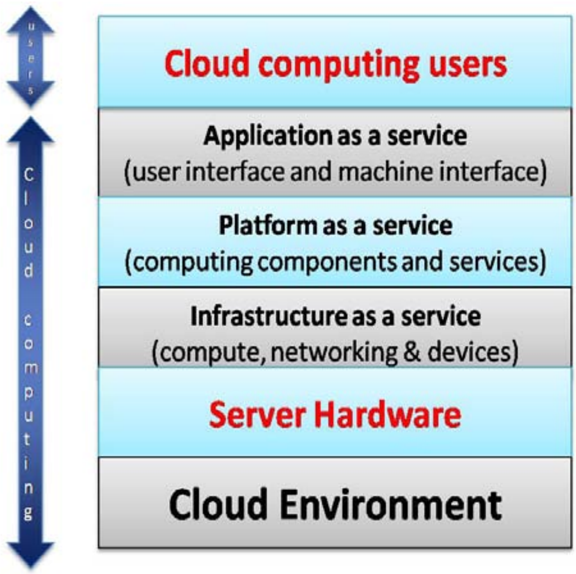

Figure 1: Cloud Computing

2. Could platform as a service-In this type of cloud computing, a customer pays to the service provider to use their platform as their IT solution. For example, if you need email system or database software for your business, you can use a third party's computing service that prove email and database solutions.
3. Application software as a service- If you only need to use a specific kind of software to get a output or to perform an analysis, then it is much cheaper to use that software service from a cloud service provider rather than buying, installing and maintaining it.

c) Cloud Service Providers

Unlike web hosting solutions, there is only a limited number of clouding computing service providers. But the good news is that all the major hardware and software brands of the world including Google and Microsoft are already providing cloud solutions. The other major cloud service providers are HP, DELL, Amazon and IBM.[4]

III. Knowledge on E-Learning

Web based training (WBT). These terms express the way of E-Learning teaches them with the advancement of computer technologies day by day, work becomes simplified with the help of preprogrammed software applications. E-Learning is one of the most famous technologies discovered to make the traditional way of education learning easier with the help of software applications and virtual learning environment. The word ―E‖ means the electronic way of learning in the E-Learning. There are various names that are used to express the term E-Learning in a technology world such as Computer based training (CBT), Internet based training (IBT), and lesson to the e-learner. E-learning comes through a network enabled computer and transfers the knowledge from the internet sources to end users machine. Usually the E-Learning works with the help of software applications and usually the information is transferred with the help of internet, audio/video files, satellite TV, media disks. These materials are having the contents like text, image, animation, audio/video to deliver the learning materials to E-Learning users. Many universities and institutions are implementing the e-learning for their distance education programmers and also used it to enhance the ability of other educational degree programmers. Cloud computing, mobile learning, communication technology, etc. are of help to bring the E-Learning to next level of IT world. (Welsh et al., 2003). [5]

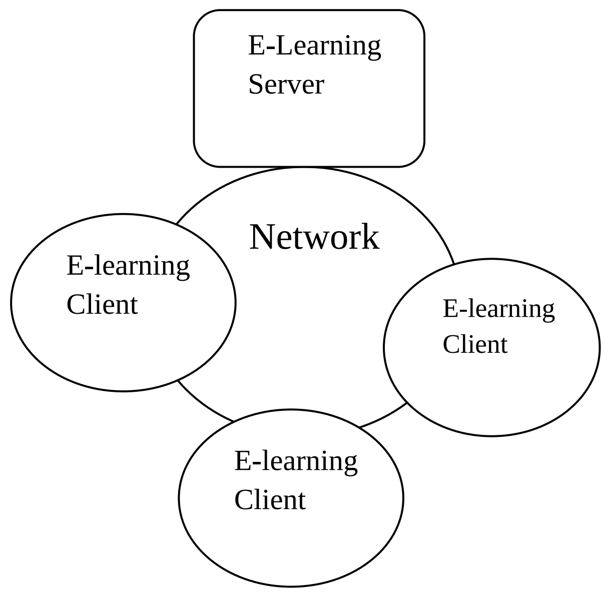

Figure 2: E-Learning systems (Pocatilu et al., 2009)

a) E-Learning Cloud Computing Model

Clearly, the traditional e-learning network is built and maintained by schools or enterprises, and their applications are also developed by themselves. Therefore, the costs of equipment investment, development and maintenance are afforded by schools or enterprises themselves, which would take a lot of expenditure. If moving e-learning system going out of schools or enterprises, entrusting its construction, maintenance, development and management to vendors, opening it up to multiple users through the Internet and letting them use on-demand and payment is based on the amount of used servers, it can not only reduce charges for schools or enterprises, but for suppliers it can also achieve economies of scale. This business model of e-learning system is called e-learning cloud model on cloud computing. [3]

b) E-learning Cloud Computing Business Model

E-learning cloud computing business model is shown in Figure 3.

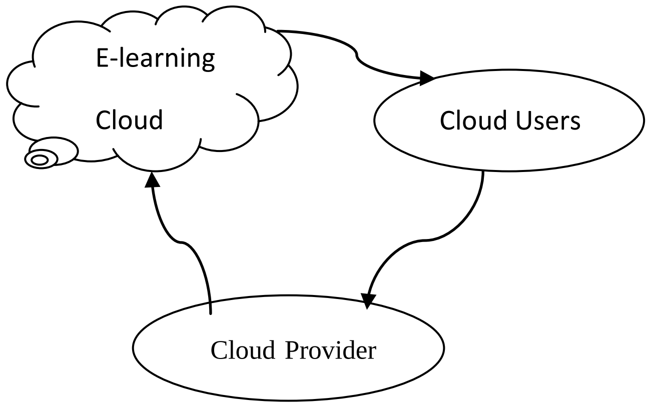

Figure 3: Business model of e-learning cloud computing

In e-learning cloud computing business model, cloud provider is responsible for building and maintaining elearning cloud, providing technical support to e-learning cloud. Cloud users paid to cloud provider for services from e-learning cloud, services accessed on-demand. In Figure 2, during the cycle, servers support users, funds support provider, technologies support e-learning cloud, what is a business cycle is a virtuous cycle. [3]

IV. Cloud Based E-Learning

Cloud based e-learning is the sub division of cloud computing on educational field for e-learning systems. It is the future for e-learning technology and its infrastructure. Cloud based e-learning has all the provisions like hardware and software resources to enhance the traditional e-learning infrastructure. Once the educational materials for e-learning systems are virtualized in cloud servers these materials are available for use to students and other educational businesses in the form of rent base from cloud vendors. Cloud based e-learning architecture is explained in the following figure:

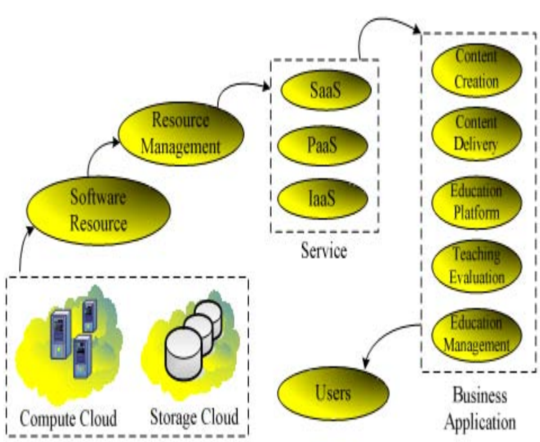

Figure 4: Architecture of e-learning cloud

Cloud based e-learning architecture is mainly divided into five layers called hardware resource layer, software resource layer, resource management layer, server layer and business application layer. [5]

1) Hardware resource layer

This is bottom most layer in the cloud service middleware where it handles the essential computing things like physical memory and CPU for the total system. This layer is most important for the total infrastructure of the system. With the help of virtualization, physical servers, network and storage are grouped and called it as upper software platform. To offer the uninterruptable power to the cloud middleware services for the cloud based e-learning systems, physical host pool is expanded dynamically and memory is scalable at any time to add additional memory.

2) Software resource layer

This layer is created with the help of operating systems and middleware. With the help of middleware technology, many software solutions combine to offer the grouped interface for the software developers. So, software developers can create many applications for e-learning system and able to embed those in cloud, which helps the cloud users to compute those applications through cloud.

3) Resource management layer

This layer plays an important role on get loose coupling of software and hardware resources. With the help of virtualization and scheduling idea of cloud computing, it brings the uninterrupted on-demand software distribution for different hardware resources.

4) Service layer

Service layer is divided into three levels namely IAAS, PAAS, and SAAS. These service layers help to cloud customers to use the various forms of cloud resources for their products like software resource, hardware resource, and infrastructure resource.

5) Business application layer

Business application layer differs from all other layers in cloud based e-learning architecture, because this layer acts as important business logic of e-learning, and frames the expansion of group of components for e-learning. Business application layer mainly consists of content creation, content delivery, education platform, teaching evaluation and education management.

a) Key Benefits of Cloud Based E-Learning

There are numerous advantages when the e-learning is implemented with the cloud computing technology, they are:

1) Lower costs

E-Learning users need not have high end configured computers to run the e-learning applications. They can run the applications from cloud through their PC, mobile phones, tablet PC having minimum configuration with internet connectivity. Since the data is created and accessed in the cloud, the user need not spend more money for large memory for data storage in local machines. Organizations also need to pay per use, so it's cheaper and need to pay only for the space they need. (Al-Jumeily et al., 2010)

2) Improved performance

Since the cloud based e-learning applications have most of the applications and processes in cloud, client machines do not create problems on performance when they are working.(Rao et al., 2010)

3) Instant software updates

Since the cloud based application for e-learning runs with the cloud power, the software's are automatically updated in cloud source. So always e-learners get updates instantly. (ibid)

4) Improved document format compatibility

Since some file formats and fonts do not open properly in some PCs/mobile phones, the cloud powered e-learning applications do not have to worry about those kinds of problems. As the cloud based e-learning applications open the file from cloud. (ibid)

5) Benefits for students

Students get more advantages through cloud based e-learning. They can take online courses, attend the online exams, get feedback about the courses from instructors, and send their projects and assignments through online to their teachers. (Pocatilu et al., 2009)

6) Benefits for teachers

Teachers also get numerous benefits over cloud based e-learning. Teachers are able to prepare online tests for students, deal and create better content resources for students through content management, assess the tests, homework, projects taken by students, send the feedback and communicate with students through online forums. (ibid).

V. Cloud Computing Issues

In the last few years, cloud computing has grown from being a promising business concept to one of the fastest growing segments of the IT industry. Now, recession-hit companies are increasingly realizing that simply by tapping into the cloud they can gain fast access to best-of-breed business applications or drastically boost their infrastructure Resources, all at negligible cost. But as more and more information on individuals and companies is placed in the cloud, concerns are beginning to grow about just how safe an environment it is [6].

a) Security

Where is your data more secure, on your local hard driver or on high security servers in the cloud? Some argue that customer data is more secure when managed internally, while others argue that cloud providers have a strong incentive to maintain trust and as such employ a higher level of security. However, in the cloud, your data will be distributed over these individual computers regardless of where your base repository of data is ultimately stored. Industrious hackers can invade virtually any server, and there are the statistics that show that one-third of breaches result from stolen or lost laptops and other devices and from employees' accidentally exposing data on the Internet, with nearly 16 percent due to insider theft [8].

b) Privacy

Different from the traditional computing model, cloud computing utilizes the virtual computing technology, users 'personal data may be scattered in various virtual data center rather than stay in the same physical location, even across the national borders, at this time, data privacy protection will face the controversy of different legal systems. On the other hand, users may leak hidden information when they accessing cloud computing services. Attackers can analyze the critical task depend on the computing task submitted by the users [9].

c) Reliability

Servers in the cloud have the same problems as your own resident servers. The cloud servers also experience downtimes and slowdowns, what the difference is that users have a higher dependent on cloud service provider (CSP) in the model of cloud computing. There is a big difference in the CSP's service model, once you select a particular CSP, you may be locked-in, thus bring a potential business secure risk.

d) Legal Issues

Regardless of efforts to bring into line the lawful situation, as of 2009, supplier such as Amazon Web Services provide to major markets by developing restricted road and rail network and letting users to choose "availability zones" [10]. On the other hand, worries stick with safety measures and confidentiality from individual all the way through legislative levels.

e) Open Standard

Open standards are critical to the growth of cloud computing. Most cloud providers expose APIs which are typically well-documented but also unique to their implementation and thus not interoperable. Some vendors have adopted others' APIs [11] and there are a number of open standards under development, including the OGF's Open Cloud Computing Interface. The Open Cloud Consortium (OCC) is working to develop consensus on early cloud computing standards and practices.

f) Compliance

Numerous regulations pertain to the storage and u se of data require regular reporting and audit trails, cloud providers must enable their customers to comply appropriately with these regulations. Managing Compliance and Security for Cloud Computing, provides insight on how a top-down view of all IT resources within a cloud-based location can deliver a stronger management and enforcement of compliance policies. In addition to the requirements to which customers are subject, the data centers maintained by cloud providers may also be subject to compliance requirements.

g) Freedom

Cloud computing does not allow users to physically possess the storage of the data, leaving the data storage and control in the hands of cloud providers. Customers will contend that this is pretty fundamental and affords them the ability to retain their own copies of data in a form that retains their freedom of choice and protects them against certain issues out of their control whilst realizing the tremendous benefits cloud computing can bring.

h) Long-term Viability

You should be sure that the data you put into the cloud will never become invalid even your cloud computing provider go broke or get acquired and swallowed up by a larger company. "Ask potential providers how you would get your data back and if it would be in a format that you could import into a replacement application," Gartner says.

i) Solution

To advance cloud computing, the community must take proactive measures to ensure security. The Berkeley paper's solution is the data encryption. Before storing it at virtual location, encrypt the data with your own keys and make sure that a vendor is ready for security certifications and external audits. Identity management, access control, reporting of security incidents, personnel and physical layer management should be evaluated before you select a CSP. And you should minimize personal information sent to and stored in the cloud. CSP should maximize the user control and provide feedback. Organizations need to run applications and data transfer in their own private cloud and then transmute it into public cloud. While there are many legal issues exist in the cloud computing, Cloud Security Alliance should design relevant standards as quickly as possible.

VI. Conclusion

Cloud computing is a recently developed advanced Internet-based computing model. By combination of cloud computing and e-learning, building cloud-based e-learning system opens up new ideas for the further development of e-learning.in this paper we discuss a cloud computing based elearning. Describe its definition, benefits & some issues. There is no doubt that the introduction of cloud computing into elearning is feasible & brings us the approximately infinite computing capability, good scalability, benefits & so on.

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Scalability of Distributed Engineering Computation over Cloud of Virtual Machines

By Han Gyoo Kim
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GJCST-B Classification: C4

SCALABILITY OF DISTRIBUTED ENGINEERING COMPUTATION OVER CLOUD OF VIRTUAL MACHINES

Strictly as per the compliance and regulations of:

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I. Introduction

With the advent of cloud computing [6], parallel processing, the method of having many small tasks solve one large problem, has been receiving attention with ever increasing demand for higher performance, lower cost and sustained productivity. In general, solving a large distributed engineering problem has been facilitated by two major techniques: massively parallel processors and network distributed computing.

Massively parallel processors [7] provide the most powerful environment under which high computational power can be attained, combining a few hundred to a few thousand CPUs connected to hundreds of gigabytes of memory. However, MPPs suffer from two drawbacks: economy and availability.

On the other hand, distributed computing over networked cloud computing environment [3, 10] is gaining its edge over MPPs because of its widespread availability of today's cloud computing with its economic advantage. Distributed computing provides well defined APIs easily applicable to various programs as well as effective compilers over a network of workstations, resulting in cost effective solutions.

Despite its widespread acceptance as one the best candidates for distributed computing paradigms, distributed virtual machines over cloud computing environment are yet to be verified whether they can offer scalable solutions to solving the distributed engineering problems in efficient and economical ways. While it is believed that employing more virtual machines from the cloud would help to expedite the execution of distributed problems, it is not clear whether we can obtain overall performance increase proportional to the number of virtual machines employed in the cloud [2].

The objective of this study is not in any specific engineering problem itself but to perform a parametric numerical experiment on parallel virtual machines by solving typical engineering differential equations of which solution can be obtained by way of PVM over a cloud computing network.

PVM (Parallel Virtual Machine) [1,8] is one of the most promising distributed computing systems available and may be applied to a network of heterogeneous workstations such as network of cloud computing. PVM provides easy to program APIs through which complex and CPU intensive scientific problems, such as global climate modeling and new drug design, can be solved without relying on expensive MPPs by decomposing them into a set of simple tasks manageable on a network of virtual machines of a cloud system.

In this paper, the experience with PVM is presented in pursuit of finding a pseudo-optimal decomposition of PVM tasks of which set are assigned to individual virtual machines in a cloud system. It will only be a *pseudo*-optimal since various types of overhead are affected by nondeterministic factors such as actual data transfer rate and the network load at time of execution. We will investigate how total execution time of a finite difference program processed in parallel varies as number of homogeneous virtual machines on a network of a cloud system is varied along with the effects of discretization size in both space and time.

II. Experiment

Distributed computing using PVM may be approached from three fundamentally different viewpoints based on the organization of computing tasks [4].

The first and the most common model for PVM applications can be termed *crowd* computing, where a collection of loosely related processes performs computations on different portions of the workload usually involving periodic exchanges of intermediate results. The second model supported by PVM is termed a *tree* computation. In this scenario, processes are dynamically spawned in a tree-like manner. This paradigm is a natural fit to applications where the total

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workload is not known a priori, for example as in recursive divide-and-conquer algorithms. The third model termed *hybrid* is a combination of the tree and the crowd model.

As mentioned above, PVM provides various methods of task decomposition that fit into modeling of diverse scientific problems. The choice of model will be application dependent and should be selected to best match the natural structure of the distributed program while taking into account the communication overhead.

For the purpose of studying the scalability of distributed virtual machine solutions, it is presented a PVM program that calculates heat diffusion in a thin wire by solving the finite difference version of a one dimensional heat equation. To accomplish the aim, as mentioned in the introduction, it suffices to choose to analyze a most simple problem preferably to which an analytic solution is also available.

Consider a thin wire of length L, density ρ, specific heat c and thermal conductivity k with the ends of the wire maintained at a fixed temperature of T_e and an initial temperature profile of;

$$T(z,\ \tau = 0) = T_e + T_0\ \sin(\pi \tfrac{z}{L}) \qquad (1)$$

With the conventional non- dimensionalization, where, $A = (T\text{-}T_e)/T_0$, and $t = \tau/L(\frac{\rho c}{k})$, and $x = z/L$, the temperature in the wire is described by the following heat equation;

$$\partial^2 A/\partial x^2 = \partial A/\partial t \qquad (2)$$

With the initial and boundary conditions of;

$$A(x,\ t = 0) = \sin(\pi x) \qquad (3a)$$

$$A(x = 0,\ t) = A(x = 1,\ t) = 0 \qquad (3b)$$

The exact solution of Eq. (2) subject to (3a) and (3b) can be found by the method of separation of variables [5] as;

$$A(x,\ t) = e^{-\pi^2 t}\ \sin(\pi x) \qquad (4)$$

Finite-difference solution to the above problem will be sought via parallel processing and in particular through distributed computing using the PVM program. We will adopt an explicit scheme with forward differencing in time and central differencing in space, and hence the solution can be obtained by marching in time from a given initial temperature distribution.

If we denote $A(x_i,t_j)$ as $A_{i,j}$, temperature at position x_i and at time t_{j+1} can be expressed as;

$$A_{i,j+1} = \beta(A_{i+1,j} + A_{i-1,j}) + (1\text{-}2\beta)A_{i,j} \qquad (5)$$

where $\beta = \Delta t/(\Delta x)^2$ and the stability criterion for the explicit scheme requires that $\beta \le 1/2$.

For our problem, where the solution over the whole space can be obtained through the same equation as provided by Eq. (5), natural choice of programming structure would be the master-slave method of the crowd programming paradigm where the slaves, spawned by the master program, perform the actual computations. We choose to divide the wire into 50 subsections and the solutions to each subsection will be obtained separately by each slave programs, although it will be required that the right most and the left most temperature information be exchanged with its right and left neighboring subsections. The workload of the slaves is allocated by the master through data decomposition whereby the initial temperature distribution of each subsection is sent to respective slaves.

Overall structure of the parallel processing adopted in this paper is as follows:

The master program spawns 50 copies of the same slave program, each of which handles a subsection of the wire. After receiving initial temperature distribution, each slave computes heat diffusion in the corresponding wire subsection. At each time step, each slave program needs to communicate boundary information with its left and right neighboring slaves. When a specified final time is reached, all 50 slave programs send its final temperature profile to the master, who then terminates the spawned slaves and ends the program.

In order to study the scalability aspects, same program was executed on 1 to 60 separate processes on the virtual machines available over the network of 1Gbps Ethernet. When more than one virtual machine is utilized, the master and the slave programs are allocated to each machine such that an even distribution of workload is achieved.

The finite difference PVM program was executed on six different configurations with four values of Δx ranging from 1/50 to 1/1000 and four Δt's for each Δx ranging from 2.0 x 10^{-4} to 6.25 x 10^{-8} until a preset final time is reached. These various processing configurations were set to investigate to find the pseudo-optimal number of virtual machines that preserve the scalability of the whole system.

The final time was chosen such that for each different Δx, the largest Δt results in 750 iterations and the smallest 6000. Hence for a given Δx, total number of iterations on Eq. 5 is inversely proportional to the size of Δt. The final temperature profile for all of the above parameter values resulted in essentially the analytic solution of Eq. (4). The total computing time elapsed in carrying out this numerical experiment on a network of virtual machines were recorded and are analyzed from the perspective of whether the cloud computing environment could effectively provide scalable solutions to such highly distributed problems.

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III. Results and Discussions

Results analyzed in this section were obtained by running a group of PVM processes on a set of virtual machines running on VMware [9]. Total computing time, including data communication overhead between machines, will definitely depend on the degree of network traffic at the time of execution. Results used in the analysis below are only one out of many trials executed under similar working environment.

a) Data Communication Overhead

To investigate the effect of data transfer over the network on the total computing time, time taken solely in data transfer between machines were investigated and the results are presented in Fig. 1.

This includes time taken for PVM setup plus network latency and data transmission over the network of virtual machines. It can be seen that the increase in the amount of data will not necessarily result in a larger communication overhead but will be strongly dependent on the number of machines on the network.

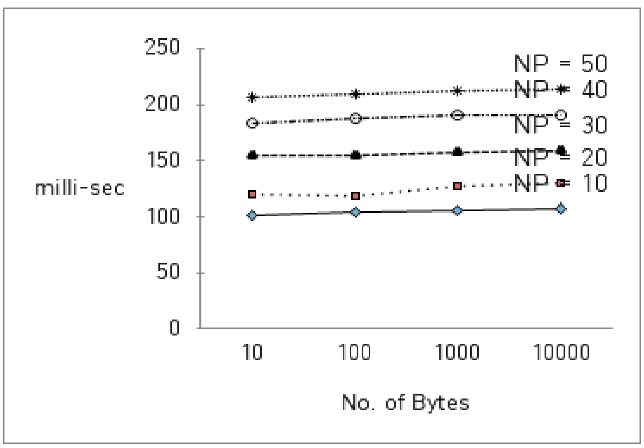


Fig. 1: Communication time for data transfer

However the results of Fig. 1 clearly show that data communication time is bounded. One can also deduce that the PVM setup time is about 100 ms for our experimental environment and the data transfer time exhibits some randomness reflecting the characteristics of some other uncontrollable glitches in the network over the execution of repeated computation.

The behavioral aspects of communication overhead are inferred to be strongly dependent on the characteristics of how much distributed the particular problem and how much data are to be transferred between the machines over the network.

However, what is important from the experimental observation is that the communication overhead does not diverge unbounded, but is rather bounded once the distributed solution is given.

This observation justifies that virtual machines in a cloud computing environment can definitely provide scalable computational means to a certain types of distributed problems such as complicated engineering differential equations.

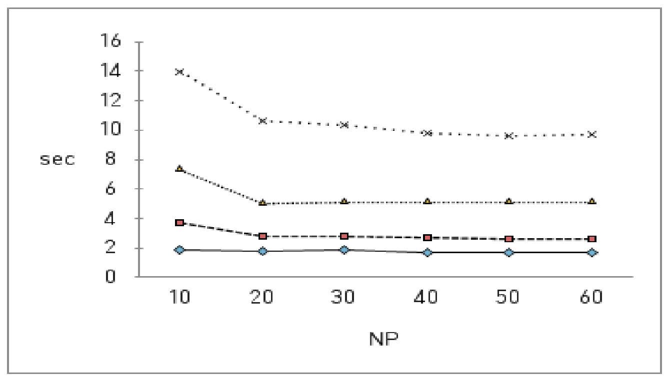
b) Total Computation Time

Fig.s 2 below describes the total computation time versus the number of machines utilized by the PVM program.

The most important result is that for all cases, it seems to exist a pseudo-optimal configuration. This pseudo-optimum becomes more pronounced as computation load increases (see Fig. 2d). This can be explained by the fact that total computation time is comprised of actual CPU time, which decreases as more virtual machines are utilized and workload is more evenly distributed, and communication overhead, which increases with NP as more data transfers are required between more machines. Hence total computation time is the least when gains obtained from work distribution minus the increase in communication overhead is the largest.

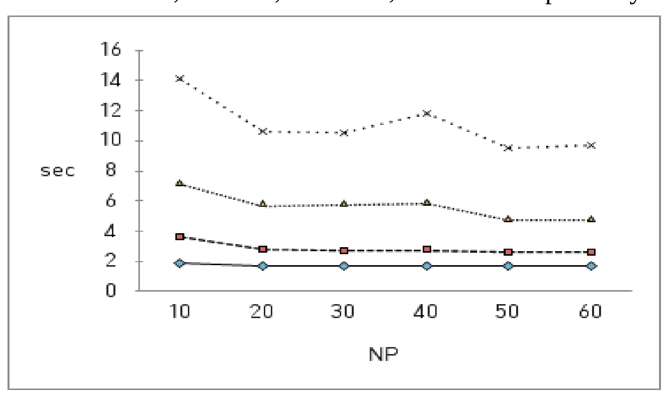
(a) $\Delta x = 0.02$

$\Delta t = 2.0 \times 10^{-4}, 1.0\times10^{-4}, 5.0\times10^{-5}, 2.5\times10^{-5}$ respectively



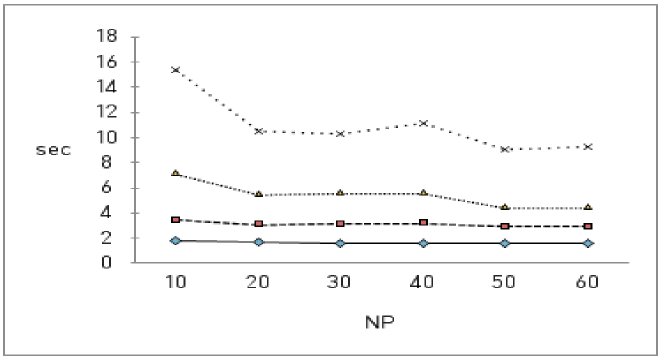
(b) $\Delta x = 0.01$

$\Delta t = 5.0 \times 10^{-5}, 2.5\times10^{-5}, 1.25\times10^{-5}, 6.25\times10^{-6}$ respectively



(c) $\Delta x = 0.005$

$\Delta t = 2.0 \times 10^{-6}$, 1.0×10^{-6}, $0..5 \times 10^{-7}$, 2.5×10^{-7} respectively



(d) $\Delta x = 0.001$

$\Delta t = 5.0 \times 10^{-7}$, 2.5×10^{-7}, $1..25 \times 10^{-7}$, 6.25×10^{-8} respectively

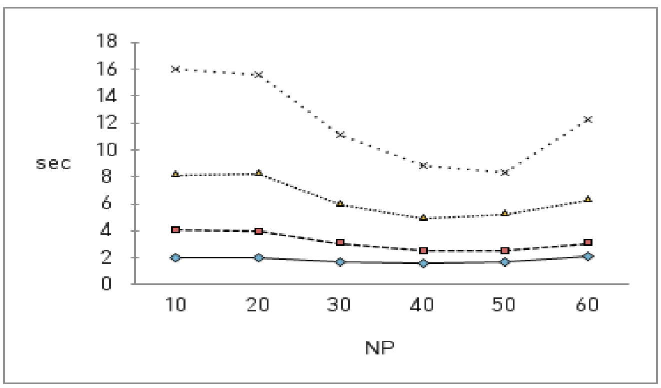


Fig. 2 : Total computing time, T, as a function of number of virtual machines, NP

For our problem it can be concluded that the optimum configuration is obtained when 45 to 55 machines are utilized. That is, about 50 virtual machines are shown to be pseudo-optimal number of machines that our cloud system can provide virtual machines to our specific problem in scalable way, i.e., the total computing time is basically proportionally decreased as the number of virtual machines is increased to about 50. It should, however, be noticed that these pseudo-optimal numbers of scalable virtual machines that deduced from our experiments should be different for other types of problems as other types of problems should demand different amount of resources such as CPU time and the amount of data communicated among the virtual machines.

It should also be remembered that this analysis is based on the fact that the programs were executed where data transfer time is almost constant. In addition, we can conclude that our problem is such that communication overhead is of comparable order to actual CPU time, especially when computation burden is not low (e.g. for small Δx) and hence different types of configuration do play an important role regarding total computation time.

The observations from the experiments fortifies the common belief that scalability is more prominent in a network of virtual machines where most of the computational powers of the machines are required to solve the problem than in a network where less powers are required.

IV. Conclusion

In this paper, a numerical computational experiment were performed over a virtual machine cluster connected by 1Gbps Ethernet using PVM to solve a one dimensional differential equation with the purpose of investigating how scalable the network of virtual machines are.

When the data transfer time is relatively constant, there exists a pseudo-optimal task decomposition set by decrease in CPU time of individual virtual machines and increase in communication overhead as more machines are utilized thus preserving the scalability of the system.

However, when the traffic is heavy with data transfer being more random, total computation time shows a certain degree of random ness with less systematic improvement as workload is distributed among more machines.

However, it is clear that in most of the cases studied, distributed computation over the cloud of virtual machines is no worse than serial computation in the worst case and shows highly scalable improvement over serial computation in many other cases.

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3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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