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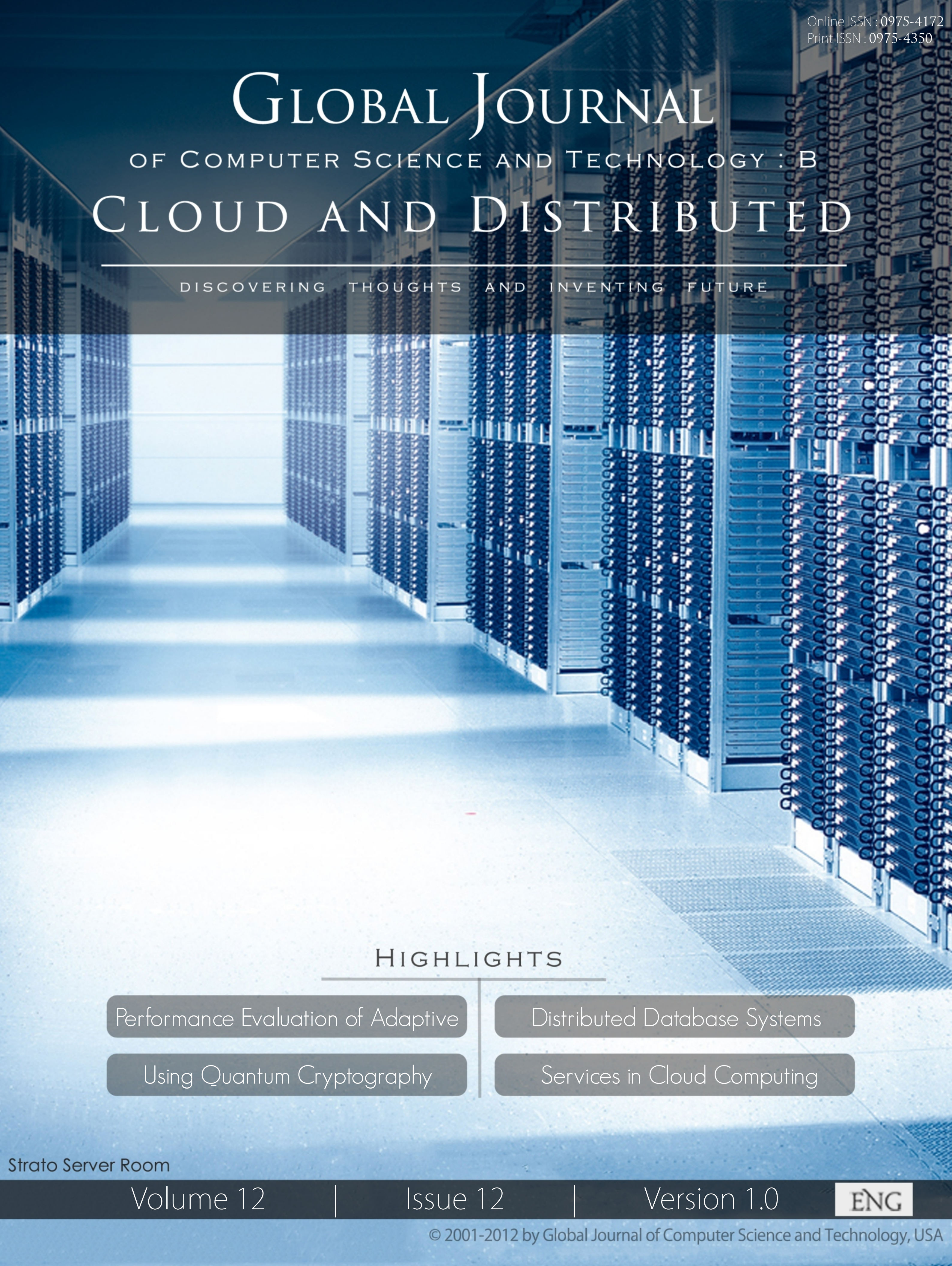

Highlights

Performance Evaluation of Adaptive

Using Quantum Cryptography

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Services in Cloud Computing

Strato Server Room

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Performance Evaluation of Adaptive Scheduling Algorithm for Shared Heterogeneous Cluster Systems

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Abstract - Cluster computing systems have recently generated enormous interest for providing easily scalable and cost-effective parallel computing solution for processing large-scale applications. Various adaptive space-sharing scheduling algorithms have been proposed to improve the performance of dedicated and homogeneous clusters. But commodity clusters are naturally non-dedicated and tend to be heterogeneous over the time as cluster hardware is usually upgraded and new fast machines are also added to improve cluster performance. The existing adaptive policies for dedicated homogeneous and heterogeneous parallel systems are not suitable for such conditions. Most of the existing adaptive policies assume a priori knowledge of certain job characteristics to take scheduling decisions. However such information is not readily available without incurring great cost. This paper fills these gaps by designing robust and effective space-sharing scheduling algorithm for non-dedicated heterogeneous cluster systems, assuming no job characteristics to reduce mean job response time. Evaluation results show that the proposed algorithm provide substantial improvement over existing algorithms at moderate to high system utilizations.

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PERFORMANCE EVALUATION OF ADAPTIVE SCHEDULING ALGORITHM FOR SHARED HETEROGENEOUS CLUSTER SYSTEMS

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Performance Evaluation of Adaptive Scheduling Algorithm for Shared Heterogeneous Cluster Systems

Amit Chhabra [α] & Gurvinder Singh [σ]

Abstract - Cluster computing systems have recently generated enormous interest for providing easily scalable and cost-effective parallel computing solution for processing large-scale applications. Various adaptive space-sharing scheduling algorithms have been proposed to improve the performance of dedicated and homogeneous clusters. But commodity clusters are naturally non-dedicated and tend to be heterogeneous over the time as cluster hardware is usually upgraded and new fast machines are also added to improve cluster performance. The existing adaptive policies for dedicated homogeneous and heterogeneous parallel systems are not suitable for such conditions. Most of the existing adaptive policies assume a priori knowledge of certain job characteristics to take scheduling decisions. However such information is not readily available without incurring great cost. This paper fills these gaps by designing robust and effective space-sharing scheduling algorithm for non-dedicated heterogeneous cluster systems, assuming no job characteristics to reduce mean job response time. Evaluation results show that the proposed algorithm provide substantial improvement over existing algorithms at moderate to high system utilizations.

Keywords : adaptive space-sharing scheduling, cluster computing systems, non-dedicated heterogeneous clusters, performance evaluation and mean response time.

I. Introduction

Traditionally multiprocessors were used as parallel computing platform to execute large-scale grand challenging applications. But for over the past decade, there have been unprecedented technological advances in the commodity personal computers (PCs) and network performance, mainly as a result of faster hardware and more sophisticated software. Another predominant trend witnessed during this era was the falling prices of these technologies. Both of these trends intuitively stimulated the creation of new cost-effective and high-performance networked-computing based parallel and distributed paradigm centering on the use of cluster of low-cost PCs (and/or workstations) interconnected with low-latency, high-bandwidth networks (like ATM, switched Fast or Gigabit Ethernet etc.). Clusters of PCs are becoming a commonplace high-performance computing platform in universities which enjoy the in-house availability of cluster constituents such as PCs and internetworking devices as commodity-off-the-shelf (COTS) components.

On par with the development of clusters as a parallel processing platform to execute large-scale applications (also known as jobs), scheduling on clusters has been an interesting research area to work with in recent years. Job schedulers are generally designed to resolve the contention among multiple competing jobs to acquire the available computational resources (such as processors, memory, storage etc.).

Parallel job scheduling problem is widely studied in traditional multiprocessor systems [3-6] and to a relatively less extent in cluster computing systems [1-2]. A common assumption in most of the existing parallel job scheduling research in both these systems, has been that all processors in the system have equal processing capacity (i.e., homogeneous) and dedicated. In contrast, in this paper we focus on proposing a scheduling algorithm to allocate processors to jobs in non-dedicated and heterogeneous cluster computing environment.

The rest of the paper is organized as follows: Section 2 discusses background knowledge on cluster computing systems and scheduling. Section 3 states the problem statement. Section 4 gives an overview of previous literature work related to the problem and describes the details of the proposed solution. Section 5 describes simulation model which discusses the workload and system model used. Section 6 evaluates the performance of new policies and compares them with existing solutions and Section 7 concludes the paper.

II. Background Knowledge

In recent times, paradigm of parallel processing in various organizations has been shifted from traditional expensive multiprocessors to commodity-based high-performance clusters due to their high-performance and cost-effectiveness. Clusters of PCs or workstations based on the duration and availability of amount of processing capacity can be generally classified into two

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classes; 1) High Performance Computing (HPC) systems, and 2) High Throughput Computing (HTC) systems. HPC systems are suitable for interactive parallel jobs as they deliver enormous amount of processing capacity over short periods of time. HTC systems provide large amounts of processing capacity over long periods of time and hence suitable for batch parallel jobs. Within these two classes, cluster computing systems are further classified into three categories [1-2] as follows:

1. Volunteer-owned Cluster Computing (VCC): Individual computer in the system may be homogeneous or heterogeneous and is assumed to be privately owned. The machines may be used for executing externally submitted jobs only if the owner is not using it. Therefore machines in the VCC systems are non-dedicated as these are not simultaneously available to external and local users. The VCC cluster type systems are commonly used as High throughput computing (HTC) platforms.
2. Community-owned Cluster Computing (CCC): All computing machines are shareable and may be homogeneous or heterogeneous. The CCC cluster computing systems are used both as HTC and HPC environments. A computer lab in an educational institution is a best example of CCC type of systems.
3. Privately-owned Cluster Computing (PCC): PCC is a dedicated cluster of computers or workstations, which is commonly referred to as Beowulf in the literature. This kind of setup is deliberated for use either as a dedicated HTC or as a dedicated HPC platform.

Space-sharing policies are commonly used to schedule parallel jobs in distributed-memory parallel systems such as multiprocessors as well as cluster computing systems. In space-sharing policy, parallel system of multiple processors is divided into disjoint set of processors (known as partitions) so that each partition can be assigned to a single job. In this way, number of jobs can be executed side-by-side by simultaneously providing processor partitions. The number of processors in each partition to be assigned to a job is known as partition size. The primary reason for preferring space-sharing over time-sharing for cluster systems is to avoid the cost of context switching due to frequent preemptions in time-sharing systems.

Space-sharing policies can be broadly divided into fixed, variable, adaptive and dynamic policies [3-4] based on the decision that whether the partition size once assigned to the jobs can be changed during execution time or not. In fixed policies, partition sizes are fixed by the administrator before the system actually starts operating and any modification to these partition sizes require a system reboot. Variable policies require partition sizes to be specified by the user at the time of job arrival. In adaptive policies, partition sizes are determined by the scheduler at the time of job scheduling on the basis of current system load and any available job characteristics. However partition size once assigned to a job cannot be changed during job execution. In dynamic policies, partition size of a job can be changed during its execution.

High performance applications for cluster computing systems are mostly presented as parallel jobs. A parallel job is said to consist of a set of tasks running concurrently to achieve a certain common objective. Each task runs to completion on its assigned processor. The number of tasks (and hence processors required) a certain job has is referred to as the job size.

Characteristics of on-line job streams that act as input workload to the job schedulers influence the performance of the schedulers. Parallel jobs can be classified into four types [3-4]; (i) Rigid, (ii) Moldable (iii) Evolving, and (iv) Malleable, depending upon the number of processor to be allocated at submission time or during execution. A rigid job demands a fixed number of processors at the time of submission and executes on these processors exclusively until completion. Moldable jobs can be made to execute on different number of processors based on the current system load. For example if system load is high, then few processors can be assigned to the moldable job and if system load then large number of processors can be allotted to the job. However this flexibility is only available at job start time and partition size cannot be reconfigured during execution. The processor requirements of both Evolving and Malleable jobs can be changed during execution. For evolving jobs, requirement changes are initiated by the application itself during the various phases of its execution. If the system cannot satisfy the job's demand, the job has to wait for exact processor allocation. For malleable jobs, the decision to change the number of processors is made by an external job scheduler.

III. Problem Statement

Most of existing parallel job scheduling policies especially adaptive space-sharing polices have been focused on homogeneous parallel systems such as distributed-memory multiprocessors and cluster computing systems (for example PCC or VCC systems) in which all the processors are dedicated and of equal capacity. It should be noted that scheduling polices for distributed-memory multiprocessors can be directly used in PCC systems without any modification due to similarity in architectures of both the systems. However clusters of PCs such as CCC systems tend to be heterogeneous due to the fact that over the passage of time, new fast machines are regularly added to cluster or some of the obsolete cluster hardware is replaced to improve cluster computing performance. Moreover in order to improve the utilization of computing machines, the processors in CCC systems are often shared by local users to execute local jobs (hereafter known as background workload).

The problem seems significant as the partition sizes obtained in non-dedicated heterogeneous parallel systems (e.g. CCC systems) will be different from those obtained in dedicated homogeneous systems. When we partition a dedicated homogeneous cluster (such as PCC and VCC), partition size is obtained by dividing total number of physical processors by the total number of jobs in the system. But in case of non-dedicated heterogeneous systems, partition size is calculated by dividing the total available computing power of all processors by the number of jobs currently available in the system. However total available computing power will be different at different times due to variations in the computing power of individual processors in the presence of varying background workload. Hence corresponding calculated partition size changes continuously. Moreover existing adaptive policies focus on using certain job characteristics (which may not be readily and cheaply available) to calculate partition size.
Therefore an efficient adaptive scheduling policy is required which can take care of heterogeneity of processor speeds as well as run-time load variations due to background workloads executing at individual processors and above all requires no job characteristics to calculate partition size.

IV. Related Works and Proposed Algorithms

The focus of the current job scheduling research in distributed-memory parallel systems is towards adaptive algorithms to schedule moldable jobs [8-15] as they have shown to achieve better mean response time than the scheduling algorithms for rigid jobs. This is due to the fact that adaptive algorithms decide the partition sizes by adapting to current system load at job scheduling time whereas rigid jobs only require a fixed number of processors resulting into increased processor fragmentation and mean response times. Dynamic policies are shown to more suitable for shared-memory parallel systems in which the associated overheads of dynamic-partitioning are outweighed by the benefits.

Adaptive scheduling algorithms for assigning partition sizes to moldable jobs have been extensively studied in homogeneous parallel systems [5-12] and to less extent in heterogeneous parallel systems [2][13]. Existing adaptive algorithms in both homogeneous and heterogeneous cluster systems share one common assumption that processors are dedicated to execute only cluster applications (no other applications can be executed locally). Available adaptive policies also differ from each other by the amount of job characteristics used in making processor allocation decisions.

In [5-6], Rosti et al. introduced several adaptive partitioning policies (known as Fixed Processors per Job (FPPJ)), Equal Partitioning with a Maximum (EPM), Insurance Policy and Adaptive Policies (known as AP1, AP2, AP3, AP4 and AP5)) for distributed-memory multiprocessors over a wide range of workload types and with different possible arrival rates. These policies try to allocate equal-sized partitions to the waiting applications since no a priori job characteristics were assumed to be available. However these policies differ from each other in how the target partition-size is computed.

Out of these adaptive policies, AP2 (known as work-conserving policy) seems to be an interesting policy that reserves one additional partition for the future job arrivals. The partition size in the AP2 policy is calculated as shown in (1).

$$Partition\ Size\ (PS) = max\left(1, ceil\left(\frac{total\_procesors}{Waiting\_jobs+1} + 0.5\right)\right) \qquad (1)$$

In [7], Dandamudi and Yu show that AP2 considers only queued jobs to calculate partition size. This will lead to a situation that contravenes the principal of allocating equal-sized partitions to all jobs. Dandamudi and Yu, suggested a modified version of AP2 known as Modified adaptive policy (MAP) which considers waiting as well as running jobs to calculate partition size as shown in (2).

$$Partition\ Size\ (PS) = max\left(1, ceil\left(\frac{total\_processors}{Waiting\_jobs+(f*Running\_jobs)+1} + 0.5\right)\right) \qquad (2)$$

Target partition size to be finally allocated to the waiting job is calculated using equation (3). It is the minimum of the partition size calculated using equation (2) and maximum parallelism of the job.

$$Traget\ partition\ size = min(PS, maximum\ parallelism\ of\ the\ job) \qquad (3)$$

The parameter f (whose value lies between 0 and 1) is used to control the contribution of the "running" jobs to the partition size. It has been shown that the MAP policy provides significant improvement in performance over policies like AP2, ASP and ASP-max etc. that do not consider the contribution of running jobs while calculating partition size. The amount of improvement obtained is a function of parameter f, system load, and workload.

The adaptive policy proposed in [8][10] is more restrictive, in that users must specify a range of the number of processors for each job. Availability of service demand knowledge of an individual job is assumed in the paper. Schedulers will select a number which gives

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the best performance. Schedulers in [8][10] use a submit-time greedy strategy to schedule moldable jobs.

In [11], Srinivasan et al. have some improvement to [8][10]: (i) using schedule time-scheduler which defers the choice of partition size until the actual job schedule time instead of job submission time and, (ii) using aggressive backfilling instead of conservative backfilling.

In [12], Srinivasan et al. argue that an equal-sized partition strategy tends to benefit jobs with small computation size (light jobs). On the other hand, allocating processors to jobs proportional to the job computation size tends to benefit heavy jobs significantly. A compromise policy is that each job will have a partition size proportional to the square root of its computation size (Weight) as in (4). This equation is used to calculate partition size in an enhanced backfilling scheme proposed in [11].

$$WeightFraction_i = \frac{\sqrt{Weight_i}}{\sum_{i \in \{ParallelJobInSystem\}} \sqrt{Weight_i}} \qquad (4)$$

In [2], a variation of MAP, known as Heterogeneous Adaptive Policy (HAP) was suggested by Dandamudi and Zhou to work with heterogeneous parallel systems. The work introduced the concept of Basic Processor Unit (BPU) to differentiate the heterogeneous processors from each other. Partition sizes are allocated to the jobs on the basis of their computation power in terms of number of BPUs rather than using a physical processor level as in homogeneous systems. The research paper showed the supremacy of HAP over MAP and AP2 policies. Partition size in HAP is calculated as in equation (5) and target partition size is calculated using equation (3).

$$Partition\ Size\ (PS) = max\left(1, ceil\left(\frac{total\_BPUs}{Waiting\_jobs + (f * Running\_jobs) + 1} + 0.5\right)\right) \qquad (5)$$

In [13], Shim suggested various adaptive policies for shared heterogeneous network of workstations (NOW) considering the priority of sequential local jobs as well as the parallel jobs. No in-depth details about the working of the algorithms are provided in the paper and no comparisons are made with the existing policies. The shortcoming of this paper is that it considers only waiting jobs to calculate the partition size which usually lead to worse results.

In [14], Doan et al. suggested priority-based adaptive policy for homogeneous PC-based cluster systems for both rigid and moldable jobs. The user can assign priority to both types of jobs. The jobs with higher priority are given preference in execution. Since rigid jobs require the fixed number of processors (e.g. partition size), so partition-function for only moldable jobs is derived from equation (2) as given in [7].

In [15], Abawajy proposed another adaptive policy known as SOUL for heterogeneous multi-cluster systems which calculates partition size on the basis of mean service rate of heterogeneous processors, local load at processors and maximum parallelism information of waiting jobs. It has been shown that SOUL policy tends to produce shorter mean job response times as compared to both AEP and MAP at various workloads. But no comparison between HAP and SOUL policy is available.

a) Proposed Robust Heterogeneous Adaptive Policy (RHAP)

From the literature survey, following lessons have been learnt which will help us to design a robust adaptive policy for non-dedicated heterogeneous parallel systems.

1) Adaptive policies which consider both current waiting and running jobs in the parallel system perform better than those policies which consider only current waiting jobs.
2) In heterogeneous systems, BPU mechanism is used frequently to differentiate the computing power of different physical processors.
3) When no job knowledge is available, equal-sized (or equivalent) partitioning mechanism is preferred over weighted square-root fair-share strategy which requires the service demand knowledge of jobs.
4) Significant cost in terms of various overheads is involved in obtaining the a priori knowledge of various job characteristics such as maximum parallelism, average parallelism, service demand knowledge etc.

Using these observations and lessons, we have suggested few modifications to HAP policy which have shown good results over various policies in dedicated heterogeneous systems. The new policy is named as Robust Heterogeneous Adaptive Policy (RHAP) to schedule jobs in non-dedicated heterogeneous cluster environment and requires no job characteristics (as opposed to HAP) to calculate final target partition size for the current waiting jobs.

Since cluster processors can be shared between local and parallel jobs, therefore at any point of time, current available computing power for execution of parallel workload at each processor in the presence of local workload is given as in equation (6).

$$Computing\ power\ (CP_k) = BPU_k * (1 - Local\_load_k) \qquad (6)$$

In a cluster system with P processors, BPUk represents the computing power of kth processor and $Local\_load_k$ denotes the load at individual processor due to the execution of local jobs.

Ideal partition size in RHAP is then calculated on the basis of current available computing as shown in (7).

$$Partition\ Size\ (PS) = max\left(1, ceil\left(\frac{\sum_{k=1}^{p} BPU_k*(1-Local\_load_k)}{Waiting\_jobs+(f*Running\_jobs)+1} + 0.5\right)\right) \quad (7)$$

It should be noted that job scheduler is invoked only at arrival and departure time of jobs. Information about local load and computing power of each processor is also collected by the job scheduler at these times. Here "Max" is system-wide Maximum Allocation parameter which imposes an upper limit on the number of BPUs to be allocated to jobs. It is equal to some fixed percentage of the total BPUs available in the system. The number of BPUs finally allocated is calculated as follows in (8).

$$Traget\ partition\ size = min(PS, Max) \quad (8)$$

Since no knowledge about maximum parallelism of the jobs is "a priori" available to the scheduler, so there is no distinction between short and long jobs. In the absence of "Max" parameter, shorter jobs can be assigned large number of processors resulting into internal processor fragmentation and increased waiting times for other jobs. Max puts a cap on the smaller jobs that tend to retain larger partition sizes. Moreover it also avoids the situations when a long job is holding up large number of processors.

V. Simulation Model

We have implemented a discrete event simulator in .Net environment to evaluate the performance of proposed adaptive scheduling algorithms under various workload conditions. Simulation modeling is preferred over the actual experimentation as it gave us the greater flexibility of covering a wide range of application characteristics and controlled parameters like arrival rates, system utilization etc. and allowed us to abstract away trivial details of the environment under study, which otherwise would complicate the performance evaluation procedure.

The developed simulator takes the on-line job stream as input parallel workload, executes parallel workload with the specified adaptive policy and generates the output in the form of mean response time. Response time of a job is defined as the sum of its execution time and waiting time. Waiting time of job is the difference between job arrival time and job scheduling time. Execution time is the actual time spent to execute the job. It should be noted that at the time of job arrival, no job characteristics (such as number of processors required, job service demand etc.) are available to the scheduler.

a) System Model

We have used an open system model of community-owned cluster of 64 independent commodity single-processor personal computers and each computer is used in a shared mode i.e. it is able to service local sequential tasks as well as the tasks of parallel job submitted by the central job scheduler. The computers differ from each other in terms of heterogeneity in processor speeds i.e. computing power they possess. Computer and processor terms are used interchangeably in context of this paper. We assume that computers in the cluster are connected using 100Mbps Ethernet switch. Relative computing power of different physical processors is represented in terms of Basis Processing Unit (BPU) [2] which can either be derived with the help of SPECfp2000 ratings based on the processor speeds or by executing independent benchmarking programs on heterogeneous processors. We have used two types of processors in the computers of cluster system; First 32 computers contain Type I processors; Next 32 computers contain Type II processors that are twice faster than Type I processors. Hence each processor in Type I has 1 BPU and Type II processor has 2 BPUs.

b) Parallel Workload Model

Parallel workload model containing online stream of parallel jobs for scheduling contains two components; 1) job arrival process and 2) job service demand. The job arrival process is characterized by job arrival rate (λ) and coefficient of variation of inter-arrival times (CVa). High arrival rate represents that inter-arrival time between successive jobs is small. We have modeled the job arrival process using exponential distribution with CVa equal to one.

Mean service demand (D) parameter is the uncorrelated cumulative mean service demand which represents the total time required to execute the job in a dedicated environment, independent of how many processors are used. Service demand of jobs is generated using 2-stage hyper-exponential distribution with coefficient of variation of service demand (CVs) greater than one. Since moldable jobs can be made to run on the varying number of processors, therefore time (tj) taken by the parallel job varies based on the number of processors (pj) assigned to it when the job starts executing. It should be noted that dj= (tj)*(pj) as we have ignored the communication and synchronization overheads, when overall mean service demand of a parallel job (dj) is distributed equally among tasks (which are always equal to "pj" processors assigned to the job) of the job.

c) Background Workload Model

We assume abstract model for representing load due to background jobs at each processor by hiding the internal details of arrival and execution times of sequential local jobs. Each cluster processor is assumed to service a stream of background jobs that arrive at individual computers independently. *Local_load* at each processor indicates the load due to the execution of sequential local jobs. As the local load increases, computing power available to service parallel workload decreases. We model the local load using discrete uniform distribution ranging from 0% to 30% i.e. U[0%, 30%] and this information is only available to job scheduler at job arrival and departure times.

VI. Performance Evaluation and Results

In this section we will evaluate the performance of proposed algorithms in terms of mean response time and also compare the simulation results with the existing approaches. The default parameters and values used in simulation experiments are for various simulation parameters for 5000 jobs are as follows in table 1.

Table 1 : Default parameters and values used

Parameters of Parallel Jobs	Values
Mean service demand (D)	16
Coefficient of variation (CV_A) of job arrival	1
Coefficient of variation (CV_S) of service demand	4
Number of processors in the cluster	64
Max	30 % of total processing capacity

Average load or utilization of the cluster system due to parallel jobs is derived using equation (9).

$$Average\ utilization = \frac{Job\ arrival\ rate * Mean\ service\ demand}{Number\ of\ processors} \quad (9)$$

a) *Relative performance of the scheduling policies*

In this section we compare the performance of the proposed adaptive scheduling policy i.e. RHAP with the HAP and MAP policy. Since no maximum parallelism information is a priori available to the scheduler, therefore target partition size for HAP policy computed in (3) will be equal to the partition size computed in (2). The default value of 'f' in the partitioning-function for RHAP, HAP and MAP policies is set to 0.5 which is suggested as a reasonable value in existing similar research works [2][7].

RHAP policy tends to produce shorter MRT values at system loads of interest (i.e. at medium to high loads) as shown in figure 1. This is due to two reasons; 1) RHAP policy produce smaller partition sizes as compared to both HAP and MAP as it considers the background workload into account. 2) Max parameter also restricts allocation of the larger partition sizes to jobs. On the other hand, both HAP and MAP try to allocate larger partition sizes since they are not aware of any background workload. But in reality the total available computing power of all processors is much less than that of assumed by MAP and HAP. Therefore jobs have to wait for a long time to receive calculated partition sizes. HAP and MAP policies also tend to produce bigger partition sizes at low to medium system

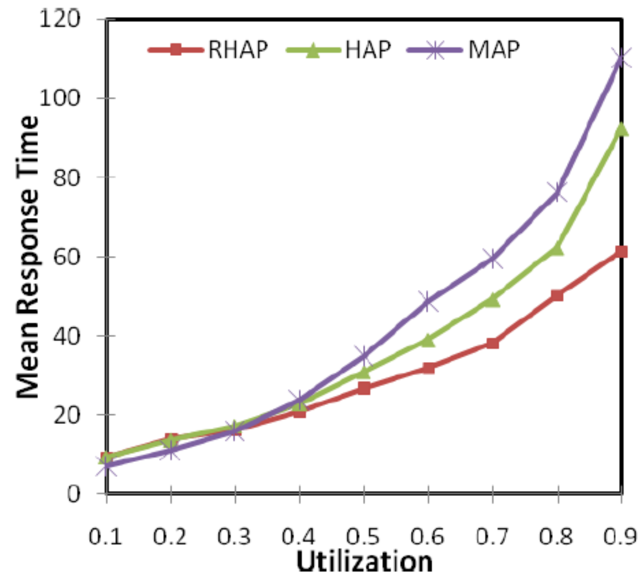

Fig. 1 : Performance of scheduling policies

Utilization since they impose no upper limit on the number of processors to be allocated to jobs. This will apparently result into allocation of large partition sizes to even smaller jobs.

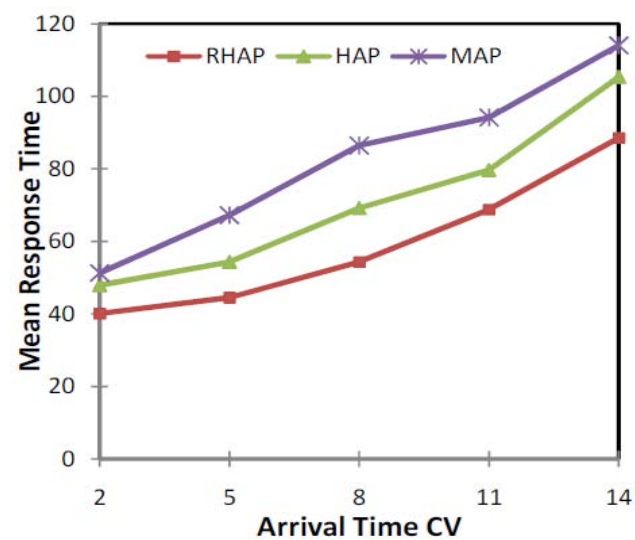

Fig. 2 : Sensitivity to arrival time CV

b) *Sensitivity Analysis*

In this section, we study the sensitivity of the three policies to variances in inter-arrival and service times. When the arrival CV is varied, the service CV is held at 4. Similarly arrival CV is fixed at 1 when the performance sensitivity to service time CV is studied. The system utilization for parallel load is fixed at 80%.

i. *Sensitivity to Arrival Time Variations*

The performance sensitivity of the three policies to inter-arrival CV is shown in figure 2. The mean response time increases with increasing inter-arrival CV for the three policies. The RHAP policy maintains its performance superiority over HAP and MAP policy at 80% system utilization.

The increase in arrival time variance means the clustered arrival of jobs into the system. This also led to longer gaps in the job arrivals. The impact of variance in arrival time is more on HAP and MAP policies as shown in figure 2. These two policies suffer from processor fragmentation induced by the background workload and the way the partition-size is computed for the jobs. Since the partition sizes are computed on the basis of total number of BPUs (in case of HAP) and total number of processors (in case of MAP), the actual number of available BPUs (in case of HAP) and available processors (in case of MAP) can be lower than the partition-size computed. This is due to the fact that there is possibility of background tasks running on some of processors at the time and both HAP and MAP doe not consider background workload when computing partition size. But RHAP policy tend to produce smaller partition sizes due to consideration of background workload as well as upper limit imposed by Max parameter, therefore the impact of arrival time variance is reduced as compared to other two policies.

ii. *Sensitivity to Service Demand Variations*

The figure 3 shows that MRT of the three policies increases with the increase in the variance in the service demand. With the increase in service demand variance, there will few large service demand jobs and large number of small service demand jobs. As the service time CV increases, the service demand of the larger jobs will increase even though their number goes down as a fraction of the total jobs.

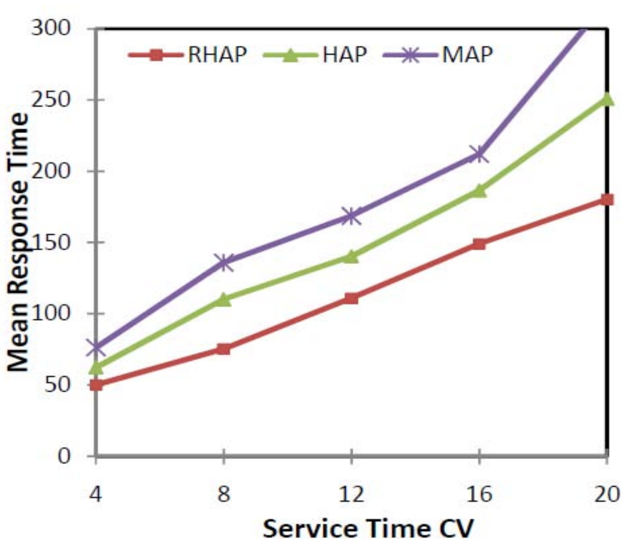

Fig. 3 : Sensitivity to service time CV

The impact of service time variance on three policies is more than the impact of arrival time variance. This is due to the fact that all of these policies use FCFS as a job selection policy which is known to be sensitive of variance in service demand, to allocate processors to jobs. FCFS allocation of processors to jobs results in a situation where small jobs could be blocked by an earlier arrived large job. This problem gets more serious as the variance in service demand increases.

VII. Conclusion

Space-sharing algorithms are preferred in distributed-memory cluster systems to avoid the overhead due to frequent preemptions involved in time-sharing systems. Adaptive space-sharing algorithms are used in distributed-memory parallel systems such as cluster computing systems and dynamic space-sharing algorithms are more suited to shared-memory multiprocessors. Most of popular adaptive algorithms are only designed for dedicated homogeneous parallel systems such as multiprocessors, PCC or even VCC type of clusters. Existing few adaptive algorithms for heterogeneous parallel systems require the knowledge of job characteristics to schedule jobs. This paper suggests a robust adaptive policy for non-dedicated heterogeneous cluster systems to schedule parallel jobs without requiring any knowledge of job characteristics. Comparative results have shown the dominance of the proposed policy over the existing similar policies at medium to high system loads of interest.

References Références Referencias

1. J.H. Abawajy. Parallel Job Scheduling Policies on Cluster Computing Systems. Ph.D. Thesis. Ottawa-Carleton Institute for Computer Science, Carleton University, Ottawa, Canada, November, 2003.
2. S.P. Dandamudi and Z. Zhou, "Performance of Adaptive Space-Sharing Policies in Dedicated Heterogeneous Cluster Systems", Future Generation Computer Systems, 20(5), 895-906 (2004).
3. D.G. Feitelson, L. Rudolph, U. Schwiegelshohn, K.C. Sevcik, P. Wong, Theory and practice in parallel job scheduling, in: Job Scheduling Strategies for Parallel Processing, Lecture Notes in Computer Science, vol. 1291, Springer-Verlag, Berlin, 1997, pp. 1–34.
4. D. G. Feitelson and L. Rudolph. Parallel Job Scheduling - A Status Report. Lecture Notes in Computer Science, Springer, Vol. 3277 (2005).
5. E. Rosti, E. Smirni, L. W. Dowdy, G. Serazzi, and B. M. Carlson. Robust Partitioning Policies for Multiprocessor Systems. Performance Evaluation, Vol.19, 141-265 (1994).
6. E. Rosti, E. Smirni, L.W. Dowdy, G. Serrazi, K.C. Sevcik, Processor saving scheduling policies for

multiprocessor systems, IEEE Transactions on Computers 47 (2) (1998).
7. S.P. Dandamudi and H. Yu, "Performance of Adaptive Space Sharing Processor Allocation Policies for Distributed-Memory Multicomputers", Journal of Parallel and Distributed Computing, vol. 58, pp. 109-125 (1999).
8. W. Cirne and F. Berman. Adaptive Selection of Partition Size for Supercomputer Requests. Lecture Notes in Computer Science, Springer, Vol. 1911, 187-208 (2000).
9. W. Cirne and F. Berman. Using Moldability to Improve the Performance of Supercomputer Jobs. Journal of Parallel and Distributed Computing, Vol. 62, 1571-1601 (2002).
10. W. Cirne and F. Berman. A Comprehensive Model of the Supercomputer Workload. Proc. of IEEE 4th Annual Workshop on Job Scheduling Strategies for Parallel Processing (2005).
11. S. Srinivasan, V. Subramani, R. Kettimuthu, P. Holenarsipur, and P. Sadayappan. Effective Selection of Partition Sizes for Moldable Scheduling of Parallel Jobs. Lecture Notes In Computer Science, Springer, Vol. 2552, 174- 183 (2002).
12. S. Srinivasan, S. Krishnamoorthy, and P. Sadayappan. A Robust Scheduling Strategy for Moldable Scheduling of Parallel Jobs. Proc. of 2003 IEEE International Conference On Cluster Computing (2003).
13. Young-Chul Shim, "Performance evaluation of scheduling schemes for NOW with heterogeneous computing power", Future Generation Computer Systems. 20(2): 229-236 (2004).
14. V.H. Doan. An Adaptive Space-Sharing Scheduling Algorithm for PC-Based Clusters, Modeling, Simulation and Optimization of Complex Processes, pp 225-234, 2008.
15. J.H. Abawajy, "An Efficient Adaptive Policy for High-Performance Computing", Future Generation Computer Systems, Vol. 25, 364-370, (2009).

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Performance Test Automation with Distributed Database Systems

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Abstract - Our previous research paper 'A Focus on Testing Issues in Distributed Database Systems' led us to a conclusion that Distributed Database Systems supports many good engineering practices but there is still place for refinements. A Distributed Database (DDB) is formed by a collection of multiple databases logically inter-related in a Computer Network. Apart from managing a plethora of complicated tasks, database management systems also need to be efficient in terms of concurrency, reliability, fault-tolerance and performance. As there has been a paradigm shift from centralized databases to Distributed databases, any testing process, when used in DDB correlates a series of stages for the construction of a DDB project right from the scratch and is employed in homogeneous systems. In this paper, an attempt is made to describe the establishment of Performance Testing with DDB systems. It focuses on the need for maintaining performance and some techniques to achieve performance in DDB systems. Three sample web based systems are tested by using TestMaker, one of the open source software, in order to highlight the helpful role of performance in the context of testing. The strengths and weaknesses of chosen performance testing tools viz., TestMaker, OpenSTA, and httperf are discussed.

Keywords : distributed database system, testmaker, openSTA, httperf , performance testing, TPS.

GJCST-B Classification: C.1.4

PERFORMANCE TEST AUTOMATION WITH DISTRIBUTED DATABASE SYSTEMS

Strictly as per the compliance and regulations of:

Performance Test Automation with Distributed Database Systems

Dr. R. Mahammad Shafi [α] & Mungamuru Nirmala [σ]

Abstract - Our previous research paper 'A Focus on Testing Issues in Distributed Database Systems' led us to a conclusion that Distributed Database Systems supports many good engineering practices but there is still place for refinements. A Distributed Database (DDB) is formed by a collection of multiple databases logically inter-related in a Computer Network. Apart from managing a plethora of complicated tasks, database management systems also need to be efficient in terms of concurrency, reliability, fault-tolerance and performance. As there has been a paradigm shift from centralized databases to Distributed databases, any testing process, when used in DDB correlates a series of stages for the construction of a DDB project right from the scratch and is employed in homogeneous systems. In this paper, an attempt is made to describe the establishment of Performance Testing with DDB systems. It focuses on the need for maintaining performance and some techniques to achieve performance in DDB systems. Three sample web based systems are tested by using TestMaker, one of the open source software, in order to highlight the helpful role of performance in the context of testing. The strengths and weaknesses of chosen performance testing tools viz., TestMaker, OpenSTA, and httperf are discussed.

Keywords : distributed database system, testmaker, openSTA, httperf , performance testing, TPS.

I. Introduction

A DDB is formed by a collection of multiple databases logically inter-related in a computer network [4]. In a distributed database, the network must allow users to share the data as transparently as possible, yet must allow each node to operate autonomously, especially when network linkages are broken or specific nodes fail. The transparences provided by a DDBMS can be understood as the high level semantic separation of the details inherent to the physical implementation of a DDB. The focus is to provide data independency in a distributed environment.

This way, the user sees only one logically integrated image of the DDB as if it were not distributed. Performance evaluation of database systems is an important concern. However, easier said than done, performance evaluation of database system is a non-rivial activity, made more complicated by the existence of different flavors of database systems fine tuned for serving specific requirements. However performance analysts try to identify certain key aspects generally desired of all database systems and try to define benchmarks for them.

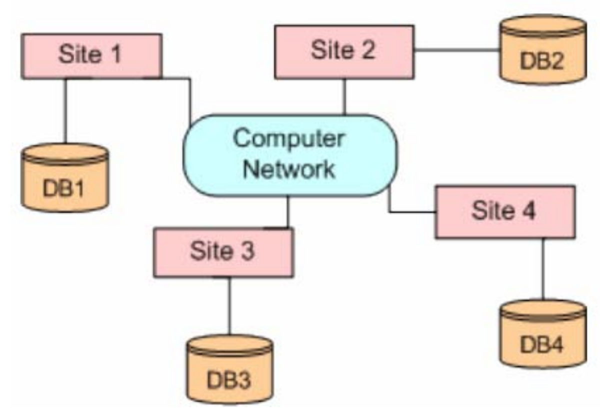

Fig. 1 : A Distributed Database on geographic dispersed Network

II. Overview of Performance Testing in DDB Systems

Distributed applications have traditionally been designed as systems whose data and processing capabilities reside on multiple platforms, each performing an assigned function within a known and controlled framework contained in the enterprise. Even if the testing tools were capable of debugging all types of software components, most do not provide a single monitoring view that can span multiple platforms. Therefore, developers must jump between several testing/monitoring sessions across the distributed platforms and interpret the cross–platform gap as best they can. Testing distributed applications is exponentially more difficult than testing standalone applications.

Neuman [2] categorizes three different dimensions used to measure the Performance of a system, viz., the size of the system, geographical performance, and administrative performance. These measurements ensure that although the users and resources may lie far apart, it is still easy to manage.

Performance testing provides the information regarding whether the system can still function in a fast

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manner under heavy load. This information assists the IT manager to decide about the inclusion of additional servers. Tanenbaum and Steen [5] discussed a number of issues caused by performance. Centralized services, data, and algorithms can become problematic when the number of users increases. Although having a single server to serve a large number of users is not a good idea, adding additional servers to increase the system performance is also not practical in some situations. For example, the information on the server is highly confidential, such as information about bank accounts; adding additional servers create more chances for security attacks.

Another issue is geographical performance which also slows down the communication between clients and server. There are some techniques that can help to maintain and improve performance of distributed database systems. The most common technique is replication which adds more and faster processors as well as design components to be scalable [6]. Several copies of the same server are made available, the requests are sent to the servers based on their physical location, the loads of the server, or can be sent randomly. Consistency should be taken into consideration when this technique is used. It is to ensure that users can only view the up-todate information and the information appears the same to all users. This technique is not suitable when handling sensitive data, which was mentioned in the previous section.

Neuman proposed another technique which is known as distribution [5]. Distribution allows a component to be split into smaller parts which can be spread across the system. For instance, a name space is divided into different parts and a part of the naming database is assigned to different servers. Hence, it reduces the number of queries and updates to be processed; also each request is handled faster since the size of the database is smaller. Caching technique is also introduced by Neuman which allow the result to be remembered, thus, additional requests for the same information can be reduced.

According to Tanenbaum and Steen, hiding communication latencies technique can be used to enhance the performance of a system [5]. That is to say, after the client sends the request, the client continues to do other tasks rather than wait for the response from the server. When the response arrives, the application is interrupted to complete the previous task.

III. Testing the Performance of Sample Web Based Systems

Web databases serve the back-ends of Web-Servers. Web databases are the classic examples of high load, high performance database systems. The OLC Assets, DCRR and Employee Directory are web based systems. These three systems are chosen as samples for the performance test which is to test how each server reacts when there is an increase in number of users. These tests aim to highlight the role of Performance testing in analyzing system performance.

These tests also explain how performance testing can assist testers in making important decisions such as whether the current server(s) are able to serve an increase in the number of concurrent users, or whether additional servers should be implemented in order to handle a high volume of users.

a) OLC Assets

Otago Language Centre receives a number of new items every day to facilitate students in studying English [3]. These items can be library books, hardware, software, TVs, desks, chairs, etc., whose details are stored in the Center's database for future maintenance. OLC Assets System is a web based system that grants user's access to enter details of each item into the database by completing a simple form. The performance of the system is tested under the situation where there are multiple users who have entered a number of items into the database. Figure 2 illustrates the scalability index and XSTest performance index in the context of virtual users and TPS.

b) DCRR

A web based system that provides access to the users to search for a particular restaurant, comment about a restaurant via an electronic evaluation form, and to add a new restaurant into the database. Figure 3 shows two main interfaces of the DCRR system. A number of virtual users accessing the system to add a new restaurant are taken as the scenario for this performance testing.

c) Employee Directory

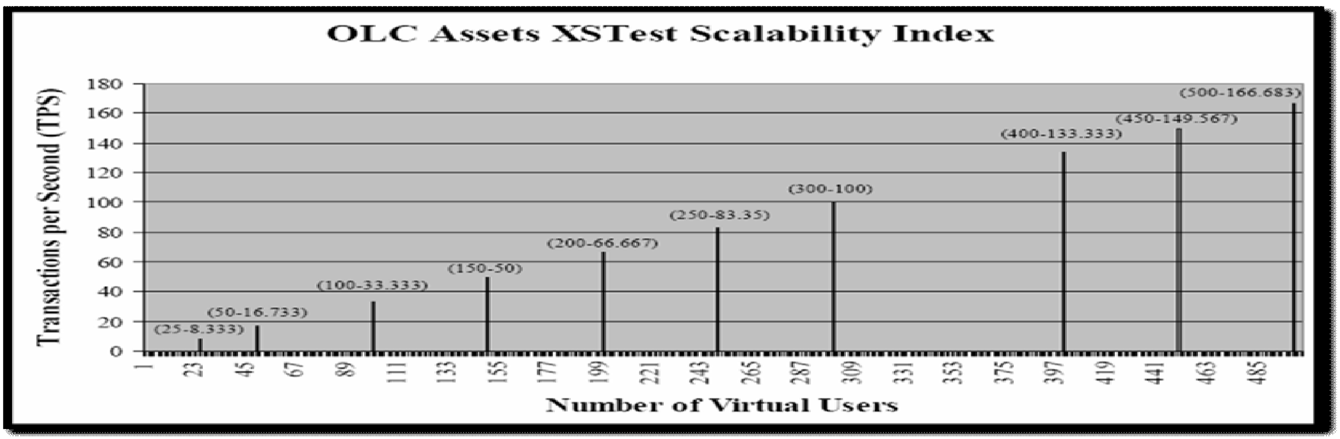
This web based system allows users to search for a particular employee and view the details of that employee. Two main interfaces of the system are shown in Figure 4. Performance testing is conducted in the situation where there are an increasing number of users searching for a particular employee.

IV. Test Results and Discussion

The three systems are tested using a range of concurrent virtual users (2 - 500) in one minute. Because of the limited resources, the maximum number of virtual users was set to 500. The output graphs (Figure 2, 3, and 4) which starts from 25 virtual users are redrawn based on the original graphs because as they do not show the ratio between number of virtual users appropriately. The original graphs are generated by TestMaker, one of the open source software that supports performance testing.

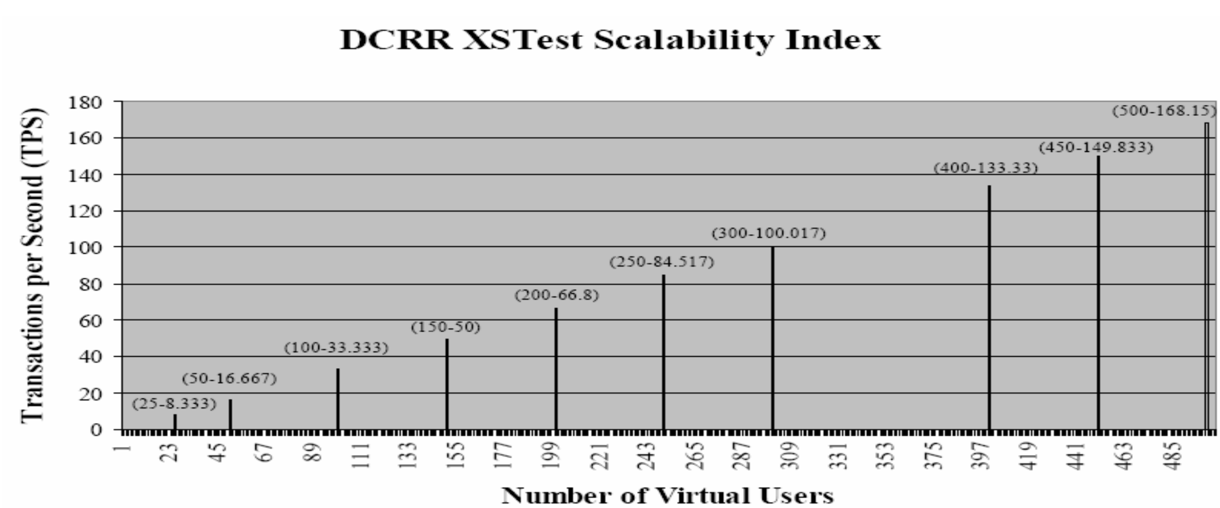
Each graph describes the number of successful transactions per second (TPS) versus the number of virtual users. The term "transactions per second" is defined as the number of pages per second a server can generate. It can be seen from the graph that as the number of users rises, the number of transactions per second gradually increases.

This indication shows that the server is still able to handle a large amount of concurrent requests. On the other hand, if the number of transactions per second drops as the number of users increases, which indicates that there is a concurrency problem and hence leading to performance problem. Although the results generated verify that the servers are still able to manage a large amount of concurrent requests; it is believed that when the number of users keeps growing, the server will fail to handle these requests at some point. Figure 2 illustrates the OLC Assets System – XSTest Performance Index, Figure 3 indicates the DCRR system performance index and Figure 4 shows the Employee Directory system performance
index.



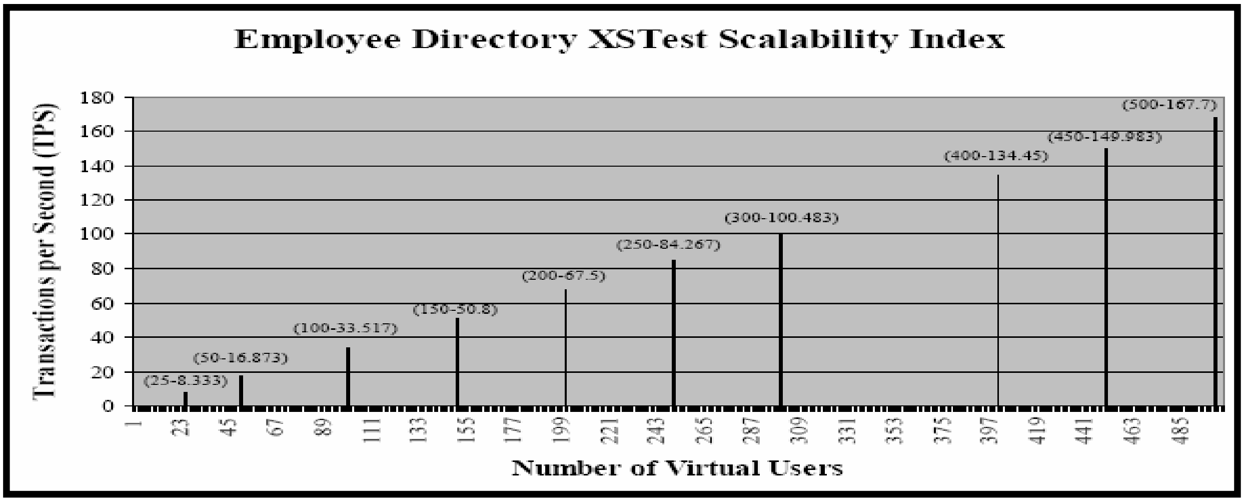
Number of Virtual Users	25	50	100	150	200	250	300	400	450	500
Transaction per Second (TPS)	8.333	16.733	33.333	50	66.667	83.35	100	133.333	149.567	166.683

Fig. 2 : OLC Assets System – XSTest Performance Index



Number of Virtual Users	25	50	100	150	200	250	300	400	450	500
Transaction per Second (TPS)	8.333	16.873	33.517	50.8	67.5	84.267	100.483	134.45	149.983	167.7

Fig. 3 : DCRR System – XSTest Performance Index



Number of Virtual Users	25	50	100	150	200	250	300	400	450	500
Transaction per Second (TPS)	8.333	16.667	33.333	50	66.8	84.517	100.017	133.33	149.833	168.15

Fig. 4 : Employee Directory System – XSTest Performance Index

V. Performance testing tools

The fact that performance testing helps in providing valuable information about the system's performance led to the development of number of performance testing tools. This section examines the strengths and weaknesses of three open source performance testing tools; viz., TestMaker, OpenSTA, and httperf.

a) TestMaker

It is a comprehensive testing framework that is used for performance, functionality, and load testing. A variety of test cases can be generated to perform thorough testing. TestMaker can support the Open Internet Protocols (HTTP, HTTPS, SOAP, XML-RPC, SMTP, POP3, IMAP, etc.). This software allows testers to create a number of virtual users and with the support from Test Network, testers can generate up to 10,000 or more concurrent test agents. TestMaker generates a clear output graph that represents the performance of the server based on the number of transactions per second versus the number of virtual users.

Apart from the strengths that are provided in the open source version, the commercial version offers some additional features such as the XSTest Pro that delivers performance index which helps to identify performance problems for capacity planning. Service Monitor System can send notifications via emails to notify, when a service fails or responds too slowly. Reports (charts and graphs) are generated to show the Performance index, result timing distribution, and performance timing by operation. This is an extremely useful feature since it is the quickest way to analyze the performance of the system. Another feature called Test Network, allows testers to generate a large amount of virtual users to test a specific web service.

On the contrary, TestMaker does have some weaknesses. Graphs are generated based on the number of transactions per second. In doing so, it assumes that all transactions are the same, even though some transactions may be long or short or complex. There is a possibility that a complex transaction may take shorter time to complete and this is not reflected on the graph. In addition, test cases should be performed more than one time to get the correct outputs.

b) OpenSTA

It is a completely free framework for testing the performance of Web Application Environments (WAEs). It is designed to create and run HTTP/S load tests in order to assess the performance of WAEs. OpenSTA provides a very simple GUI to create a new test, new collector, and a new script.

A new script is written in Script Control Language (SCL) and created by recording a list of activities that are carried out by the users. According to OpenSTA documentation [5], the process of creating collectors involves "deciding from which host computers or other devices performance data has to be collected and the type of data to collect".

After scripts and collectors are created, they are added into a test. Each test can be edited and controlled by using a number of features that are provided by the Graphical User Interface. These features include description about the test, start time, number of iterations, host name, number of virtual users, duration of the test, delay between each iteration, etc. Test can be monitored during execution and the result is displayed in graph when the test completes. Graphs can be customized to improve the presentation of data.

Finally, Easy to follow documentation along with online help and commercial support are provided by the vendors. One of the weaknesses is that OpenSTA can only support HTTP and HTTPS protocols; it can only run on Windows OS. Another difficulty is that testers have to understand the SCL language.

c) httperf

It is a tool for measuring web server performance. A test is executed at the command line by specifying hostname, port, page address, rate, number of connections, and timeout. Timeout features help testers to define the number of seconds that each client is willing to wait for the response from the server. When a test completes, the result is generated in the form of plain text. Mosberger and Jin explained that the output consists of six groups [1]. These groups covers the overall results, results pertaining to the TCP connections; requests that were sent; results for the replies that were received; CPU and network utilization figures and a summary of the errors that occurred. A performance graph is generated by httperf to illustrate the server performance. httperf has some weaknesses such as it only supports the HTTP protocol and can only run on a Linux OS. In addition, Mosberger and Jin point out that the testers have to start httperf on each client machine collect and summarize each clientresult. They also suppose that a single command line that can control multiple clients could help in improving httperf.

Table 1 : Comparative Analysis of performance Testing Tools

FEATURES	TOOLS		
	TestMaker	OpenSTA	httperf
Unix OS	✓		✓
MacOS X	✓		
Windows OS	✓	✓	
Support Junit Test	✓		
Commercial Version	✓		
Open Source Version	✓	✓	
Extensible Library of Protocols (HTTP, HTTPS, SOAP, XML-RPC, SMTP, POP3, IMAP)	✓	Only HTTP & HTTPS	Only HTTP
Friendly and easy to use GUI	✓	✓	
Support J2EE and .NET	✓		
Support for Test Result Analysis (i.e. graphs and charts)	✓	✓	
Object Oriented	✓		✓
Maintainability and Support	✓	✓	
Agent Recorder	✓	✓	
Sample Test Agent	✓		
Run Test from Command Line	✓		✓
Support for Virtual Users	✓	✓	✓
P2P Support			

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GPL Open Source License	✓	✓	
Script Control Language		✓	
Transaction per Second	✓		
Calculate the rate of data transfer (bytes/sec)		✓	
Timeout Management		✓	✓

VI. Conclusion

A distributed database is not stored in its entirety at a single physical location. Instead, it is spread across a network of computers that are geographically dispersed and connected via communications links. A key objective for a distributed system is that it looks like a centralized system to the user. The user should not need to know where a piece of data is stored physically. Testing the performance of such an environment is really a typical task. Existing web-application performance-testing tools offer a broad variety of functionality. However, none of them combines all the functionality we expected to use in our projects. In an ideal world, everything works perfectly when the test is run. In reality, first runs often show problems in server configuration or in application itself. An effort has been made to test the performance of DDB systems like OLC Assets, DCRR and Employee Directory using some open source performance testing tools like TestMaker, OpenSTA and httperf.

References Références Referencias

1. Mosberger, D. & Jin, T., httperf – A Tool for Measuring Web Server Performance.
2. Neuman, B. C., Scale in Distributed Systems. Readings in Distributed Computing Systems. IEEE Computer Society Press.
3. OLC Assets System – University of Otago Language Centre. (2005).
4. R. Mahammad Shafi, Dr. B. Kavitha – A Framework for Designing and Testing a Distributed Database System, Proceedings of AMCM-2011.
5. Tanenbaum, A. S., & Steen, M. V., Distributed Systems – Principles and Paradigms. America: Prentice-Hall.
6. Emmerich, W. (1997). Distributed System Principles. UK: University College London.
7. Yuanling Zhu and Kevin Lu, Performance analysis of Web Database systems, LNCS, Volume1873/2000, pp 805-814, 2000
8. Codd, E.F., "A Relational Model of Data for Large Shared Data Banks". Communications of the ACM 13 (6): 377-387, 1970
9. Stonebraker, Michael with Moore, Dorothy. Object-Relational DBMSs: The Next Great Wave. Morgan Kaufmann Publishers, 1996.
10. Yao-S Bing, Alan R. Hevner, A Guide to Performance Evaluation of Database Systems, Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402,1984
11. Haran Boral, David J DeWitt, A methodology for database system performance evaluation, ACM SIGMOD Record, Volume 14, Issue 2, June 1984
12. Peter G. Harrison and Catalina M. Llado, Performance Evaluation of a Distributed Enterprise Data Mining System, Vol 1786/2000,pp 117-131, 2000
13. C. J. Date: "What is a Distributed Database System?" in Relational Database writings 1985-1989, reading, Mass:Addision-Wesley (1990).
14. Stefano Ceri and Giuseppe Pelagatti: Distributed Databases: Principles and Systems, New York, McGrawHill (1984).

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Secure Key Distribution using Quantum Cryptography

By S.G.K Murthy, MV Ramana Murthy, M. Shuaib Qureshi, Mohamed Asslam Madathilakath & Mahaboob Sharief Shaik

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Abstract - Cryptography plays a vital role in Internet based applications. Present cryptographic systems on classical computers are providing sufficient security by utilizing symmetric and asymmetric cryptographic technologies but the advent invention of quantum computer makes the present asymmetric cryptographic systems vulnerable. The Quantum theory, which makes present cryptographic systems vulnerable, provides an alternative approach for secure key distribution. This paper depicts various issue related to conventional as well as quantum cryptography and secure key distribution using quantum cryptography.

Keywords : *cryptography, symmetric, asymmetric, security, key, quantum, photons.*

GJCST-B Classification: *D.4.6*

SECURE KEY DISTRIBUTION USING QUANTUM CRYPTOGRAPHY

Strictly as per the compliance and regulations of:

Secure Key Distribution using Quantum Cryptography

S.G.K Murthy [α], MV Ramana Murthy [σ], M. Shuaib Qureshi [ρ], Mohamed Asslam Madathilakath [Ѡ] & Mahaboob Sharief Shaik[¥]

Abstract - Cryptography plays a vital role in Internet based applications. Present cryptographic systems on classical computers are providing sufficient security by utilizing symmetric and asymmetric cryptographic technologies but the advent invention of quantum computer makes the present asymmetric cryptographic systems vulnerable. The Quantum theory, which makes present cryptographic systems vulnerable, provides an alternative approach for secure key distribution. This paper depicts various issue related to conventional as well as quantum cryptography and secure key distribution using quantum cryptography.

IndexTerms : cryptography, symmetric, asymmetric, security, key, quantum, photons.

I. Introduction

Information security is emerging filed in computing. Various security features are attained by using different cryptographic algorithms (symmetric and asymmetric). Present asymmetric cryptographic systems are based on certain hard problems, which cannot be solved in polynomial time. The key length is decided, such a way that it takes exponential time to break the key [1]. With the invention of quantum computers, proved that, it is possible to achieve enormous speed (computation) in solving certain hard problems. As a result current asymmetric cryptographic systems are not proficient of granting absolute security in near future. However the same quantum theory provides an alternative approach for absolute security [3]. This method of distributing, quantum key with the help of quantum physics can provide absolute security to information.

II. Present Cryptographic Systems

Presently there are two types of cryptographic systems available for confidentiality. In symmetric cryptographic systems, single key (secret key) is shared by the sender and recipient. These systems are not useful in large environment [2]. To overcome the with these systems, asymmetric cryptographic systems have been developed. In these systems pair of public and private keys is related mathematically with the property that the private key cannot be derived from public key.

Any information, which is encrypted by a public key, is decrypted only with the corresponding private key. This is a well-known method used by public key cryptographic systems to achieve confidentiality. As asymmetric cryptographic systems are based on very large number based computations and (unlike symmetric cryptographic systems) entire key is used directly in operation, the system becomes slower in encryption and decryption process. So these systems are used for secure key distribution as well as digital signatures.

Secure key distribution problem is solved by asymmetric cryptographic systems. Secret key can be used as a onetime pad. By using asymmetric cryptographic systems users can transmit secret key securely [5].

All asymmetric cryptographic algorithms are depending on a fact that certain mathematical functions can be done easily in one direction but not reverse. These types of functions are called trapdoor one-way functions.

RSA algorithm is a most famous asymmetric cryptographic algorithm that derives its strength from the hard problem, factorization of large composite numbers into two large prime integers. Factorization of very large integers is very difficult further it is exponentially growing, by adding each digit [4]. For a reasonable security, to be achieved, a 1024-bit key size is recommended in RSA cryptographic system. It is realized that for any asymmetric system, the ultimate strength lies on hard problem. Whether the hard problem is prime factorization or discrete logarithm, it takes enormous time for the present classical computers to break the key [6].

Presently, quantum and DNA based computing are newly emerging research areas, which facilitate faster computing. The invention of quantum computer has proved its strength in factorizing very large integers in polynomial time, which makes all asymmetric cryptographic systems vulnerable. To solve this problem, a new way of key distribution by using quantum physics has been proposed. This concept is based on certain fundamental properties of photons,

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like quantum entanglement, polarization of photons etc that provides absolute security.

An agreed random sequence of bits generated by quantum cryptography can be used as one time pad cipher, by using existing symmetric cryptographic system.

III. Quantum Physics

Photons (normal light) travel in the space with vibrations. The polarization of photon is the angle of vibration. The angle of vibration may vary in normal light even photons are travelling in the same direction. An un-polarized light is generated by normal light. We are considering four possible polarizations of photons in this paper, which are left, right, horizontal and vertical diagonals [1].

The orthogonal quantum states perception is raised by the two photons with vertical ('V') or horizontal ('H') polarization. 'V' and 'H' photons never pass from the polarizer that is destined for the other photon. Hence both 'H' and 'V' photons are two orthogonal quantum states of a photon [3]. Additionally 'H' and 'V' form a basis for the space of polarizations. Sending an un-polarized light through a Polaroid can generate a light of a particular polarization. The polarization of the polarized light is decided by the axis of the Polaroid.

In classical computers a bit has two logical states either 0 or 1. Unlike classical bits, quantum bits (qbits) can have two values at once. A qbit can exist in a coherent superposition of the two states. so that in quantum computers, one qbit can be encoded as 0 and 1 at any given moment. As L qbits are capable of storing 2^L numbers at time, a quantum computer performs massive parallel computation in a single operation on 2^L different numbers. To achieve the same task, it takes 2^L computations by classical computers. This feature helps quantum computers to factor large integers in polynomial time. Shor's algorithm facilitates efficient factorization of very large numbers by using quantum principles.

We cannot measure every aspect of a particle at the same time. The measuring of one aspect destroys the possibility of measuring the other aspect. This natural uncertainty is used as a concept to generate a secrete key. Further this secret key is used by utilizing symmetric cryptographic systems to achieve absolute security.

Considering the representation of binary numbers by orthogonal quantum states, quantum mechanics provide powerful new methods for information transmission.

IV. Quantum Concepts for Key Distribution

The author [7] states the photon polarization between Bob and Alice. If Alice polarized a photon in a given direction and Bob measured it in the same direction with Polaroid, the Bob acquires the photon with certainty. But random result will be acquired by Bob if he measures it is wrong direction depending upon the probability. So using quantum mechanics, how two parties could agree on a secret key is described as follows.

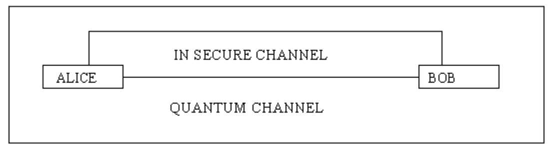

Fig. 1 : Key Distribution

Two communication channels i.e. insecure channel and quantum channel must be used by Bob and Alice for communication as shown in Fig.1.

For quantum bits communication, quantum channel is used, while as for symmetric cryptographic and general encryption, insecure channel is used.

Step 1 – Alice starts communication with the Bob by sending a series of randomly polarized photon.

Assume Alice communicates with the Bob by sending photons in the following polarizations.

| | \ — — \ — | / / | —

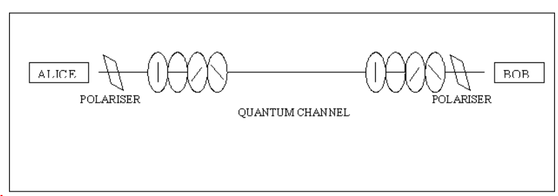

Fig. 2 : Quantum Channel Communication

Step 2 – At the Bob's side, there is a photons detector called as polarizer that detects the photons. For measuring the diagonal polarizations or rectilinear, Bob can amend the polarizer in any one direction. But due to the natural uncertainty of photons, this process is not doable for both.

Suppose Bob adjust his polarizer in the following directions corresponding to each photon.

Z + Z Z + + Z + Z + + Z

If the polarizer setting and the corresponding photon's polarization are matched with each other, then Bob gets the photon through the Polarizer. Suppose Bob acquires the below result,

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Step3 – Now Alice is informed by the Bob about the adopted setting using in-secured channel.

Step4 – Alice notifies Bob which settings are approved.

Step5 – Those polarizations are considered by Alice and Bob who were appropriately measured.

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Then the photons polarization measurements are translated into bits using pre arranged code. The below string of bits is generated by translating the above commonly agreed polarizations,

0 0 1 0 1 0

0.5 is the average probability of estimating the correct polarizations. 2n photons are needed by Alice for generating n bits for transmission.

Step 6 – The integrity of the bit string is checked by Alice and Bob using testing.

Step 7- If the integrity test is verified, the same bit string is used as one time pad. Else the above procedure is repeated.

Using the above scheme, Bennet and Brassard proposed an operational model of quantum key distribution. Quantum cryptography provides absolute security by exchanging a series of qbits through fiber optic link.

V. Conclusion

In this paper the factorization issue created by quantum computers and the way that quantum cryptographic system providing a method to achieve absolute secrecy by utilizing quantum key distribution is discussed. Presently quantum cryptography has already been demonstrated by using optical-fiber networks. Over long distance, transmission of polarized photons without the use of fiber optics is proved by the latest experiments, but digital signature is one of the important features, widely used for internet related applications, achieved by asymmetric cryptographic systems. As the invention of quantum computers makes the present asymmetric cryptographic systems vulnerable, there is a need to form a method to create quantum digital signatures. In comparison to classical bit storages, storing quantum states is more difficult and generation and verification of quantum digital signatures requires extensive research in this direction.

References Références Referencias

1. Singh, S. Code, The Evolution of Secrecy from Mary, Queen of Scots to Quantum Cryptography, Doubleday, 1999.
2. Schneier B, Applied Cryptography, John Wiley New York, 2000.
3. Zeilinger, A, Fundamentals of Quantum Information, Physics world, March 1998.
4. William Stallings, Cryptography and Network Security Principles and practices, Pearson Education Ltd, Delhi, 2003.
5. Stinson, D, cryptography: theory and Practice, CRC Press, 2002.
6. Omar M.B, A. Irshad Khan, Mahaboob S. Shaik, MV Ramana Murthy, “Secure Communication using Symmetric & Asymmetric Cryptographic Techniques” I.J. Information Engineering and Electronic Business, pp. 36-42, 2012.
7. SGK Murthy, M.V.Ramana Murthy, P.Ram Kumar, New Trends in Cryptography by Quantum Concepts, Advances in Computer and Information Sciences and Engineering, pp. 428-432, 2008.

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A Survey on Secure Storage Services in Cloud Computing

By Ms. B.Tejaswi, Dr. L.V.Reddy & Ms. M.Leelavathi
Sree Vidyanikethan Engg College, Tirupati-AP, India

Abstract - Cloud computing is an emerging technology and it is purely based on internet and its environment. It provides different services to users such as Software-as-a-Service (SaaS), PaaS, IaaS, Storage-as-a-service (SaaS). Using Storage-as-a-Service, users and organizations can store their data remotely which poses new security risks towards the correctness of data in cloud. In order to achieve secure cloud storage, there exists different techniques such as flexible distributed storage integrity auditing mechanism, distributed erasure-coded data, Merkle Hash Tree(MHT) construction etc. These techniques support secure and efficient dynamic data storage in the cloud. This paper also deals with architectures for security and privacy management in the cloud storage environment.

Keywords : cloud computing, data correctness, distributed data integrity, auditing, security.

GJCST-B Classification: C.2.1

A SURVEY ON SECURE STORAGE SERVICES IN CLOUD COMPUTING

Strictly as per the compliance and regulations of:

A Survey on Secure Storage Services in Cloud Computing

Ms. B.Tejaswi [α], Dr. L.V.Reddy [σ] & Ms. M.Leelavathi [ρ]

Abstract - Cloud computing is an emerging technology and it is purely based on internet and its environment. It provides different services to users such as Software-as-a-Service (SaaS), PaaS, IaaS, Storage-as-a-service (SaaS). Using Storage-as-a-Service, users and organizations can store their data remotely which poses new security risks towards the correctness of data in cloud. In order to achieve secure cloud storage, there exists different techniques such as flexible distributed storage integrity auditing mechanism, distributed erasure-coded data, Merkle Hash Tree(MHT) construction etc. These techniques support secure and efficient dynamic data storage in the cloud. This paper also deals with architectures for security and privacy management in the cloud storage environment.

Keywords : cloud computing, data correctness, distributed data integrity, auditing, security.

I. Introduction

From the perspective of data security in cloud, this has always been an important aspect of quality of service. The data stored in the cloud may be frequently updated by the users, including insertion, deletion, modification, appending, reordering, etc. To ensure storage correctness under dynamic data update is hence of paramount importance. In [1], as cloud-based services continues to grow, it has become clear that one of the key barriers to rapid adoption of enterprise cloud services is customer concern over data security (confidentiality, integrity, and availability). According to sun micro systems, the concept of transparent security makes the case that the intelligent disclosure of security design, practices, and procedures can help to improve customer confidence. According to K Ren, C.Wang and Q.Wang (Ref [2]), cloud storage allows data owners to outsource their data to cloud. However owners no longer have physical possession of the outsourced data raises big security concerns on the storage correctness. Hence, enabling secure storage auditing in the cloud environment with new approaches becomes imperative and challenging. In [3], the authors specified a new scheme called Proof of Retrievability (POR), is a kind of cryptographic proof and is designed to handle large file. In [4], the authors introduced a model for provable data possession (PDP) that allows a client that has stored data at an untrusted server to verify that the server possesses the original data without retrieving it. The PDP model for remote data checking supports large data sets in widely-distributed storage systems.In [5], the authors specified third party auditing which is important in creating online service-oriented-storage economy. It allows customers to evaluate risks. Also the authors introduced two types of auditing mechanisms; those are internal auditing and external auditing. In [6], the authors introduced privacy-preserving protocols. To make storage services accountable for data loss, authors presented protocols that allow a third- party auditor to periodically verify the data stored by a service and assist in returning the data intact to the customer. Most importantly, protocols for privacy-preserving never reveal the data contents to the auditor. In [7], the authors dealt with data dynamics. In order to achieve efficient data dynamics authors improved the Proof of Retrievability model by manipulating the classic Merkle Hash Tree (MHT) construction for block tag authentication. In [8], the authors (Q. Wang, K. Ren, W. Lou, and Y. Zhang) proposed a novel dependable and secure data storage scheme with dynamic integrity assurance. Based on the principle of secret sharing and erasure coding, they first proposed a hybrid share generation and distribution scheme to achieve reliable and fault-tolerant initial data storage by providing redundancy for original data components. In [10], the authors introduced the concept of an aggregate signature, and presented security models for such digital signatures, and given several applications for aggregate signatures. They have constructed an e-client aggregate signature from a recent short signature scheme based on bilinear maps. In [10], the authors described a privacy manager for cloud computing, which reduces the risk to the cloud computing user of their private data being stolen or misused, and also assists the cloud computing provider to conform to privacy law. They described different possible architectures for privacy management in cloud computing; given an algebraic description of obfuscation, one of the features of the privacy manager; and described how the privacy manager might be used to protect private metadata of online photos. In [11], the authors explored a newly emerging problem of information leakage caused by indexing in the cloud.

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They designed a three-tier data protection architecture to accommodate various levels of privacy concerns by users. According to the architecture, they developed a novel portable data binding technique to ensure strong enforcement of users' privacy requirements at server side.

II. Methods

a) *Concept of Transparent security*

According to NIST (National Institute of Standards and Technology)Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

i. *Definition of Transparent security*

Transparent security can be defined as appropriate disclosure of the governance aspects of security design, policies, and practices. A security policy explains the high level approach to security and typically represents an organization's executive management position on security and risk. The policy might state that user data will be protected from unauthorized access both while being stored in the cloud and while in transit. The security design might then go into more detail by specifying that file-level encryption will be used along with an identity management implementation that restricts access to stored data. Security practices might also drill down further, describing the processes for proper management of encryption keys. The actual implementation would then choose a specific encryption algorithm such as Advanced Encryption Standard (AES).

ii. *Transparent Security Principles*

The following transparent security principles help to identify the types of information that should and/or should not be disclosed. The following conditions are examples of when disclosure is recommended:

- Principle-1—Disclosure of common security policies and practices. Common security features such as the use of firewalls and encryption of data in transmission or at rest should be disclosed because they are considered basic security features that most security people would expect to be in place anyway.
- Principle-2—Disclosure when mandated. When disclosure is imperative due to a legal or regulatory requirement, then this disclosure must be performed.
- Principle-3—Security architecture. Security architectural details that may either help or hinder security management should be disclosed. For example, the implementation of secure by default configuration should be disclosed. However, if these types of details also create a security risk as described in other items below, disclosure would not be appropriate.
- Principle-4—Governance. It means responsibilities of the customer versus those of the cloud providers, should be clearly articulated so that the customers are clear on what they must do themselves to protect their data.

b) *Proof of Retrievability (POR) Model*

POR protocol encrypts F and randomly embeds a set of randomly-valued check blocks called *sentinels*. The use of encryption here renders the sentinels indistinguishable from other file blocks. The verifier challenges the prover by specifying the positions of a collection of sentinels and asking the prover to return the associated sentinel values. If the prover has modified or deleted a *substantial* portion of F, then with high probability, it will also have suppressed a number of sentinels. It is therefore, unlikely to respond correctly to the verifier. To protect against corruption by the prover of a small portion of F error correcting codes are there. Let F' refer to the full, encoded file stored with the prover.

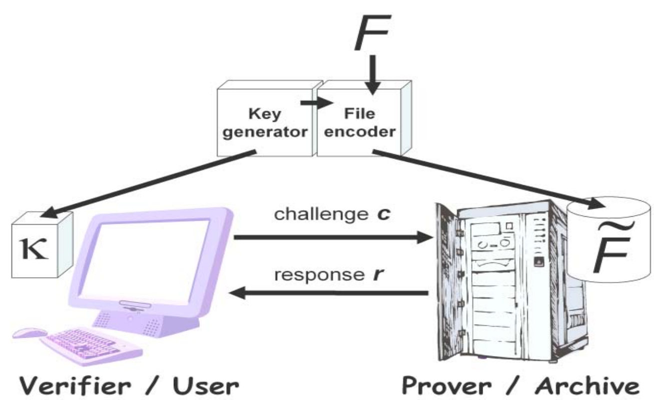


Fig. 2.2.1 : Schematic diagram of a POR system

An encoding algorithm transforms a raw file F into an encoded file *F* to be stored with the prover / archive. A key generation algorithm produces a key stored by the verifier and used in encoding.

c) *Provable Data Possession (PDP) Model*

Provable data possession (PDP) model provides probabilistic proof that a third party stores a file. The model is unique in that it allows the server to access small portions of the file in generating the proof; the above technique is used to access the entire file. Within this model, the authors (Ref [4]) give the first provably-secure scheme for remote data checking. The client stores a small O (1) amount of metadata to verify the server's proof. This model uses homomorphic verifiable tags. Because of the homomorphic property, tags computed for multiple file blocks can be combined into a single value. The client pre-computes tags for each block of a file and then stores the file and its tags with a server. At a later time, the client can verify that the server possesses the file by generating a random challenge against a randomly selected set of file blocks. Using the queried blocks and their corresponding tags, the server generates a proof of possession. The client is thus convinced of data possession, without actually having to retrieve file blocks. A PDP protocol checks that an outsourced storage site retains a file, which consists of a collection of n blocks. The client C (data owner) pre-processes the file, generating a piece of metadata that is stored locally, transmits the file to the server S, and may delete its local copy. The server stores the file and responds to challenges issued by the client.

d) Third Party Auditing (TPA)

Third Party Auditor: an entity, which has expertise and capabilities that clients do not have, is trusted to assess and expose risk of cloud storage services on behalf of the clients upon request. The task of TPA is to verify integrity of the dynamic data stored in the cloud. Users rely on the CS for cloud data storage and maintenance. They may also dynamically interact with the CS to access and update their stored data for various application purposes. The users may resort to TPA for ensuring the storage security of their outsourced data, while hoping to keep their data private from TPA. We consider the existence of a semi-trusted CS as does. Namely, in most of time it behaves properly and does not deviate from the prescribed protocol execution. However, during providing the cloud data storage based services, for their own benefits the CS might neglect to keep or deliberately delete rarely accessed data files which belong to ordinary cloud users. Moreover, the CS may decide to hide the data corruptions caused by server hacks or Byzantine failures to maintain reputation. We assume the TPA, who is in the business of auditing, is reliable and independent, and thus has no incentive to collude with either the CS or the users during the auditing process.

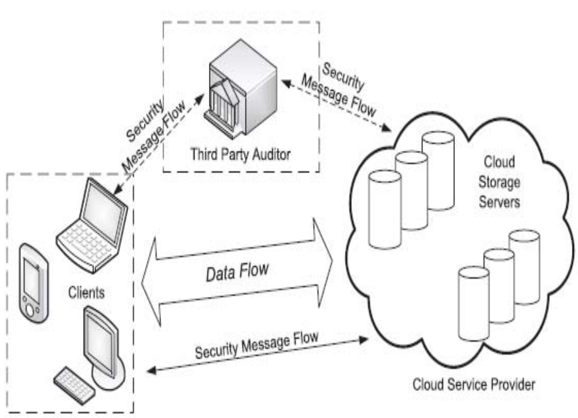


Fig. 2.4.1 : Cloud data storage architecture

e) Secret sharing and Erasure coding

Secret Sharing- Shamir proposed an *(m, n)* Secret Sharing (SS) scheme based on polynomial interpolation, in which *m* of *n* shares of a secret are required to reconstruct the secret.

Erasure Code -An *(k, n)* erasure code encodes a block of data into *n* fragments, each has 1/*k* the size of the original block and any *k* fragments can be used to reconstruct the original data block. Examples are Reed Solomon (RS) codes and Rabin's Information Dispersal Algorithm.

In the basic scheme, suppose a sensor node *v* has *data* to be stored locally. To protect *data*, it can perform the following operations to ensure the data integrity and confidentiality:

- **Step 1**: Generate a random session key *kr* and compute the keyed hash value *h*(*data, kr*) of *data*.
- **Step 2:** Encrypt *data*, *h* (*data, kr*) with *kr* and obtain *{data, h* (*data, kr*) *}kr* .
- **Step 3**: Encrypt *kr* using the key KUV shared between the authorized users and itself. This key can be either symmetric or asymmetric depending on the chosen user access control mechanism, which is independent to our design here and will not be discussed in this paper.
- **Step 4:** Store DATA $= <$ *{data, h*(*data, kr*) *}kr* , *{kr}KUV* $>$ and destroy *kr*.

III. Architectures

a) Privacy Manager in the Client

Privacy Manager Software on the client helps users to protect their privacy when accessing cloud services. A central feature of the Privacy Manager is that it can provide obfuscation and de-obfuscation service, to reduce the amount of sensitive information held within the cloud. Privacy Manager allows the user to express privacy preferences about the treatment of their personal information, including the degree and type of obfuscation used. Personae – in the form of icons that correspond to sets of privacy preferences – can be used to simplify this process and make it more intuitive to the user.

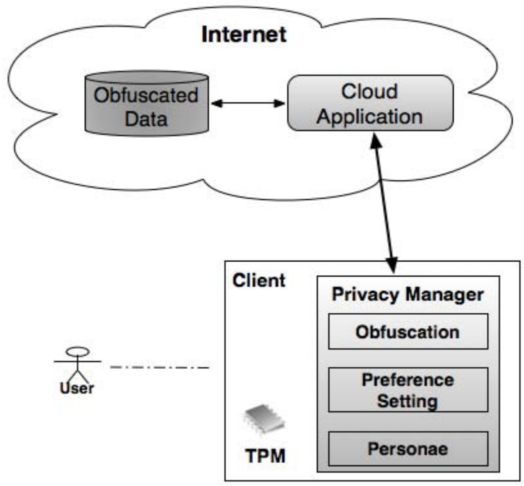
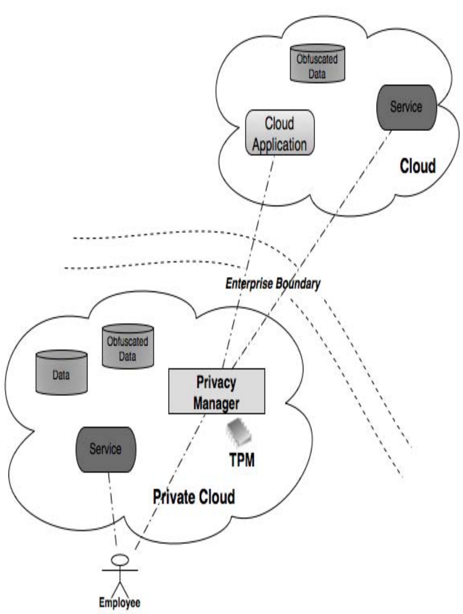


Fig. 3.1.1 : Client-Based Privacy Manager

b) Privacy Manager in a Hybrid Cloud

Privacy Manager may be deployed in a local network, or a private cloud, to protect information relating to multiple parties. This would be suitable in environments, such as enterprise environments, where local protection of information is controlled in an adequate manner and its principal use would be to control personal information passing to a public cloud.

Fig. 3.2.1 : Enterprise-focused Privacy Manager



Advantages to this approach include that the benefits of the cloud can be reaped within the private cloud, including the most efficient provision of the Privacy Manager functionality. It can provide enterprise control over dissemination of sensitive information, and local compliance. The Privacy Manager would act on behalf of the user and decide the degree of data transfer allowed, based upon transferred user policies and the service context, and preferably also an assessment of the trustworthiness of the service provision environment.

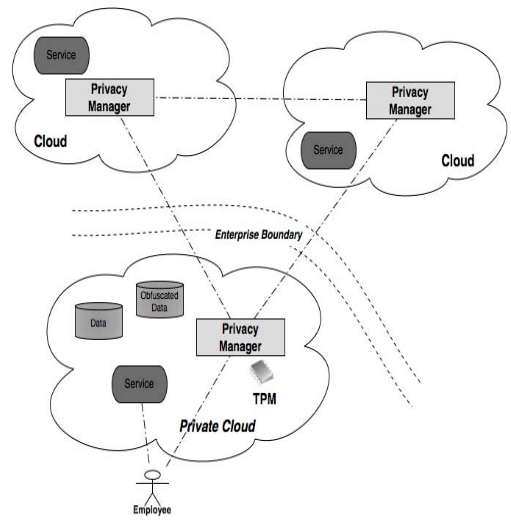


Fig. 3.2.2 : Privacy Manager within the Cloud

IV. Conclusion

This paper dealt with different security models to protect the data which is stored in the cloud. According to the user requirements, they may choose the most appropriate model. However, in the case of Third Party Auditing (TPA), cloud data storage security is critical because of its poor service quality. This paper also dealt with different architectural representations for privacy management. We provide the extension of the proposed one to support TPA, so that the users can safely delegate the integrity checking tasks.

References Références Referencias

1. Sun Microsystems, Inc., "Building Customer Trust in Cloud Computing with Transparent Security," https://www.sun.com/ offers/details/sun_ transparency.xml, White paper, Nov. 2009
2. K. Ren, C. Wang, and Q. Wang, "Security Challenges for the Public Cloud," IEEE Internet Computing, vol. 16, no. 1, pp. 69-73, 2012.
3. A. Juels and B.S. Kaliski Jr., "PORs: Proofs of Retrievability for Large Files," Proc. 14th ACM Conf. Computer and Comm. Security (CCS '07), pp. 584-597, Oct. 2007.
4. G. Ateniese, R. Burns, R. Curtmola, J. Herring, L. Kissner, Z. Peterson, and D. Song, "Provable Data Possession at Untrusted Stores," Proc. 14th ACM Conf. Computer and Comm. Security (CCS '07), pp. 598-609, Oct. 2007.
5. M.A. Shah, M. Baker, J.C. Mogul, and R. Swaminathan, "Auditing to Keep Online Storage Services Honest," Proc. 11th USENIX Workshop Hot Topics in Operating Systems (HotOS '07), pp. 1-6, 2007.

6. M.A. Shah, R. Swaminathan, and M. Baker, "Privacy- Preserving Audit and Extraction of Digital Contents," Cryptology ePrint Archive, Report 2008/186, http://eprint.iacr.org, 2008.
7. Q. Wang, C. Wang, J. Li, K. Ren, and W. Lou, "Enabling Public Verifiability and Data Dynamics for Storage Security in Cloud Computing," Proc. 14th European Conf. Research in Computer Security (ESORICS'09), pp. 355-370, 2009.
8. Q. Wang, K. Ren, W. Lou, and Y. Zhang, "Dependable and Secure Sensor Data Storage with Dynamic Integrity Assurance," Proc. IEEE INFOCOM, pp. 954-962, Apr.2009.
9. D. Boneh, C. Gentry, B. Lynn, and H. Shacham, "Aggregate and Verifiably Encrypted Signatures from Bilinear Maps," Proc. 22nd Int'l Conf. Theory and Applications of Cryptographic techniques (Eurocrypt '03), pp. 416-432, 2003.
10. S. Pearson, Y. Shen, and M. Mowbray, "A Privacy Manager for Cloud Computing," Proc. Int'l Conf. Cloud Computing (CloudCom), pp. 90-106, 2009.
11. A. Squicciarini, S. Sundareswaran, and D. Lin, "Preventing Information Leakage from Indexing in the Cloud," Proc. IEEE Int'l Conf. Cloud Computing, 2010.

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The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

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(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

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Key points to remember:

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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.

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· Use present tense to report well accepted

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- Significant conclusions or questions that track from the research(es)

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- 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.
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- 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.

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- 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.
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Approach:

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- Leave out information that is immaterial to a third party.

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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.
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- Do not present the similar data more than once.
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Approach

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- 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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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
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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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