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PREEMPTIVE PRIORITY SCHEDULING WITH AGING TECHNIQUE FOR EFFECTIVE DISASTER MANAGEMENT IN CLOUD

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Abstract- Cloud computing has intern the attention of today's leading IT industries offering huge potential for more flexible, readily scalable and cost effective IT operation. There is a significant anticipation for emergent innovation and expanded capabilities of a cloud-based environment as the cloud services are still in the infant stage. With all technology innovation, the biggest gain will be realized when the Cloud services are efficiently utilized. One of the prime contributions of Cloud is its capacity to handle a huge amount of data for either processing or storing. The inadequacy of this model is that it is prone to disaster. Some of the popular scheduling techniques applied by the researchers and leading IT industries are Round Robin, Preemptive scheduling etc. This research focuses on a novel approach for disaster management through efficient scheduling mechanism.This paper presents a Priority Preemptive scheduling (PPS) with aging of the low priority jobs in Cloud for disaster management. The implementation results show that the jobs at any instance of time are provided with the resources and henceforth preventing them to enter the starvation, which is one of the prime causes for disaster.

Keywords- *Disaster; Starvation; Preemptive; Execution time; Throughput; Reliable; Aging;*

I. INTRODUCTION

The Cloud computing Services are rapidly growing in popularity. It is a pay-go-model which provides high quality services through the popular business models deployed such as Software, Platform and Infrastructure as Services.

A.Software as a Service (SaaS)
SaaS is a multitenant platform, also called as application server provider (ASP) model because it provides subscriber access to both applications and resources. Its customers have provision to access to already developed applications. Microsoft, Net Suite, SalesForce.com (SFDC), Lotus Live, Oracle, IBM etc are some of the providers of SaaS.

B.Platform as a Service (PaaS):
Platform as a Service provides the user with development environment system i.e. the customer can access the component they require to operate and develop applications. Developers and deployers will use this service to deploy and create applications. The providers of PaaS are GAE, Microsoft's Azure, etc.

C.Infrastructure as a Service:
IaaS is the newest technology in cloud computing. It gives the virtual infrastructure. In Iaas the user can select his own infrastructure like network, server, operating system and storage capacity. Go Grid, Flexi scale, Layered technologies, Joyent and mosso/Rack space, Amazon web services, rack space hosting etc are some of the leading IaaS providers.

The regular deployment models in use by service providers and users to use and maintain the cloud services such as the Private, Public, Community and Hybrid cloud [1].

A.Private Cloud:
Data in the private cloud is managed by the single private organization. Hence, to access the resources available in private cloud, the registered users have to adhere to the set of rules to be followed by the group. The importance of private clouds is that data is highly secured, scalability, metering and agility. The Drawbacks of private clouds is that the investment is high as the organization has to spend and maintain the required hardware and software.

B.Public Cloud:

Public cloud can be accessed by any customer with internet connectivity via web applications or services. The significance of public cloud is that the user pays for the use based on the time. The public cloud is easy to configure, easy for deployment and highly elastic. However, security is the major issue of public cloud due to their availability to all users leading to loss of data or stealing of the data.

C.Community Cloud:
Community cloud shares infrastructure between several organizations from a specific community with common security, compliance, jurisdiction, etc. The service is shared by various organizations and made available to only those groups.

D.Hybrid Cloud:
Hybrid Cloud is Combination of two or more Clouds (Private, Public and Community).The Significance of hybrid cloud is its highly Scalable and flexible. The

drawback of hybrid cloud is lack of security. Some of the important hybrid cloud providers are HP and VMware, etc

Cloud computing help users applications enthusiastically provision as many compute resources at particular locality due to the features like shared infrastructure, dynamic provisioning and network access and managed metering, etc. [12]

The performance of the model depends on efficient scheduling and allocation of the resources in the virtualized environment. The system should be highly reliable and secured. There are few challenges like Security and Privacy, associated with this Computing model may cause a slow-down while delivering the services. Disaster is one of the major threats in Cloud Computing [10] [2].

Disaster is an unexpected incident in the system during its life time. In the cloud many applications such as, banking, online shopping, media player, agriculture and health care pop up simultaneously. Due to the concurrency of the jobs, the cloud is overloaded and hence leads to disaster as shown in Figure 1.

Various deployment models the Public cloud,Private Cloud and Hybrid Cloud and Various Cloud Services are prone to Disaster as shown in Table 1.

It is can be observed from TABLE 1 that deadlock, Inefficient scheduling, Non availability of resources are some of the common causes for the occurrence of disasters in various cloud services platforms

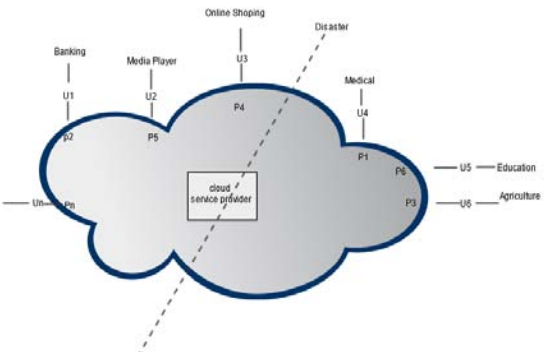

Figure. 1 The Conceptual model of Disaster in Cloud.

TABLE 1: OCCURRENCE OF DISASTER IN VARIOUS DEPLOYMENT MODELS

Cloud models	Cloud services	Disasters Due to	Occurrence of Disaster
Public cloud, Private Cloud And Hybrid Cloud.	Software as a service	DeadLock	Possible
		Inefficient scheduling	
		Non availability of resources	
	Platform as a Service	DeadLock	Possible
		Inefficient scheduling	
		Non availability of resources	
	Infrastructure as a Service	DeadLock	Possible
		Inefficient scheduling	
		Non availability of resources	

One of the major challenges however with upcoming cloud technology is effective Disaster Management. Inefficient Scheduling, Deadlock, Non-availability of resources are some of the factors which influence Disaster in Cloud [1] [8]. Some of the other frequently predictable reasons for disaster include limited energy, power outage, power failure, mobility of nodes, link failures, dynamic topology, limited bandwidth of the nodes, network failure, etc. To have a better business performance, Disaster should be controlled and managed [2].The objective of this research is to control Disaster through efficient Scheduling technique.

Inefficient scheduling leads to a decline in the system performance [11]. Henceforth, it is one of the major causes for the occurrence of Disaster. Efficient Scheduling is one of the remedy to enhance the system performance due to which parameters like availability and reliability of resources could be accomplished. This work presents Priority Preemptive Scheduling with Aging.

A.Priority Preemptive Scheduling

In this scheduling strategy, the scheduler ensures that at any given time, the processor executes the highest priority job (the highest priority may be set with respect to Criticality of the job and ROI) of all those jobs that are currently ready to execute. A time slice will be given to each job to utilize the resources for processing. After the expiry of the time slice the scheduler has the control to reallocate the resources to the next highest priority job in queue [9]. The figure 2 depicts this strategy.

With reference to Figure 2, the Jobs Job_1, Job_2, Job_3 … Job_n are submitted for computation. The submitted jobs are initially put in the general Wait queue. Later the job Priority –Classifier as shown in the figure classifies the jobs into High priority and Low priority jobs. This classification is done with respect parameter like the job criticality, ROI and job size. After classification, the scheduler communicates to the Virtual Machine Manager (VMM) regarding the requirement of the number and size of each virtual machine.

The VMM later supports the formation of virtual machine with required size.

$$VM\ Size\ \alpha\ Job\ Size \ \ldots\ldots (1)$$

The limitation of this approach is that the low priority jobs may wait for indefinite period of time for the requested resources due to which they may enter the starvation state, henceforth this may lead to disaster.

To minimize Disaster in the model, the Aging technique is implemented along with Priority Preemptive Scheduling.

B.Aging of the Jobs

One common method to overcome the situation of starvation of lower priority jobs is Aging. In the Aging process the priority of the job is gradually increased with respect to their wait time in the Wait queue, i.e., more the wait time higher the priority of the Job.

Aging (A) α Wait Time (WT) …….. (2)

The advantage of this strategy is that it improves the system performance by maximum utilization of the requested resources.

The organization of this paper is as follows. Section II of this paper provides Literature Survey, section III Research work, section IV elucidates the result analysis, section V presents the Conclusion.

II. LITERATURE SURVEY

There exist several techniques having their distinctive ways to minimize disaster in the Cloud environment. The identified techniques focus on three different aspects, such as Cost controlling, Data duplication and Security.

Giuseppe Pirr'et al. have proposed a technique an Efficient Routing Grounded on Taxonomy (ERGOT),which is a semantic based system for service discovery in distributed and cloud computing environment. It compromises of 3 components namely (i) a Distributed Hash Table (DHT), (ii) a Semantic Overlay Network (SON) (iii) a semantic Similarity Measure. Their work provides an efficient approach to retrieve data [5][7].

Vijaykumar Javaraiah has proposed a simple approach for data recovery and data backup. He has suggested a Linux box for the data back up and disaster recovery. However, the drawback of this approach is that it is not possible to achieve complete server backup due to low bandwidth [6].

Yoichiro Ueno et.al, have focused on data backup and data recovery. They have used High Security Distribution and Rake Technology (HS-DRT). HS-DRT is a file back-up model, which makes use of an effective load balancing mechanism for scalability and a high-speed encryption technology [3][7].

However, Chi-won Song et al., have proposed (PCS) Parity Cloud Service for data backup and data recovery. This is applied for data recovery based on Parity recovery service. This approach recovers data with high probability and generates a virtual disk in the user's system for data backup [4].

Manish Pokharel et al. have suggested a reliable Markov model approach for disaster recovery. This model has lower energy loss and further the model has low implementation cost. With this approach the authors were able to achieve, high availability, high survivability and short downtime [13].

The authors, Andrea Bianco et al. have recommended that in order to support the recovery process and operational services, the resources should be distributed fairly and efficiently. They further indicated that disaster recovery has two key elements i.e. backing up data at remote sites and reliability of services by virtualization. For disaster recovery they have suggested DRF algorithm and for less cost they have recommended MIN COST MAX FLOW algorithm [14].

Kruti Sharma and Kavita R Singh suggested remote server backup architecture to overcome back-up and to recover data. With this technique the authors have achieved data privacy, security, reliability, cost effectiveness, appropriate timing and easy migration from one server to another server [7].

Andrea Bianco et al. have focused on disaster recovery and business continuity issues. For the disaster recovery the authors have applied virtual migration and off-site data replication techniques. The authors have also discussed the issue of optimizing network planning (ONP) to support disaster recovery and business continuity, ILP (Integer Linear Programming) used for ONP problems. The main goal of their work is to improve network performance and enhance then speed of operation to control Disaster [15].

III. RESEARCH WORK

Disaster is one of the factors influencing the performance of the Cloud. Figure 3 represents few approaches that could be applied to control Disaster.

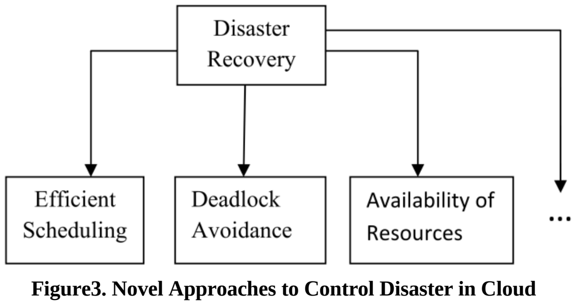

Figure3. Novel Approaches to Control Disaster in Cloud

With reference to Figure 3 the methodology applied to control disaster is through efficient Scheduling. Efficient scheduling is one of the approaches to minimize Disaster. Most of the leading IT industries use Preemptive Priority Scheduling or Round Robin Scheduling technique. With these approaches, the possibility of job rejections and disaster is more.

This research introduces Preemptive Priority Scheduling with Aging, by which the low priority jobs are provisioned the requested resources by increasing the Priority with respect to the wait time as shown in Figure 4

The algorithm 1 and 2 are designed to control Disaster in the Cloud Environment. The algorithm 1 presents the Priority Classification of the Job based on the three significant features i.e. Criticality, Return on Investment (ROI) and Job Size.

The algorithm classifies the job into Low Priority and High Priority Jobs. This is done to apply Aging to the low priority job to avoid starvation and prevent Disaster in the Cloud.

The algorithm 2 presents the Aging technique. At this juncture the Wait Time of the Low Priority jobs is checked. If the Wait Time is greater than the Wait Threshold time then, the priority of that particular Job is assigned 1, which means it has the highest priority. By doing so the low priority job is prevented from starvation thereby controlling the amount of Disaster.

Algorithm 1: Priority Classification

```
If
   {Criticality high}

If
   {ROI high}

If
   {Job Size is high}

        then
                Schedule job to high priority queue
             else

                Schedule job to low priority queue
```

Algorithm 2: Aging

```
  If
   {Priority low of Job_n }

  If
  {Wait Time (WT) >> Wait Time Threshold
(WTT)}

  Set priority =1

        Schedule
  else
        exit
```

IV. RESULT ANALYSIS

TABLE2. JOB ARRIVAL PATTERN

Jobs	Job Arrival time "T" (min)	Burst time (min)	Job priority
J_2	1	6	100
J_3	2	14	1
J_1	2	6	12
J_4	5	16	15
J_5	6	15	10

The Table 2 shows the arrival pattern of jobs with different Job Priority. As an example, job J_2 has a priority 100 (least priority) which arrives first i.e at time T=1.

Table 3 and Table 4 show a comparison between the VM (Virtual Machine) utilization with respect to the job priority based on Preemptive and Preemptive with Aging.

Table 3 presents the Virtual Machine utilization with respect to Priority Preemptive Scheduling From the Table 2 at time T=2, job J_3 arrives with priority "1" (higher priority), it is observed in Table 3 that job J_2 is immediately preempted by job J_3. Similarly the other jobs in the queue having higher priority than Job J_2 will be provisioned the requested resources thereby denying the resources for job J_2. This priority preemptive scheduling technique causes the job J_2 to enter starvation, there by leading to Disaster in the Cloud.

TABLE 3. VM UTILIZATION BASED ON PRIORITY PREEMPTIVE SCHEDULING

VM utilization time (in Minutes) of preemptive
J_2(1 to 2) =1
J_3(2 to 6) =14
J_5(16 to 31) =15
J_1(31 to 37) =6
J_4(37 to 53) =16
J_n(53 to ….) = (Job Jn having higher priority than J2 will be scheduled)

TABLE 4 VM UTILIZATION BASED ON PRIORITY PREEMPTIVE SCHEDULING WIT AGING

VM utilization time (in Minutes) of preemptive with aging
J_2(1 to 2) =1
J_3(2 to 6) =14

J_5(16 to 31	=15
J_2(53 t0 58)	=5 (J2 gets the VM when WT>>WTT)
J_1(31 to 37)	=6
J_4(37 to 53)	=16

Table 4 presents the Virtual Machine utilization with respect to Priority Preemptive Scheduling with Aging. According to Algorithm 2 the Wait Time Threshold (WTT) is assumed to be 30 minutes. Job J_2 which is having a least priority, is provisioned the requested resource once the WT of the J_2 exceeds the WTT. The jobs with higher priority than J_2 has less WT will be scheduled after J_2. Therefore, from this approach the least priority jobs are also provisioned with the requested resources preventing them from starvation. The graph in Figure 5 presents a comparison between the two Scheduling techniques. It depicts the occurrence of disaster with respect to Priority Preemptive Scheduling (PS) and Priority Preemptive Scheduling with Aging (PSWA). From the result analysis it is observed that PS causes starvation of lower priority jobs henceforth the Disaster occurrence percentage is higher than in PSWA.

The graph indicates that Disaster in Cloud can be controlled by applying Efficient Scheduling technique.

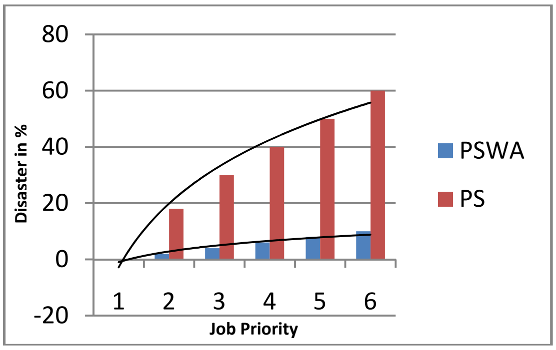

Figure. 5. Performance Analysis of Preemptive Scheduling (PS) and Preemptive Scheduling with Aging (PSWA) to manage Disaster in Cloud

V. CONCLUSION

Cloud computing is an evolving paradigm. Features like On-demand self–service, Broad network access, Resource pooling, Rapid elasticity, Measured service etc has increased the demand for Cloud Services by leading IT industries. However, the performance of this computing model is influenced by various factors. Disaster is one of the factors which deteriorate the Cloud performance. This paper focuses upon controlling Disaster through efficient Priority preemptive scheduling with Aging.

From the result analysis it is observed that the proposed approach controls Disaster by providing resources to all requesting jobs henceforth preventing the low priority jobs to enter the starvation state.

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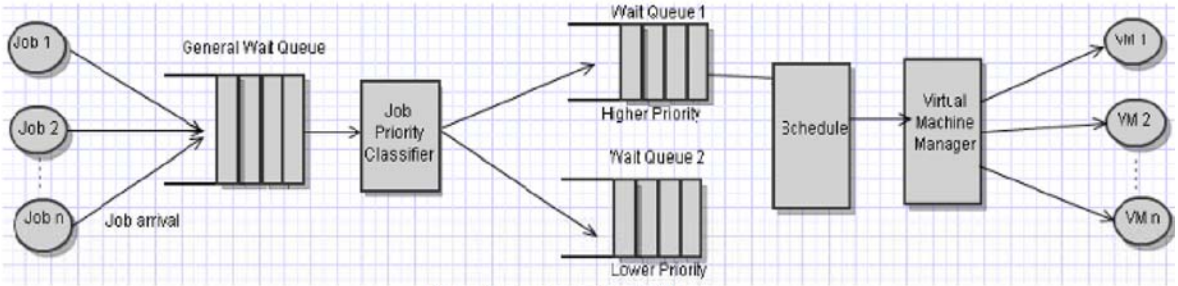

Figure 2. Scenario Leading to Disaster

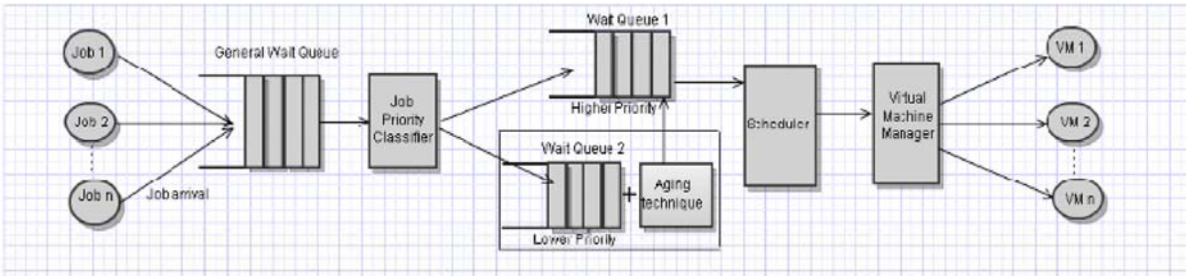

Figure4. Scenario Controlling Disaster

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