Improved Resource Allocation using k-Backfill Algorithm based on priority of job scheduling in Cloud Computing

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Abstract - **The Cloud computing is large group of remote servers and networks which allows centralized data storage and online access of computer services. Cloud is scalable, flexible, and supports multi-media applications. Job scheduling is big issue in cloud computing. Scheduling is more than one process to be loaded into CPU and CPU provides to share memory allocation in each process. The different types of scheduling algorithms are First Come First Serve (FCFS), Shortest Job First (SJF), Round-Robin (RR), Improve Backfill Algorithm (IBA), Backfill and P-Backfill algorithm. We have proposed modify step in Backfill and P- Backfill algorithm for job scheduling. The modify k-Backfill algorithm is schedule a job in CPU base on priority sequence and it is overcome starvation problem in P-Backfill algorithm.**

keywords - **cloud, scheduling, algorithm, starvation, memory.**

I. INTRODUCTION

Cloud computing is a next stage of greed computing. Cloud computing is provides everything in internet services. You will be easy to access any kind of services and storage with network capability. Cloud computing is recently develop the concept to increase on demand resources, network access capability our internet. Cloud computing is a very large pools of system which connected in public and private networks. The public and private cloud networks to provide a dynamically scalable infrastructure for application and data storage file. Cloud computing is cost benefit and easy to use with IT services.[3]

Cloud is parallel and distributed computing system. It is interred connected with virtual machines and dynamically computer resources. Cloud computing is a large group's of virtual resources. The virtual resources can be dynamically reconfiguration to adjust to variety system. Cloud computing is collection of multiple data center and multiple scalable resources. The resources may be hardware, software, infrastructure and platform etc. Each data center are includes one or more virtual machines. The multiple virtual machines in one data center are called Meta scheduler. Virtual machine (VM) has one or more processing elements (PE's) of them. Each process elements are schedule by local scheduler. [4]

Cloud Computing Services

Cloud computing are three various type of services

1. Infrastructure as a Service
2. Platform as a Service
3. Software as a Service.

Infrastructure as a Service (IaaS): Infrastructure as a service provides a platform virtualization source of service. The customer can be used platform as a service. The customers are purchase servers, software, data center space or network equipment. The customers instead pay on service and uses resources are operating system, storage, deployed applications in infrastructure as a service. E.g. Amazon virtual server.[15]

Platform as a Service (PaaS): Platform as a service provides development environment as a service. The consumer can use to develop his own program and deliver it to the users through internet and servers. The service is run time platform as a service and on demand service as a customer. E.g. Microsoft Azure.[15]

Software as a service (SaaS): Software as a service can be defined as "Software is deployed as a hosted services and accesses over the internet. The service providers deploy the software and user can be directly use software as a services. User can no need to updating and no extra hardware requirements. E.g.SalseForce.Com.[15]

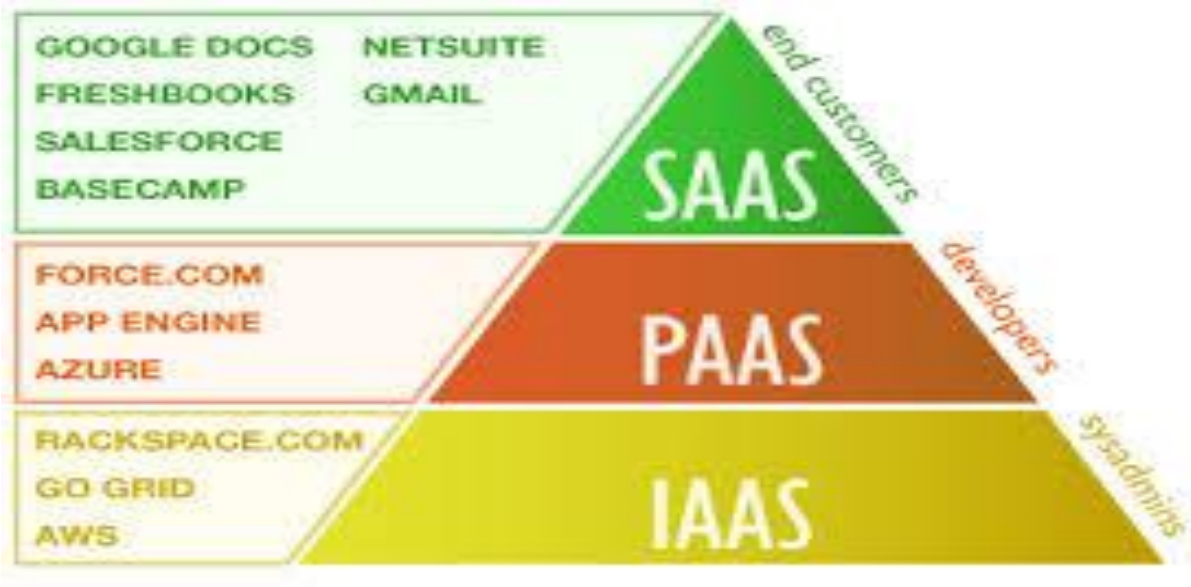

Figure 1: Cloud computing services

II. PROBLEM DEFINITION.

The scheduling is main problem in cloud computing. Cloud computing in many different scheduling algorithms is available for job scheduling likes FCFS, SJF, RR, BACKFILL and P-BACKFILL. Schedule a job in CPU that time many problems is occurrence base on job scheduling. The waiting time, turnaround time, starvation and throughput are also depending on job scheduling algorithm. The priority is also important on job scheduling. Priority has been defined based on class or frequency. Some of the job scheduling is higher class (priority) and less frequency occupied that time throughput is always increase and some of job scheduling in higher class and higher frequency occupied at a time throughput is decrease .

The priority based job scheduling and starvation is big problem in cloud computing. The priority base backfill algorithm is used job scheduling that time starvation problem is occurrence. (Starvation: Bigger jobs due to waiting for a long time. Sometimes the execution of these bigger jobs is needed at a higher priority but this Backfill algorithm doesn't give any provision to do it. It is called starvation). The main problem is backfill algorithm in starvation. [1]

The starvation problem is remove is not easy in priority base job scheduling because of priority is depend on class and frequency. The Priority is given in random number or sequence base scheduling. The priority of sequence may be 1234,2341,3412,4123 etc. The random number priority is given that time small jobs are given first priority and throughput is increase with starvation problem overcome compare to backfill job scheduling.

III. OPEN ISSUES

1. **Resource allocation and utilization:** Cloud computing is large group of remote server and networks which provided to storage data and access resources. Scheduling is importance in cloud computing, because in which type of resource uses in task performance.[11]
2. **Job migration of virtual machine:** Migration is mostly dependent on processor, memory space and all virtual hardware resources. In this also includes the entire disk space, including system and user directories as well as swap space used for virtual memory operating system scheduling. Mostly migration is used job base scheduling. Some of the virtual machine is less resource utilization and that time other virtual machine in resource allocation is large at a time use job migration system.[6]
3. **Performance & cost:** Cloud computing is performance issue in CPU servers. CPU provided shared memory allocation and virtual migration of job scheduling. Cloud computing is high cost due to its requirement for servers and resources.[8]
4. **Availability:** Cloud technologies can increase availability through wide internet-enabled access, but the client is dependent on the timely and provision of resources. Availability is supported by capacity building and good architecture by the provider, as well as well-defined contracts and terms of agreement also important in load balance in server.[9]
5. **Bandwidth & quality of service:** Cloud computing is require for high speed network with high speed bandwidth. Quality of service is provides based on CPU performance with utilization resources. The amount of time will be complete the process with less delay in resource services. Quality of service also depends on processing delay, packet loss, response time etc. [5]
6. **Security:** Cloud base service is on demand service model. The cloud base company is providing to collection of data with secure and trusted resources. Data access in cloud computing in confidentiality and access availability is secure. Secure communication and execution for cloud environment.[11]
7. **Time complexity& process delay:** Clouds computing in many data center and each data center have many virtual machines are run on them. Each virtual machine is performing base on CPU. The many different processes are executed on CPU. Some of the process is stop at a time and delay will be increase. The virtual machine is run on parallel that time some of job is run on different virtual machine. That job is failed at a time and time complexity is high and thought-put is less in process scheduling.[4]

IV. REVIEW WORK

Scheduling is more than one process to be loaded into CPU and CPU provides to shared memory allocation in each process. The different type of scheduling algorithms are available in cloud computing. User can be used different type of scheduling algorithm base on requirement. Some different types of scheduling algorithms are First Come First Serve (FCFS), Shortest Job First (SJF), Round -Robin (RR), Backfill and P-Backfill algorithm.[1]

The scheduling at a time some following Assumption

- All jobs are waiting time of queue.
- Job is scheduling in one virtual machine.
- The schedule a job in CPU with priority base and class base job scheduling.

Table 1: Process Scheduling Example[1]

Process ID	Burst-Time	Priority
A	5	2
B	6	3
C	2	1
D	4	4
E	9	3
F	1	1
G	7	2
H	3	4
I	10	3
J	1	1

1. **First In First out (FIFO):** It is a simple step algorithm. First come first serve process is according to arrival task process. It means which process comes first that process start first at a time.(only FCFS-not consider priority)[1]
   Arrival sequence: ABCDEGGHIJ
   Average waiting time: 21.70 = 22 ms

Table 2: Process Scheduling Example [1]

Process	5	6	2	4	9	1	7	3	10	1
waiting Time	0	5	11	13	17	26	27	34	37	47

2. Shortest Job First (SJF): Shortest job first algorithm. In this process job is execute base on completion time of job. The small job execution time will be first arriving at a time of process element.[1]
   Arrival sequence: FJCHDABGEI
   Average waiting time: 13 ms

Table 3: Process Scheduling Example [1]

Process	1	1	2	3	4	5	6	7	9	10
waiting Time	0	1	2	4	7	11	16	22	29	38

3. **Round Robin (RR)**: Round Robin algorithm is based on interval task process. In this interval task is slice manner. The round robin scheduling process is FIFO manner but that are given a limited amount of CPU time one process execute. Same as FCFS. The interval time. (4 ms)[1]
   Average waiting time is dependent on interval task process.
   Average sequence :ABCDEFGHIJABEGIEI
   Average waiting time: 24.64 =25 ms

Table 4: Process Scheduling Example [1]

Process	4	4	2	4	4	1	4	3	4	1	1	2	4	3	4	1	2
waiting Time	0	4	8	10	14	18	19	23	26	30	31	32	34	38	41	45	46

4. **Backfill Algorithm:** The backfill algorithm is schedule a job in priority base algorithm. It is schedule a job in CPU at a time first coming job is first priority of scheduling and after check the priority of this job. The priority of job is lower, than a schedule a highest priority of job sequence in scheduling but also in small job in scheduling in priority.[1]
   Arrival sequence: ACFJBDEGHI
   Average waiting time: 16.40 ms
   Average waiting time: (0+5+7+8+9+15+19+28+35+38) / 10 = 16.40 ms

Table 5: Process Scheduling Example [1]

Process	5	2	1	1	6	4	9	7	3	10
waiting Time	0	5	7	8	9	15	19	28	35	38

5. **P-Backfill Algorithm.** The P-backfill algorithm is scheduling a job of arrival sequence priority. P –backfill algorithm is work on priority base and frequency base scheduling. Arrival of job sequence is makes a four classes A, B, C and D. Each class on priority and frequency is given. Class A is highest priority and less Frequency of job occupied. Same class B is high priority but less than A and more frequency occupied. Similarly class C also higher priority and more frequency occupied and class D more priority and less frequency occupied.[1]
   Arrival Sequence: CFJAGBEIDH
   Average waiting time: 17.29 ms
   Average waiting time (0+2+3+4+9+16+22+31+41+45) / 10 = 17.29 ms

Table 6: Process Scheduling Example [1]

Process	2	1	1	5	7	6	9	10	4	3
waiting Time	0	2	3	4	9	16	22	31	41	45

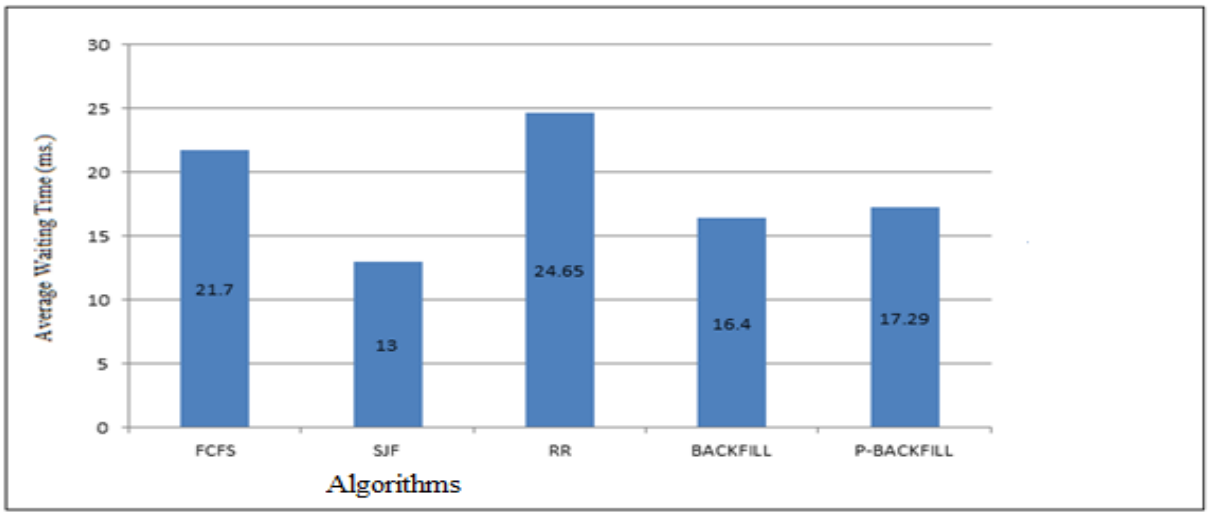

Figure2: Comparison of Existing Algorithm

V. PROPOSED ALGORITHM

Implementation

The cloudSim is a toolkit which is used for modeling and simulation a result in cloud environment. Simulation of cloud environment is provides dynamically, distributed and scalable resources. CloudSim is also provides data center, computational resources, virtual machines, application, users, and policy for management. [14]

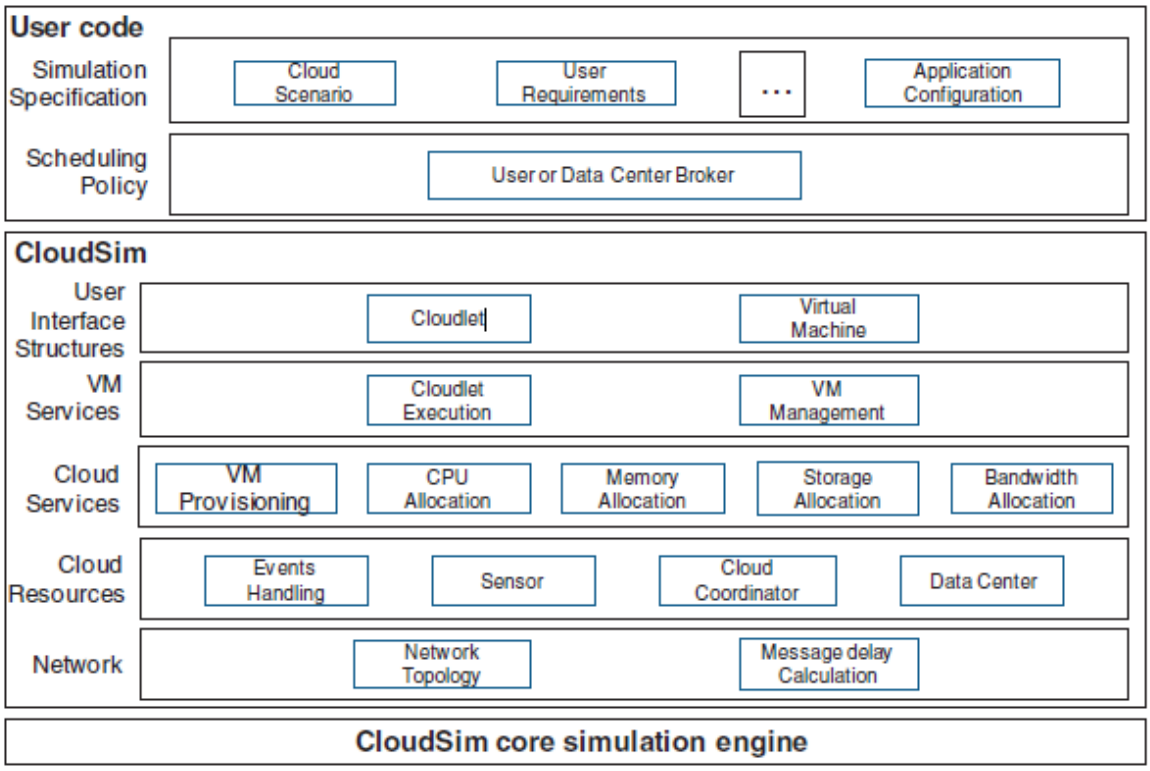

Figure 3: Cloud Structure [14]

The Main Components of CloudSim Framework Are Described In Detail:

The CloudSim layer provides support for modeling and simulation of cloud environments interfaces for memory, storage, bandwidth and VMs. CloudSim is also provisions hosts to VMs, VM execution policies and dynamic system state monitoring.[14]

Regions: The model of geographical regions in which cloud service providers allocate resources to their customers. In cloud analysis, there are six regions that correspond to six continents in the word.

Data centers: The model infrastructure services provided by various cloud service providers. It encapsulates a set of computing hosts or servers that are either heterogeneous or homogeneous in nature, based on their hardware configurations.[14]

Host: It is physical resources (computer or storage).

The user base: It models a group of users considered as a single unit in the simulation, and its main responsibility is to generate traffic for the simulation. The services to the request from the user base.[]
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Cloudlet: It specifies the set of user requests. It contains the application ID, name of the user base that is the originator to which the responses have to be routed back, as well as the size of the request execution commands, and input and output files. It models the cloud-based application services. CloudSim categorizes the complexity of an application in terms of its computational requirements. Each application service has a pre-assigned instruction length and data transfer overhead that it needs to carry out during its life cycle.[14]

Service broker: The service broker decides which data center should be selected to provide services to the request from the user base.

VMM allocation policy: It models provisioning policies on how to allocate VMs to hosts.
VM scheduler: It models the time or space shared, scheduling a policy to allocate processor cores to VMs.[14]

The proposed algorithm is work same as a P-Backfill algorithm but the schedule in CPU that time change a priority sequence of arrival time for job scheduling. The proposed algorithm is defined as a FCFS based. The first priority of job sequence is first allocation in CPU but at an arrival time the shortest jobs are first scheduling in CPU and calculate a waiting time of process. The other jobs in process at a time first priority of waiting time is add and calculate for a jobs scheduling.

Arrival sequence :FJCAGBEIDH
Average waiting time : 17.10 ms
(0+1+2+4+9+16+22+31+41+45) / 10 =17.10ms

Table 7: Process Scheduling Example [table 1]

Process	1	1	2	5	7	6	9	10	4	3
waiting Time	0	1	2	4	9	16	22	31	41	45

START ALGORITHM

STEP 1: Declare the variables.
STEP 2: Input the process ID, burst time their priority (type).
STEP 3: put a jobs into a queue according to priority A to D
STEP 4: SJF algorithm is apply priority A
STEP 5: calculate a burst time A
STEP 6: calculate bt[A] + collect all jobs according to B to D in FCFS based on priority
STEP 7: calculate all waiting time
STEP 8: complete the process

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========== OUTPUT ==========
Cloudlet ID    STATUS    Data center ID    VM ID    Time    Start Time    Finish Time
    0          SUCCESS        2             0        1        0.1          1.1
    1          SUCCESS        2             0        1        1.1          2.1
    2          SUCCESS        2             0        2        2.1          4.1
    3          SUCCESS        2             0        5        4.1          9.1
    4          SUCCESS        2             0        7        9.1          16.1
    5          SUCCESS        2             0        6        16.1          22.1
    6          SUCCESS        2             0        9        22.1          31.1
    7          SUCCESS        2             0        10        31.1          41.1
    8          SUCCESS        2             0        4        41.1          45.1
    9          SUCCESS        2             0        3        45.1          48.1

proposed algorithm of K-Backfill sucessfully
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Figure 4: K-Backfill Algorithm

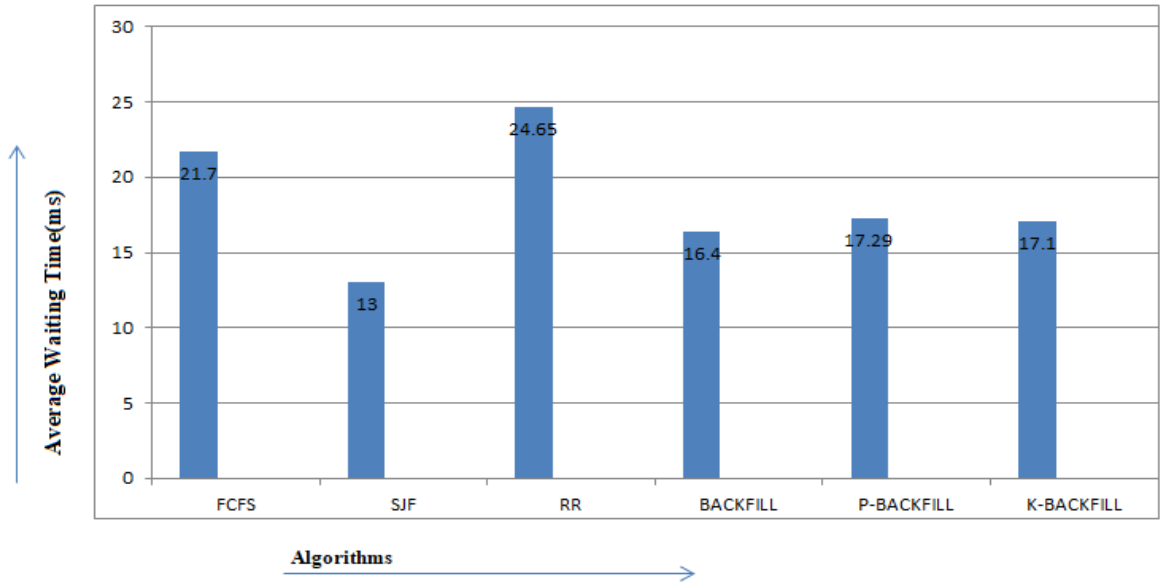

Figure 5: Comparison of all Algorithms

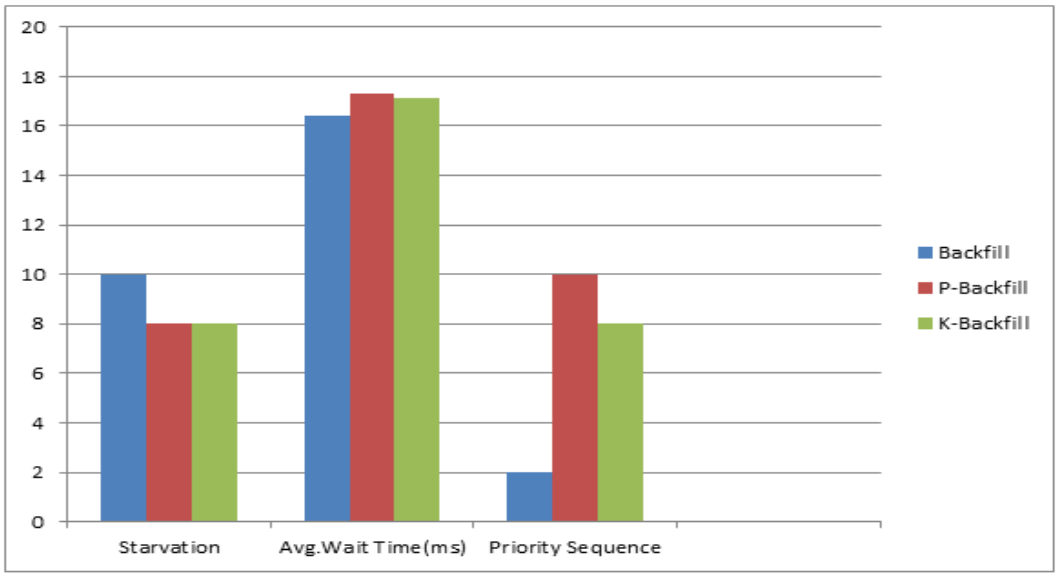

Figure 6: Compare of Backfill-Backfill and K-Backfill

As show in figure6, The P-Backfill and K-Backfill algorithm in starvation problem is low compare to Backfill algorithm. Consider values in table (5, 6 and 7)

The Average waiting time in Backfill is 16.4 ms. and P-Backfill algorithm in 17.29 ms. and K-Backfill waiting time is 17.1 ms. consider values in figure5

The Priority based schedule a jobs that time only P- Backfill algorithm is schedule in CPU with sequence of process. Consider values in table (5, 6 and 7)

VI. CONCLUSIONS

The scheduling is main issue in cloud environment. The various types of scheduling algorithms like First Come First Serve (FCFS), Shortest Job First (SJF), Round-Robin (RR), Backfill and P-Backfill algorithm. The comparison of various types of scheduling algorithms is as show in figure 2. Now we not consider the SJF priority of job scheduling. The P-Backfill algorithm is schedule a job in CPU base on priority of job scheduling. The Backfill algorithm in waiting time is less compare to P- Backfill algorithm but starvation problem is high in Backfill algorithm. We proposed K-Backfill algorithm for a job scheduling. The K-Backfill algorithm is achieved a better through-put compare to P- Backfill algorithm and overcome a starvation problem for a Backfill algorithm as well as waiting time is less compare to P-Backfill algorithm show in figure (5,6).

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