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# STASR: A New Task Scheduling Algorithm For Cloud Environment

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**Abstract**

The cloud is a technique based on the expansion of the possibilities and capabilities of the user's device by providing resources to implement the user's tasks. So, there has to be a mechanism to organize and distribute tasks for resources' availability as the multi-tasking and resources. In this case, scheduling algorithm can be used in which it regulates and distributes the tasks, resources as the scheduling algorithm that affect the efficiency and speed of execution of tasks in terms of the appropriate choice that corresponds between tasks and resources. In this paper will study several algorithms to develop a new scheduling algorithm working on the mechanism of tasks and resources distribution in the groups based on parameters and standards to reduce the waiting time and responses as well. In addition, this paper will work to choose the resource that the completion time compatible with the task's execution time, as the compatibility is equivalent to the resource's ability to perform the task with the processing requirements.

**Keywords:** STASR, scheduling algorithm, cloud, tasks, resources, completion time, execution time.

## 1. Introduction

Cloud computing is based on the communication with users through the Internet, where it provides users the interfaces of software and hardware to connect resources from anywhere and to benefit from cloud services which are direct storage, social networking sites, e-mail service

and other services [1] The basic idea of cloud computing is to provide users with a direct file storage service. The public cloud is not the only type of cloud, but there are private and hybrid cloud computing [2] in the cloud, the user who can access the information from anywhere, and at any time [3] The user can communicate with the cloud systems management through brokers or organizers, which are based on the provision of services requests provided by the user to process them [4].

The cloud resources are divided into physical and virtual resources, where the sharing of the physical resources , using multiple applications , virtual computing , and savings through (parameters) , the details of memory, and disk needed by request the default resources for processing [5] In order to meet the user's demands in computer systems ,There is parameter to the quality of different service (QOS) , where they are holding a service level agreement (SLA) between the service provider and the customer to ensure the quality of service between the two parties [6], Customers and consumers use various available services in the cloud, Upon the request of them, Therefore, the users must agree to the cloud service level agreement (SLA) specified by the cloud provider, Where the cloud provider makes it easier for users through the use of services and integration of computing tool before the signing of a service level agreement. The users have to verify the service level agreement which contains a quality of service transactions (Quality of Service) which are pre-requisites of the consumer, before utilizing cloud services [7] the cloud develops and the increasing number of users, In order to provide perfect use of resources , the cloud is considered a difficult task for those who provide cloud services , There are some matters that must be considered when using resources which are the algorithms scheduling tasks and load balancing [8], Many of the tasks have to be implemented by the available resources based on user requests and to regulate the distribution the tasks to those resources , there must be scheduling algorithm used by the task scheduling to allocate appropriate resources to tasks. There are many scheduling which depend on several criteria such as fixed , variable, central and distributed scheduling ,scheduling of preventive or protective, scheduling collaborative, instant or immediate mode scheduler, batch or offline mode scheduling…etc. [9] , During the process of distribution of tasks for resources , there are some problems in the tasks scheduling , which is balancing, scalability, reliability, performance and the re-allocation of resources to the computing nodes, the main concept of cloud computing is connecting resources from various servers [10].

## 2. Scheduling Algorithm Tasks in the Cloud Computing

Scheduling algorithm is based on conforming and allocating each task to the appropriate resource, until now, no perfect algorithm is there, On the other hand, the best scheduling, which takes a suitable solution for both of two parties, the tasks and resources as to the time required, which depends on the mechanism of the algorithm. So, it rolls evaluation and so the evaluation of the performance of the algorithm goes back to the period of time necessary to carry out the task [11], the aim of tasks in the cloud computing scheduling is to reduce the execution time. The other goal is to increase profits and get user satisfaction [12] As for the balanced loading for all nodes in the computerized cloud , It must find a schedule

to identify the execution time of the tasks in the available processors in order to achieve the perfect choice on complete set of tasks [13] So the main role of the scheduling is to estimate the execution time of the application after detection applications and resources allocated, This is the factor to improving the performance of the scheduling algorithms [14].

The main goal of the algorithm's scheduling is to reduce the implementation of tasks, and raise the level of use efficiency resource. In the case of re-scheduling, it is done only when the client requests the same type of resources .The difference between the tasks to be in bandwidth, response time, the resources expenses, and memory storage. where the effectiveness of the algorithm lies in maintaining the important balance in an effective manner, and In general , the efficiency of the cloud environment only depends on the type of algorithm's scheduling that is used to schedule tasks [15] ,The purpose of the scheduling tasks in the cloud environment is to find a scheduling tasks in the flexible way , it offers to the users an integrated cloud system in production, at the same time the quality of service (QOS), Focus and taking into account the loading balance , quality of service ,financial cost, as the balance of loading is associated with task scheduler on one level of importance and are considered the first measurement in the cloud in terms of work efficiency and development, while comes the role of the quality of service to ensure the quality of service in the case of allocation the task to resource [16].

## 3. Review some tasks of the scheduling algorithm

The main role of the scheduling algorithm in distributed systems is to distribute the load, the burden on the processors, and increase the utilization ratio, taking into account the decreasing the implementation of the task's time however, the problems facing the scheduling algorithms is to find the appropriate resource, and compatible with Adaptive time, which entails knowing the proper sequence of functions that can be implemented under the transaction logic, constraints [17]. In a distributed computing system there are different scheduling algorithms, every algorithm has the specific mechanism work, The application of scheduling algorithm in cloud's environment achieves high efficiency, improves productivity ability, while traditional algorithms cannot be used in the cloud environment [18].

### 3.1. (FCFS) First Come First Served Scheduling Algorithm

This algorithm is based on the principle of time access. The implementation mechanism for those who come first, and so according to the order, namely that the tasks awaiting execution for a long time in the task state with a long time to complete the implementation [19]. In this sense , it showed a defect in the FCFS algorithm, when the tasks are assigned to resources do not take into account the foundation of their work load, scheduling queue, length queuing, scheduling follow along each line, in the case of the arrival of a new task examines the waiting queue. The shortest queue will be chosen, and assigns the task to the queue, where it is set the length of the queue by the network manager the length of the queue means the number of tasks in the queue, or the total execution times [20].

### 3.2. (RR)Round Robin Algorithm

The Round Robin algorithm is based on the mechanism of action in quantum time, or slides time,Where the division is split into multiple segments of time , and given every knot the quantum time, or a period of time, and based on the idea of time is determined by the quantum of resources in servers services, because it was in the case a very large quantum time, namely that the round robin scheduling algorithm is the same FCFS scheduling, if the two cases of the quantum time is a little, so the round robin algorithm is called post treatment as the number of context switches a lot, In light of this decision to choose the load on a random basis, which take the lead to put load some nodes are significantly, and the others are small, the algorithm (RR),It also looks very simple, there is an additional burden on the schedule to determine the quantum size ,and have a longer average wait time, and low productivity, is known as the main focus of the round robin algorithm works when it is distributing the load evenly on all nodes [21] Where the algorithm (RR) is focusing of the parity problem ,and equality, based on determine the quantum time, while restricts the implementation each task just in the specific quantum time , In the case of not completing the task in quantum exact time , it will go back to the queue Where the algorithm (RR) is focusing of the parity problem ,and equality, based on determine the quantum time, while restricts the implementation each task just in the specific quantum time , In the case of not completing the task in quantum exact time , it will get back to the queue and waiting to the next round. By the above, we reach the algorithm (RR) is characterized as the tasks carried out in turn, and do not need to wait for the completion of the previous task [22].

### 3.3. (SJF) Shorter First Task Algorithm

The first task of the shortest algorithm (SJF) is based on the selection of tasks with shorter execution time. Lined jobs with the shortest execution time, firstly, put and tasks with longer execution time put in the other ,and gave it the lowest priority, where this algorithm is based on the principle of scheduling Shorter mission to the fastest resources so as to reduce the response time, this principle does not deal with all the tasks where they are giving preference to some job categories on the other set of functions, If we compare this algorithm with other algorithms such as (FCFS) this principle in the listing is unfair, because the tasks with shorter execution time, if it continues to access to the functions with a duration of longer implementation not be able to get a chance of implementation ,and will wait until an unspecified period of time, and this is known in environmental of scheduling algorithms to "famine" is considered a problem in scheduling tasks [23].

### 3.4. MIN-MIN Algorithm

The action mechanism of algorithm scheduling Min-Min is based on determining the minimum completion time for each task. All tasks go through in two steps; In the first step is looking for a set of minimum time finishing tasks, and then begin the second step is appointed the task that has been selected in the previous step to the right resource, This task is then excepted and so on. But the principle upon which the Min-Min algorithm is implemented with minimal task completion time when the upper limit of the time you finish the tasks to be implemented after the completion of tasks with minimal time [24].

### 3.5. MAX MIN Algorithm

That the mechanism of Max-Min algorithm the same mechanism of action Min-Min algorithm , but Max Min algorithm is based on determining the expected time for is based on determining the expected time for completion of tasks, and then the job had to be with the maximum expected overall implementation to a resource that contains a minimum of time is finished and then are removed as this task of tasks, and is updated all the time, and Max Min algorithm is applied to the task, that task with the concept of maximum execution time means that the larger size of the task, and the concept of the minimum time completion of resources means that the resource is the slowest in resources [25].

### 3.6. RASA Algorithm

It is composed of two traditional scheduling algorithms; Max-min and Min-min. RASA uses the advantages of Max-min and Min-min algorithms and covers their disadvantages, if the number of available resources is odd, the Min-min strategy is applied to assign the first task, otherwise the Max-min strategy is applied. The remaining tasks are assigned to their appropriate resources by one of the two strategies, alternatively. For instance, if the first task is assigned to a resource by the Min-min strategy, the next task will be assigned by the Max-min strategy. In the next round the task assignment begins with a strategy different from the last round. For instance if the first round begins with the Max-min strategy, the second round will begin with the Min-min strategy [26].

Table 1. The Comparison between Algorithms in the Cloud Computing.

| Scheduling algorithm | parameters of task and resource | The mechanism of the work algorithm | Disadvantage | Advantage |
|---|---|---|---|---|
| **FCFS** | arriving time | jobs are executed according to the order of job arriving time | non preemptive is incompatibility among task ,the shorter task is waiting for a long time until it completes another task. | simple |
| **SJF** | Priority by execution time | That selects the job with the smallest execution time. The jobs are queued with the smallest execution time placed first and the job with the longest execution time placed last and given the lowest priority | Actually impossible to know time of the next task. | Reducing average of waiting time |
| **Round robin** | time quantum | employs time-sharing, giving each job a time slot or quantum | An Average of waiting time is worst than FCFS, then performance level depends on slice. | Low response time reducing average of waiting time in case of different lengths of working on large scale ,and tasks processing without priority |

| | | | | |
|---|---|---|---|---|
| **Min-Min** | Min ,execution time, Min completion time | The set of minimum expected completion time for each task in MT is found. In the second stage, the task with the overall minimum expected completion time from MT is chosen and assigned to the corresponding machine | The priority depends on less task .it is positive based on little task more than big task | The performance level depends on tasks in case of the task was shortest |
| **Max-min** | Max of execution time, Min of completion time | Then the task with the overall maximum expected execution time (Largest Task) is assigned to a resource that has the minimum overall completion time (Slowest Resource) | The priority depends on less task .it is positive based on big task more than little task | The performance level depends on tasks in case of the task was longest |
| **STASR** | set of execution time and completion time Priority arriving time | It based on choosing task and distribute it in to group depend on executive time ,from another side the resources arrange as a group depends on capacity and compatibility on tasks | The performance depends on resource property , this performance is negative on network structure, not on star processing algorithm | Little average of waiting time is processing the task based on the priority of group level, whereas choosing the task into group and the resources into group depend on compatibility and parity between them. |

## 4. The Suggestion of New Scheduling Algorithm

The algorithm (Set resources Task Associated Set Resources) (STASR) group of tasks linked to group of resources is based on reducing the load balances and the waiting time by distributing the tasks in an interrelated groups, where they are set up groups on the basis of execution time, so determined the scope of the group at the time of execution, Where each group represents the period of time from the time of execution. for Example Group 1 represents the time period has a range of 0 to 19 second bits and group 2 represents the period of time from 20 to 40, so any task that requires Execution time is distribution on groups according to the time period of Execution, if task requires execution time is 25, they automatically belong to Group 2 and task requires execution time is 7 it automatically belongs to Group 1 as shown in Figure 1.

As for the reaching times can be arranged according to preference and be according to groups it belongs to, not at the level of all the advanced applications by the user and here we reduce the waiting time, and also are arranged and the distribution of resources in the form of groups according to specifications and capabilities so that the resource selection process is fast and automatic .Here we reduce the waiting and response time together, for example, are pooling resources with capabilities processors kernel 3 and memory 2 GB in a group, either in relation to the use of resources or occupancy rate resource, it branched into groups according

to the proportion of use and occupancy tidily sequential group that belong level resources, hence deduce the ability and the extent of the algorithm efficient functions linked group set through the speed of the task assigned to the appropriate resource within a short period of time and this leads to reduce the waiting and the time it takes and load balancing period through compatibility between tasks and groups of resource groups.

The distribution of resources and tasks in groups helps to identify cost value where the user can adjust within the scope of community resources and tasks, and in the case of user requests were repeatedly within a certain range of tasks and resources groups can this wave of this user requests had to be automatically and Assume to those groups where are the exception requests from the user of the queue and because it has been designated in advance by default and automatically. In the case, that group of resource groups are busy or any other circumstance which increased the demand for them and became the tasks in a long wait, and to solve such problems we can assign group from resources groups as a virtual or resource on the level of each group are tasks by directing,, and here we can raise the efficiency of the algorithm and this leads to the lifting of valuable performance computerized network cloud.

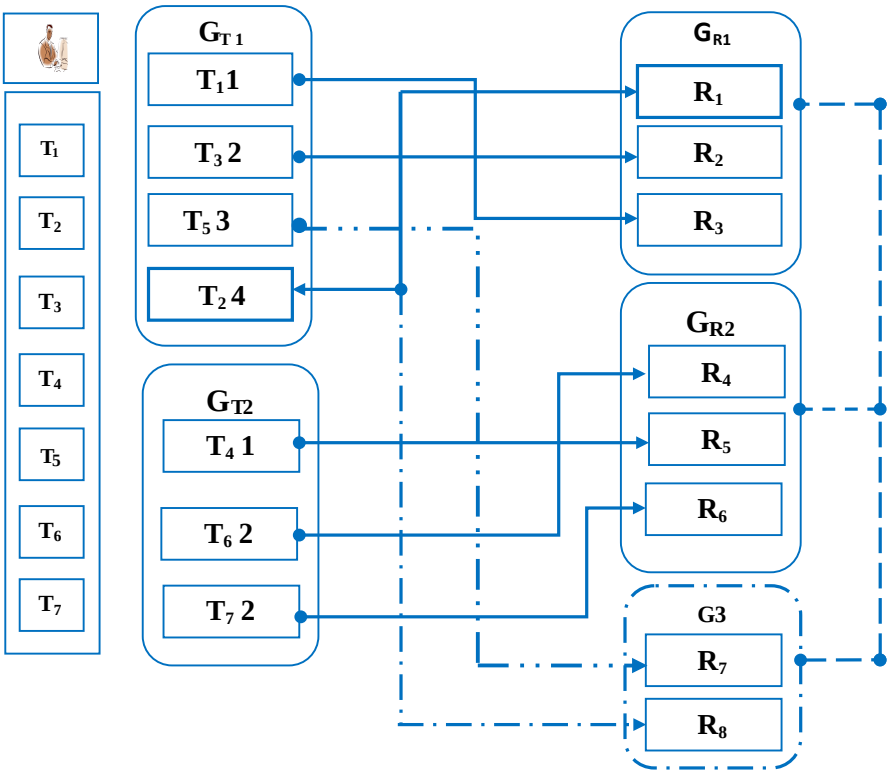


Figure 1. Scheduling algorithm set task associated set resource (STASR)

**Proposed Algorithm Procedure:**

When: **Ts** set of task, **Tt** execution time of task, **Ti** one task of set **Ts**, **Rj** set of resources, $\mathbf{R}_A$ one resources of set **Rj**.

**Algorithm:**

1. **For** all submitted tasks in set-task; Ti
   1.1. **For** all resources; Rj
1. Find task Tt execution time
2. Found Tt for Set Ts
3. **Select** Ts
   3.1. **Case** (**1**) Assign task Ts to resource Rj with completion time
4. **IF** $T_i$ frequently to $R_A$
   4.1. **Case** (**2**) Assign task $T_i$ to resource $R_A$
   4.1.2. **Case** (**3**) Assign task $T_i$ to resource set Rj
   4.1.3. Remove task $T_i$ from set tasks
5. **Else**

5.1. **Case** (**4**) Assign task Ti to resource set R Default

6. Remove task Ti from tasks set.
7. Update rj for selected Rj.

### 4.1. The Proposed Algorithm (STASR)

The strategy that algorithm works on (STASR) is the proportionality between the execution time, and completion time, as in Figure 3 (a, b), If the execution time increases, the completion time decreases. It helps tasks and resources to distribute in the groups, in addition, the compatibility between tasks, and resource capacity to handle the requirements levels. As for the request that is presented from the task's user is frequently appointed to the resource groups, in the case if the resource was busy, the request is transferred to the backup resources, these backup resources are only used in case the resource's groups are busy, also if the several tasks in waiting list, so, the tasks are transferred to the backup resources groups.

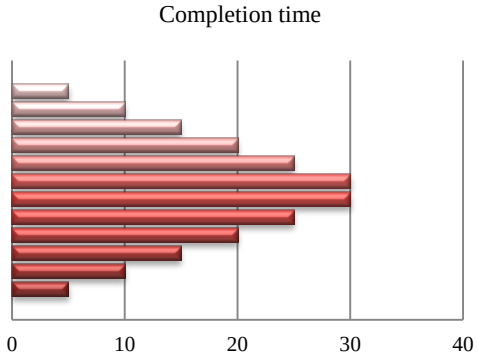


Figure 1. (a). The Relationship between execution time and Completion time in algorithm (STASR)

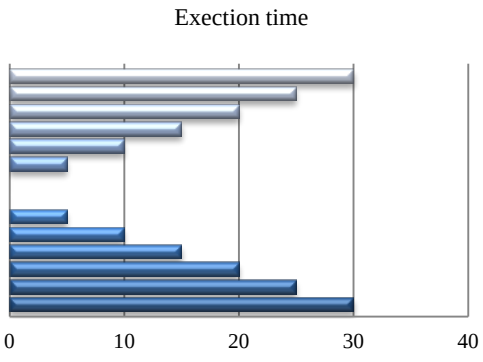


Figure 1. (b). The Relationship between execution time and Completion time in algorithm (STASR)

The proportionality between the execution time and the completion time of the task, help to reduce the loading, where the resources will be ready after the process implementation is complete. They are consistent and commensurate with the tasks that come to her implementation role, through limited the tasks during the execution time, in addition, the resources according to their capacity and their specifications in a group.

Table 2.The Relationship between the Execution Time, And Completion Time in (STASR)

| Execution Time | Completion Time |
|---|---|
| Min | Max |
| Max | Min |
| (STASR) Equivalent | |

Table 3. Properties, Specifications and Distribution of Resources in Group

| Resources | Processing Speed (MIPS) | Bandwidth (Mbps) | Completion time | Group |
|---|---|---|---|---|
| R1 | 70 | 140 | 11 | G1 |
| R2 | 140 | 70 | 4 | G1 |
| R3 | 70 | 140 | 15 | G1 |
| R4 | 250 | 100 | 6 | G2 |
| R5 | 100 | 250 | 9 | G2 |
| R6 | 100 | 250 | 3 | G2 |
| R(7) | 250 | 100 | 0 | GA |
| R(8) | 140 | 70 | 0 | GA |

Table 4. Characteristics, Requirements of the Tasks, And Distributed In Groups.

| Tasks | Arrival Time | Execution Time | Group |
|---|---|---|---|
| **T1** | 0 | 18 | **G1** |
| **T2** | 9 | 17 | **G1** |
| **T3** | 2 | 19 | **G1** |
| **T4** | 1 | 21 | **G2** |
| **T5** | 3 | 13 | **G1** |
| **T6** | 7 | 24 | **G2** |
| **T7** | 5 | 27 | **G2** |

As in the table (5) , tasks are distributed on the resources, based on the completion time, and commensurate with the execution time, as shown in Figure (1), which, shows the mechanism of the algorithm's work where the resources and tasks belong to groups. The resource is determined based on the compatibility between the resource group and tasks, also according to the requirements of the task.

Table 5.Distribute the Tasks to the Resources at the Completion Time

| Ts | | G1 | | G2 | | | GA | |
|---|---|---|---|---|---|---|---|---|
| Execution Time) | R1 | R2 | R3 | R4 | R5 | R6 | R(7) | R(8) |
| T1 (15) | | | 11 | | | | | |
| T2 (17) | 7 | | | | | | | 0 |
| T3 (19) | | 4 | | | | | | |
| T4 (21) | | | | | 9 | | | |
| T5 (13) | | | | | | | 0 | |
| T6 (24) | | | | 6 | | | | |
| T7 (27) | | | | | | 4 | | |

**The First Scenario**

In the figure 4, represents the distribute the tasks to resources, based on that every resource represents a group, then ignoring the other resources in the same group, the tasks distribution to resources on this basis represents, in the figure 4, The value of Makespan is 21, while in the figure 5 the tasks distribution to resources based on the completion time, algorithm (RASA), the value of Makespan is 30.

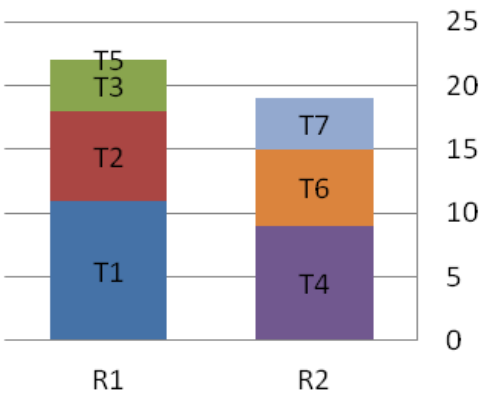


Figure 4. Distribute the tasks to resources at the completion time, the algorithm (STASR)

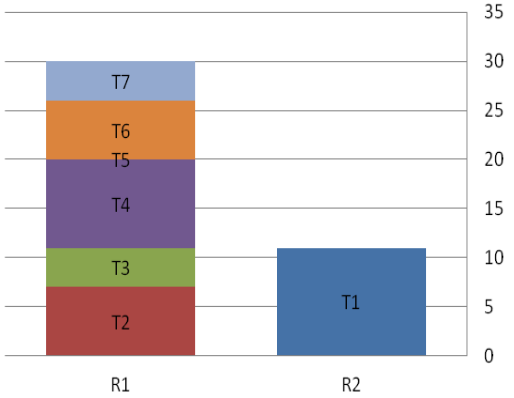


Figure 5. Distribute the tasks to resources at the completion time, the algorithm (RASA)

**The Second Scenario**

In Figure 6, which represents the tasks distribution to resources, on the basis of the algorithm (STASR), in groups, the value of (Makespan) and 24, but In Figure 7, which represents the tasks distribution to the resources, on the basis of the algorithm (RASA) in groups, the value of (Makespan) is 42.

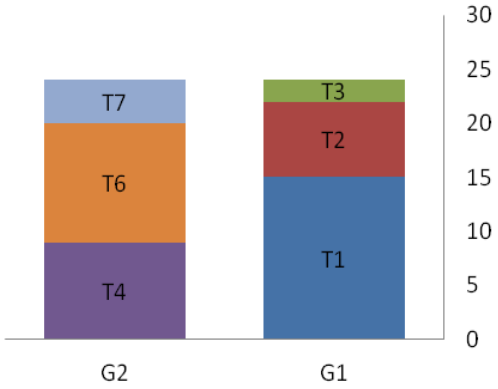


Figure 6. The Tasks Distribution to the Resources, Algorithm (STASR), In Groups.

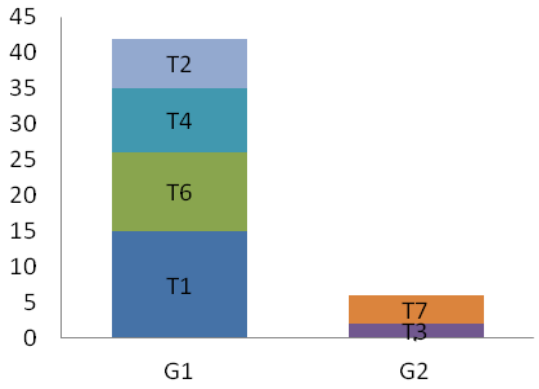


Figure 7.Tasks distribution to the resources, Algorithm (RASA), in groups.

## The Third Scenario

In this scenario, the tasks distribution to resources on the basis of the algorithm (RASA), each resource in the separated form, noticed from the table 6 , and figure 8 that there is a compatibility between the processing of the task requirements, and the capabilities of the resource does not correspond , so it generates loading on the resource, that is lead to delays in the next response time for task , while, in the figure 9 ,shows the compatibility between the tasks with resources, and parity between execution time and the end time , this helps to reduce the loading on the resource, and decrease the response time.

Table 6.The Distribution Tasks to the Resources. Algorithm (Rasa)

| R1 | R2 | R3 | R4 | R5 | R6 | Tasks |
|---|---|---|---|---|---|---|
| 15 | | | | | | **T1** |
| | | | | | 7 | **T2** |
| | 2 | | | | | **T3** |
| | | | | 9 | | **T4** |
| | | | | | | **T5** |
| | | 11 | | | | **T6** |
| | | | 4 | | | **T7** |
| **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | |

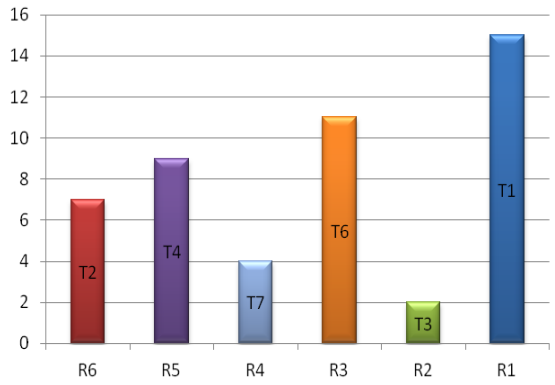


Figure 8.Distribution of tasks on individual resources algorithm (RASA)

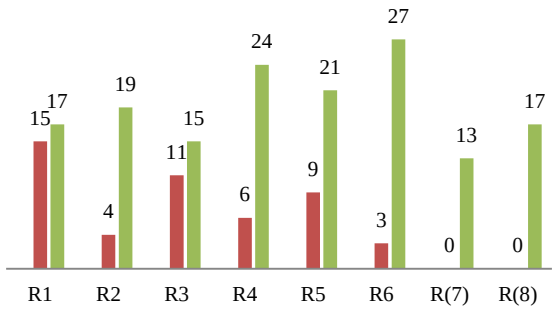


Figure 9. Distribution of tasks on individual resources, algorithm (STASR)

Table 7. Distribution of Tasks on Individual Resources, Algorithm (STASR)

| Tasks | Execution Time | Completion time | Resources |
|---|---|---|---|
| **T2** | 17 | **15** | **R1** |
| **T3** | 19 | **4** | **R2** |
| **T1** | 15 | 11 | **R3** |
| **T6** | 24 | **6** | **R4** |
| **T4** | 21 | **9** | **R5** |
| **T7** | 27 | **3** | **R6** |
| **T5** | 13 | 0 | **R(7)** |
| **T2** | 17 | 0 | **R(8)** |

The factors which contribute to measure any algorithm, Makespan value: the relationship between performance and Makespan is Inverse relationship, whenever Makespan value is little. The performance is high Makespan value account by this Eq. (1) [27].

$$Max\text{-}min = max\ (rtj) \quad (1)$$

Where **rtj** denotes the standby time of each resource.

- The rate of utilizing resources: is the time that the resource takes to implementation the task .It represents the difference between the beginning and completion the execution time can be calculated by the equation (1), where the algorithm (STASR) is tracking the mechanism of the distribution resources in the groups. It helps to exploit the resources capabilities through appoint task commensurate with the resource's capabilities, and this compatibility leads to accelerate implementation and enhance performance.

- Response time : it is the sum of the waiting time and service time and affects the effectiveness of the work of scheduling algorithm so that the service is provided in the appropriate time , whenever the time of response is less whenever the effective performance of the algorithm being best, in (STASR) algorithm used a compatibility strategy in tasks and resource groups , that lead to development specific dimensions when we want to serve a resource for service or doing a task and that help to find out the right resource at the right time, each task in the group has several specific resources , and every resource has several tasks option as shown in Figure 10.

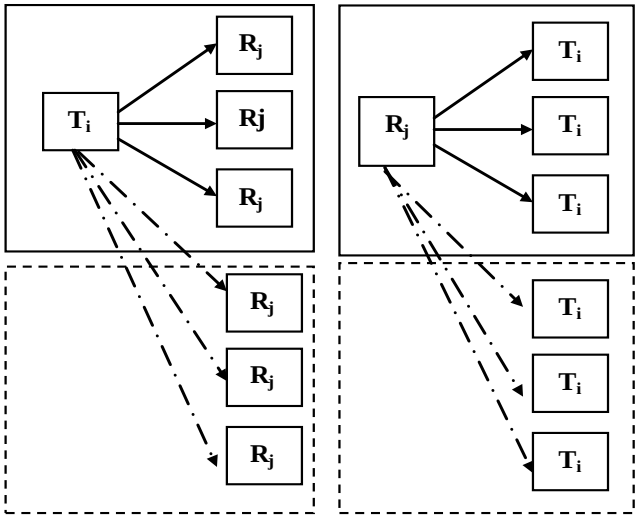


Figure 10. The Possibility of Distribution between the Tasks and Resources

Productivity: can determine the productivity of any algorithm by identifying the numbers of tasks that can process them in a unit of time, the algorithm (STASR) contribute to improving productivity by giving task to the appropriate resource.

## 5. Conclusion

With the continuous developing in cloud computing, it has been noticed that the number of customers are increasing, and in order to provide cloud computing service appropriate with the requirements, there has to be an algorithm contribute to raising the performance. In this paper we have suggested algorithm that can achieve the requirements of the evolution of the cloud computing through the distribution of tasks and resources in groups, this leads to accelerate the process of identifying resources to tasks compatible with the resource's ability for processing the requirements of task.

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