ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

*Website: www.ijircce.com*

Vol. 4, Issue 12, December 2016

# Survey on Scientific Workflow Scheduling Algorithms using Deadline Constraint in Public Cloud Environment

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**ABSTRACT:** Cloud computing is blooming technology in these years. As an application of cloud computing, cloud workflow is mostly applied in scientific research.The elasticity property of cloud infrastructure is available for the public cloud provides the pay-per-use service to user. It provides the dynamic scaling in response to need of the application capability of cloud make it suitable platform to host the deadline constraint for scientific workflow, because the resources available to application can dynamically increase which results in speed up of application. As cloud workflow scheduling is major problem of the research on cloud workflow application**,** there are many algorithms which are used to automate the workflows to satisfy the Quality of service (QoS). This uses the deadline as a major criterion, i.e. fulfils the needs of the user with minimum cost and within the minimum execution time. This paper surveys various scientific workflow scheduling algorithms having the deadline as its criterion.

**KEYWORDS:** Scientific Workflow, Deadline, Workflow Scheduling, Critical Path.

## I. INTRODUCTION

Cloud computing is one of the latest emerging domain and has popularity in the recent years among all those users who uses the Internet. Cloud has many properties which attracts the user. High reliability, extendibility, versatility and Virtualization are some of the characteristics of this upcoming technology. The user consumes there services based on the service level agreement. This defines the required Quality of Service (QoS) parameters on a pay-per-use basis.Clouds can offer the users a wide range of services from hardware to the application level. Currently, these services are classified into three major classes: Infrastructure as a Service (IaaS)-IaaS Clouds, for example Amazon, provide virtualized hardware and storage on top of which the users can employ their own applications and services. Platform as a Service (PaaS)-PaaS Clouds, for example Microsoft Azure, provide an application development environment in which the users can implement and run applications on the Cloud. Software as a Service (SaaS)- in SaaS services there are two types of Cloud which deliver the software applications to the users. Where first group offers an entire application as a service to the usersand can be used without any changes. For examples of these Clouds are Google services like Google document / Google calendar etc. The second group provides the web services to the users which are also known as on-demand web services, these can be used to build more complex applications like Xignite and StrikeIronthese offer various web services deploy on a Cloud on a pay per use basis.Pay per use is the property of the public cloud and this property attract the user as user need to pay the good only for the part used by him, comely know as elasticity property. The services like IaaS and SaaS are use this property of cloud. The cloud uses the hardware resources like virtual machine to deploy the services. The research issues in the area of cloud computing is security, fault tolerance, workflow scheduling. Among these deadlines constrained workflow scheduling is main issue.

**Scientific Workflows:**

Workflow constitutes a common model which describes the wide range of scientific application in the distributed system. Scientific workflows are generally described as direct acyclic graphs (DAG).In the DAG, nodes are

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representing tasks and vertices are representing dependencies among tasks. Workflow Scheduling is a common NP-complete problem. This is the process of mapping the workflow tasks to its appropriate resources in the public cloud. Workflows mainly concentrate on the resource automation of procedures which passes the files and data among the participants based on a set of rules. Using scientific workflows numerous complex applications can be broken down into smaller components and that components can be executed reliably and efficiently than original one. The Pegasus Workflow management system is one of the most used workflow of scientific workflow application. This scientific workflow compiles the complex workflows into executable workflow. Following are the workflow scheduling algorithms:Ant Colony optimization Algorithms,Genetic Algorithms, Particle Swarm Optimization algorithms(PSO), Partial Critical Path algorithms(PCP).

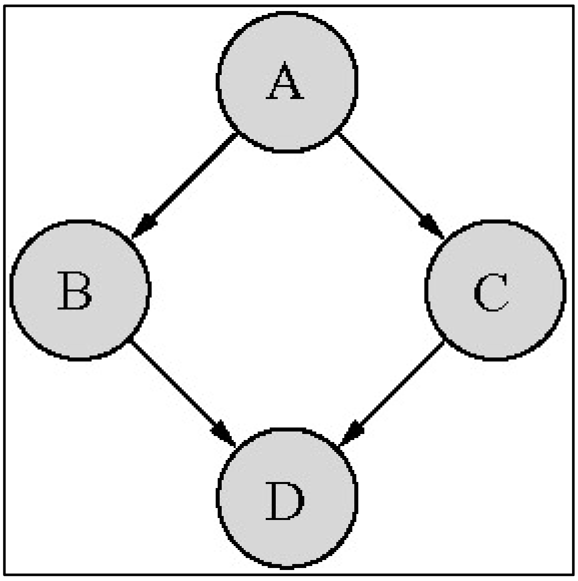


Figure1: Workflow Represented as Direct Acyclic Graph

## II. DEADLINE CONSTRAINT ALGORITHMS TILL DATE

Some of the commonly used algorithms to schedule workflows with deadline are partial critical algorithm(PCP), generic algorithm,Particle Swarm Optimization algorithms(PSO), IaaS Cloud Partial Critical Path algorithm(IC-PCP), Enhanced IC-PCP with Replication(EIPR), Location based Minimum Migration in Cloud(LBMMC). These algorithms are explained below:

A. **Generic algorithms:** The genetic algorithms are used to schedule scientific workflows with budget and deadline constraints to minimize the cost [7]. Genetic algorithm gives optimized solution on the various evolutionary techniques in the polynomial time. Thefitness function use as a key function used in this type of algorithm. This function determines how much an organism can be reproduce before the function dies. The mutation, recombination and selection operations are used by the generic algorithms. An optimized solution to the problem can be implemented within the specific deadline which mainly depends on the generic algorithm.

B. **Particle Swarm Optimization algorithms(PSO):** In the paper [8] Particle swarm Optimization is used efficiently to schedule scientific workflows. PSO and generic algorithm shares many homogenous attributes, but PSO does not have any evolutionary operators.The PSO algorithm works by initializing means population (swarm of) candidate solutions (known as particles). The basic unit of the PSO algorithm in a particle and each particle will keep track of pbest and also gbest. Where the pbest is personal best i.e. best solution for particle and gbest is global best i.e. best value for any particle. Every particle has the specific quandary space with its current optimum

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particles. Depends on current position and speed each particle change its position. To add on the particles the distance between the recent position and pbest also the distance between the current position and gbest are also considered.

C. **Partial critical algorithm (PCP):**In the paper [5] PCP algorithm is partial critical algorithm. This algorithm has two main phases: Deadline Distribution and Planning. In the Deadline Distribution phase, the overall deadline of the workflow is distributed over individual tasks. In the Planning phase of algorithm, schedules the workflow by assigning each task to the cheapest service which meets its sub deadline. It assigns the start and end node of the critical path. After assigning the start and end node of a critical path algorithm then assigns these nodes to the resources that process them earlier, for minimization of the execution time of the entire workflow.For scheduling the critical nodes, it minimizes the price of executing the critical path before the user-specified deadline. After scheduling all critical nodes, each of them has a start time which is a deadline for its parent nodes, i.e. its (direct) predecessors in the workflow. So, then we can carry out the same procedure by considering each critical node in turn as an exit node with its start time as a deadline, and creating a partial critical path that ends in the critical node and that leads back to an already scheduled node.

D. **IaaS Cloud Partial Critical Path algorithm(IC-PCP):**In the paper [2] IC-PCP algorithm is IaaS Cloud Partial Critical Path algorithm. This algorithm is used for the scheduling of the workflow in cloud in such way that algorithm will meet user defined deadline in public cloud.ICPCP is a one-phase algorithm. This algorithm works as a similar to the deadline distribution phase of the PCP algorithm, but instead of assigning sub deadlines to the tasks of a partial critical path, IC-PCP tries to actually schedule them by finding an (existing or a new) instance of a computation service which can execute the entire path before its latest finish time.

E. **Enhanced IC-PCP with Replication (EIPR):**In the paper [1] Enhanced ICPCP algorithm is used to calculate the distancebetween the start to end task in the DAG graph that is usedon the computer network and configuration in the workflowsystem. Task shares their requirements details with theother task exist in the graph. Normal standard used in thealgorithm to operate the resources in the graph and itreduces the decremented results in the graph . It wouldnot allow the user to submit the secondary requirements intheir task. So user gets permission to log into the node andthe workflow system. Each user has the own username andpassword to submit the task. Entry is missed in the startingnode it should be consider to be a failed task. User wants toresubmit the task again in the workflow system. Differentlogarithmic algorithm used to enhance the particular task inthe system and it degrades the workflow application.Each task is changed based on the respond from theworkflow system. It adjust the information belongs to theworkflow system but it dynamically increase the automaticupdates in the application. Open loop indicates the graphhave the earlier estimation time to detect the performancesof the task performed in the algorithm.

F. **Location based Minimum Migration in Cloud (LBMMC):**In the paper [3] The EIPR algorithm is used to reduce the impact of performance variation of cloud resources using deadline constraint of workflow. To get the application deadline replication of task is use by the algorithm to schedule the process in the cloud resources algorithms. The new algorithm location based minimum migration in cloud is proposed. This algorithm monitors the all virtual machines (VMs) in all cloud location centres. This algorithm states the virtual machines status i.e. the VM is sleep, ideal or running is checks. It also checks the number of tasks which are running and task which are able to run. When there is overloading is detected in the virtual machine then live migration of process is done to the nearby cloud centre. Also when the under load is detected then live migration is done. The LBMMC is used to select the process to migrate. The steps involved in this algorithm are: 1. Resource Assumption andTask Analyse, 2. Allocate resource for jobs, 3. ModelAnalyse for Migration, 4. Migration of tasks.

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## III. CONCLUSION

The provisioning and scheduling property of Cloud infrastructures makes it a suitable platform which can be execute the workflow applications considering the soft deadlines. Many times fluctuation is occurred in the public clouds while actual performance delivered by resources. To reduce the impact of performance variation of public Cloud resources in the deadlines of scientific workflows, are used. This is useful for the behaviour of cloud resources during the scheduling process to increase the chance of meeting application deadlines.

## IV. ACKNOWLEDGMENTS

On the submission of this paper, I would like to extend my gratitude & sincere thanks to my project guide Prof. S. S. Patel, of Information Technology for her constant motivation and support during the course of my work. I truly appreciate and value her guidance and encouragement. I would like to thank all faculty members of SKN College of Engineering and all who's direct and indirect support helped me in my research work of paper.

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