Exploration of secured Workflow scheduling models in cloud environment:
Cost, Makespan, Robustness and Security level requirement aware workflow scheduling

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Summary

1. Introduction
2. Components of SW and SWS
3. State of the art(SWS)
4. State of the art(WS)
5. Proposal
6. Conclusion and future works
## Environment

- Considering the virtual machines from **one provider**.
- Considering the virtual machines from **more than one provider**.

## Objectives

- **Single objective and Multi-objective**.
- Optimization of (makespan, Cost, Energy, Resource Utilization)

## Constraints

- **Single or Multiple constraints**.
- Budget, Deadline, Risk Rate, Reliability, Security level Requirement

## Models/approach types

- Meta-heuristic
- Heuristic
- Hybrid

## Workload

- Static
- Dynamic

## Category of WS

- Single workflow scheduling
- Multiple workflow scheduling
**Services**
- Processing
- Storage

**Factors**
- **Environment**: Hybrid, Multiple cloud and within Datacenter.
- **Application requirements**: with sensitive information.

**Domains**
- Most of the domain with sensitive data (Defense, Bio-informatics, business, etc)

**Security**
- **Common attacks**: snooping and Change
- **Common solutions**: Confidentiality, Integrity and Authentication
- **Source of threat**: Providers side, User Side and Application side

**Security strength and time overhead differ**
- **Confidentiality**: RC4, IDEA
- **Integrity**: HMAC-SHA-1, HMAC-MDS
- **Authentication**: MDA, SHA-x, DES
Secured workflow scheduling

Alto stratus project

- Considered executing workflow tasks in Hybrid cloud (public and private).
- To fulfill **Security Level Requirements**: decided tasks (less sensitive) to be executed in public cloud and the most sensitive tasks to be executed in private.
- **Objective**: Cost, under Deadline constraint and fulfill Security requirement.


SOLID

- To reduce the data dependency encryption overhead they have used task duplication technique. **Problem**: generate useless data.
- **Objective**: Makespan, cost and fulfill Security level requirement.

Secured workflow scheduling

SAWS

- The same as SOLID but with main focus on the minimization of start time of each task.

- **Objective**: Makespan, cost, Resource utilization and fulfill Security level requirement.
  

MOPA

- Uses **divide and conquer technique**: Divide tasks instance into multiple group and then execute each group separately.

- **Objective**: Makespan, monetary cost and privacy.
  
  Y. Wen et al “Scheduling workflows with privacy protection constraints for big data applications on cloud,” Future Generation Computer Systems
Secured workflow scheduling

**SCAS**

- In order to be able to optimize Multidimensional and Multi constraint problem, SCAS has employed PSO.

  **Objective:** Makespan and cost under deadline and budget, fulfill Security level requirement.


**SABA**

- Introduced the concept of immovable dataset. This concept affect the performance and restrict the movement of certain dataset due to their cost and security.

- The concept helps in providing short makespan and security service.

  **Objective:** Security level requirement, budget and makespan

Secured workflow scheduling

**CEDP**

- Provide awareness over big data application in Hybrid cloud.
- Use cost and Energy aware data placement to reduce cost, access time and energy consumption.
- It is better reducing energy and saving renting monetary cost.
- **Objective**: Reduce energy, save monetary cost for renting and fulfill Security level requirement.

X. Xiaolong et al Data placement for privacy-aware applications over big data in hybrid clouds," Security and Communication Networks.

**Common consideration**

- **Alto Stratus Project, FFBAT and CEDP**: Considered Hybrid environment. They deal with deciding which tasks to be scheduled in private and which to be scheduled in public environment.
- **FFBAT and SCAS**: considered Risk Rate as the additional constraint.
- **SOLID and SAWS**: both considered task duplication technique.
workflow scheduling

**HEFT**

- Selects the task with the highest upward rank value at each step and assigns the selected task to the processor, which minimizes its earliest finish time with an insertion-based approach.
- Schedules the critical tasks onto the processor that minimizes the total execution time of the critical tasks
- **Objective:** High performance and Makespan reduction


**Robustness Policies**

- Robust and fault tolerant scheduling algorithm with three multi-objective resource selection policies. (Deal with 3 type of failures: Task failure, workflow Level failure and VM failure)
- **Objective:** Minimize makespan and cost under deadline and budget constraints by maximizing the robustness.

workflow scheduling

Cost aware models

- Considered the emergence of new pricing (Combination of CPU frequency and Cost) schema and its impact to the User CPU frequency Selection.

- **Objective : Optimize cost under deadline constraint**

Comprehensive comparison of WS models

- Study the performance of different workflow scheduling models.

- Their studies shows that many WS model have the same performance for the same workload.

- **Objective : Minimise cost under deadline**
Objectives, Relationship and Difference

Multi Objectives

- Minimize cost and Makespan under Deadline and budget.
- Maximize Robustness probability.
- Ensure Security Level Requirement.

Relationship with other works

- Like SCAS and Robustness policies we consider cost and makespan as our main objectives to optimize.
- Like Cost aware models and Comprehensive comparison of WS models we consider CPU frequency as the only one fact to charge VM and VM performance variation.
- Like Robustness policies we consider to use maximum Robustness.
- Like all SWS models we want to ensure Security Level Requirement.

Difference with other Multi objectives

- Optimization of multiple objectives based on the parameters defined by the users.
Cost, Uncertainties, Execution time

Cost

- Cost will depend on the CPU frequency allocated to the VM during the execution of each task.
- In other papers, they had a rounding policy for the cost (5.1 hours: 6 hours)

Uncertainties

- **VM performance Variation**: Depends on the CPU frequency allocated.
- **Task failure**: Depends on the performance of the VM. This may cause the failure of the whole workflow.
- Diversity of users’ requirements.

Execution time, Makespan

- **Execution time**: will depend on the CPU frequency allocated to the machine.
- **Makespan**: will depend on the Execution time and Encryption time.
Priorities: Cost, Makespan, Security Level Requirement

**Cost**
- Ensure Low cost high makespan by running the model using Minimal CPU frequency at each VM.
- Change CPU Frequency to reduce makespan according to the Deadline.
- Check robustness for each security Level Requirement (Choose maximum).

**Makespan**
- Ensure Low Makespan high cost by running the model using Maximum CPU frequency at each VM.
- Change CPU Frequency to reduce cost according to the Budget.
- Check robustness for each security Level Requirement (Choose maximum).
Priorities: Cost, Makespan, Security Level Requirement

Security Level Requirement: Low and High

- Ensure Low Makespan, Low Security Level Requirement high cost by running the model using Minimum CPU frequency at each VM.
- Change CPU Frequency to reduce cost according to the Deadline.
- Check robustness for each security Level Requirement(Choose maximum).

Security Level Requirement: Low and High

- Ensure Low Makespan, High Security Level Requirement high cost by running the model using Minimum CPU frequency at each VM.
- Change CPU Frequency to reduce cost according to the Deadline.
- Check robustness for each security Level Requirement(Choose maximum).
Recall

- we have reviewed WS and SWS model and determine their objective.
- we have identified Relationship and difference of our model and the state of the art.

Future works

- Experiments
Q and A

Thank You