|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cloud Providers | Price | | | | | | | | | | |
| CPU Price ($/107MI) | | | Storage Price ($/Gb) | | | BW Price ($/Gb) | | | | |
| US | EU | AS | US | EU | AS | Intra-DC | US | EU | AS | Inter-Regions |
| Provider 1 | 0.020 | 0.025 | 0.027 | 0.006 | 0.006 | 0.0066 | 0.001 | 0.0015 | 0.002 | 0.004 | 0.008 |
| Provider 2 | 0.020 | 0.018 | 0.020 | 0.0096 | 0.008 | 0.0096 | 0.001 | 0.0015 | 0.002 | 0.004 | 0.008 |
| Provider 3 | 0.0095 | 0.0090 | 0.0080 | 0.00120 | 0.0096 | 0.0090 | 0.001 | 0.0015 | 0.002 | 0.004 | 0.008 |

Configuration of the simulation parameters.

Parameter Value

Number of cloud provider 3

Number of regions 3

Number of DCs per provider Between 2 and 5 data centers

Number of VMs within a DC 8

Number of submitted Task Between 1000 and 10000 tasks

Task size Between 200 and 1000 MI

Number of data 200 Data size Between 300 Mb and 1 Gb

Inter-region BW (resp. delay) 500 Mb/s (resp. 150 ms )

Intra-region BW (resp. delay) 1 Gb/s (resp. 50 ms)

Intra-DC BW (resp. delay) 8 Gb/s (resp. 10 ms)

VM processing capability 1500 MIPS

VM number of CPU 2

VM RAM 4 Gb

VM storage capacity 8 Gb

Provider revenues per task execution (𝑅𝑒 ) 0.7$

Penalty per violation (𝐶𝑝𝑒𝑛𝑎𝑙𝑡𝑦) 0.0025 $

Response time service level objective𝑆𝐿𝑂𝑅𝑇 180 s

Minimum availability service level objective 𝑆𝐿𝑂𝑀𝐴 0.95

Specific parameters to the strategy   
Replication period 𝑃 32 violating tasks

𝑤 = 0.8 hence 𝑇 ℎ𝑅𝑇 = (0.8 × 180)

Number of K clusters to extract using the spectral clustering algorithm K 3

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Rule | Data transfer time ratio | Virtual Machine load | Data availability | Provider profit | Placement potential |
| 1 | High | High | NR | NP | Very Low |
| 2 | High | Medium | NR | P | Low |
| 3 | Medium | Medium | NR | P | Medium |
| 4 | Medium | Medium | R | P | High |
| 5 | Low | Low | R | P | Very High |

The goal of the strategy is to reduce the amount of SLA violations while preserving the monetary profit of cloud providers.

The strategy consists of two main phases: data identification and replica placement. In the data identification phase, use the spectral clustering to extract the correlations between remote data related to SLA violations. This information is then used to identify the data that is most likely to cause SLA violations if it is not replicated. In the replica placement phase, use the neuro-fuzzy inference system to place the identified data on the cloud resources that are most likely to reduce SLA violations. The neuro-fuzzy inference system takes into account four main parameters: the response time of the resource, the availability of the resource, the cost of leasing the resource, and the potential for data correlation.

The strategy should also able to adapt to changing workloads and resource availability.

Lastly evaluate the performance

(A) Average response time (in ms) for each task (1000, 2000, 3000, 5000, 7000, 10000)

(B) Amount of SLA violations in terms of response time of single cloud-based strategies for each task (1000, 2000, 3000, 5000, 7000, 10000)

(C) Effective Network Usage for each task (1000, 2000, 3000, 5000, 7000, 10000)

(D) Average total monetary profit per provider of single cloud based strategies (provider 1, provider 2, provider 3)

(E) Average response time (in ms) while varying the tasks number for each task (1000, 2000, 3000, 5000, 7000, 10000)

(F) Average response time (in ms) while varying the data centers number (6, 9, 12, 15)