QoS Resource Management for Cloud Federations

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QoS Resource Management

Conclusion and Future work
• Contrail Federation sits in the middle
  - serving the users
  - exploit efficiently the providers

• Must operate a trade-off between two apparent discording objectives
  - optimize for users (e.g., minimize cost)
  - optimize for providers (e.g., ensuring fairness in providers’ revenues)

• Federation is an autonomous entity
  - directly corresponds for providers’ violations
Common Cloud Approach

- bin-packing
- performance corrective actions (e.g. VM migration host-basis)

Federation Issue

- migration across providers is very expensive
  - increasing down-time (provider negotiation, image transfer time, etc.)
- smart allocation to avoid migration
Problem Formulation

- Allocating N services on M providers
- Respecting QoS constraints from user (e.g. dedicated bandwidth, bounded response time, provider location, etc.)
- Input: app reqs and provider characteristics
- Objectives
  - Minimizing user criteria (e.g. cost)
  - Maximize federation revenue (minimizing risk of paying penalties)
Broker case

- Sub-problem of the federation allocation
- Optimization on cost
- Loosely-coupled architecture (cannot provide additional guarantees)
- Can mitigate vendor lock-in
QBrokage

- Genetic approach
- QoS = cost, ram, storage, location
- Support multiple provider cost models
- Flexible to plug-in
- Scalable (250 ms increment on m-time from 50 to 500 $P$)

Table: Lock-in Degree

<table>
<thead>
<tr>
<th>$P$</th>
<th>QBrokage Cost ($P$)</th>
<th>Naive Cost ($P$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.082 (1.5)</td>
<td>0.082 (1.0)</td>
</tr>
<tr>
<td>100</td>
<td>0.078 (2.35)</td>
<td>0.077 (1.0)</td>
</tr>
<tr>
<td>150</td>
<td>0.082 (3.20)</td>
<td>0.080 (1.0)</td>
</tr>
<tr>
<td>200</td>
<td>0.075 (3.50)</td>
<td>0.073 (1.0)</td>
</tr>
</tbody>
</table>
Addressing Federation Issues

- Resource cost model that consider providers’ reputation
  - federation directly corresponds penalties
  - acquiring resources from bad providers may cost more at the end
- Monitoring applications and SLA violations
  - updating reputation and costs per provider
- Dynamic provider reputation
  - transient overloads must be considered
  - avoiding fluctuations
1 QoS Resource Management

2 Conclusion and Future work
Today

- **libcloud** drivers for the Contrail Federation
- PaaS layers can run transparently on top of the federation

Tomorrow

- Towards a PaaS Federation
- Third-party layers can benefit from quantity and quality of resources
- Reusing existing federated mechanisms
Translating PaaS requirements

- To address heterogeneity of providers
- Enforce high-level QoS guarantees

Enforcement strategies

- VM Elasticity
  - Increasing/decreasing VM number
  - Less precise but widely supported

- Resource scaling
  - Increasing virtual resource quantity
  - Require underlying support
Conclusion

- Inter-Cloud Computing brings benefits in terms of interoperability and dependability
- ...but the complexity of management is increased and poses many challenges
- Cloud Federations cannot scale if relying on ad-hoc methods
- Leveraging other research fields
  - Cloud Control
  - Real-time techniques
  - Cognitive heuristics
Gaetano F. Anastasi, Emanuele Carlini and Patrizio Dazzi
Smart cloud federation simulations with CloudSim
In *Proceedings of the first ACM workshop on Optimization techniques for resources management in clouds, ORMaCloud ’13*, June 2013
https://github.com/ecarlini/smartfed/

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Usage Control in Cloud Federations

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QBROKAGE: A Genetic Approach for QoS Cloud Brokering

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A Hybrid Cross-Entropy Cognitive-based Algorithm for Resource Allocation in Cloud Environments

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An OVF Toolkit Supporting Inter-Cloud Application Splitting