Optimal Virtual Machine Placement in Multi-Tenant Cloud

Hana Teyeb, Ali Balma, Nejib Ben Hadj-Alouane and Samir Tata

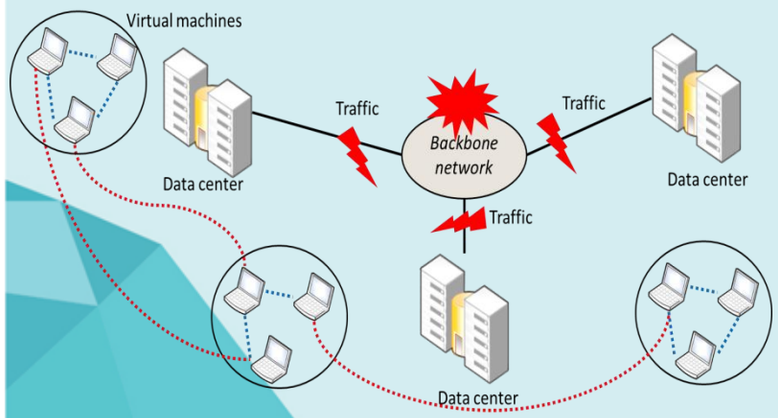
Context

- In an IaaS environment, DCs are geographically distributed in order to be in proximity of end-users and to reduce operational costs
- Thousands of nodes consuming a large amount of energy
- Generating a large amount of traffic

Objectives

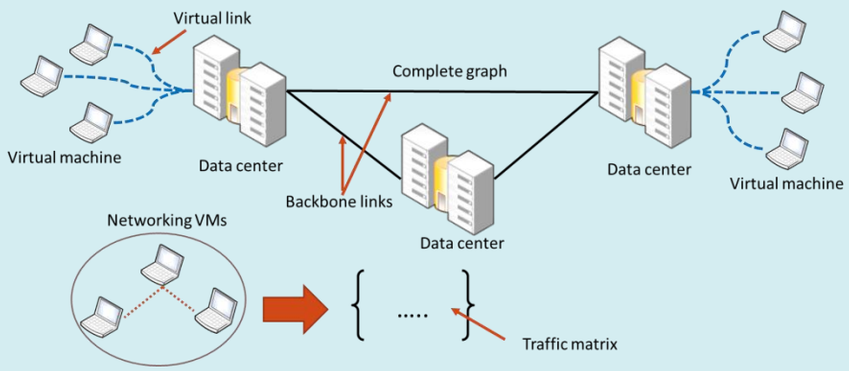
- Minimize the traffic circulating on the backbone network.
- Prevent from network congestion problem.
- Performance and QoS garanties.
- Reduce time latency
- Reduce energy consumption.

Challenges



Methods

- Exact methods
- Two ILP (Integer Linear Programming) formulations
- Variable aggregation approach



The aggregated Formulation

Objective function

$$\min \sum_{i \in V} \sum_{h \in D} \varphi_{ih}$$

Subject to:

Flow conservation constraint

$$O_i.z_i^h - \sum_{j \in V} d_{ij}.z_j^h \leqslant \varphi_{ih} \quad \forall i \in V, \forall h \in D$$

Location constraint

$$z_i^h \leqslant a_i^h \quad \forall i \in V, \forall h \in D$$

Allocation constraint

$$\sum_{h \in D} z_i^h = 1 \quad \forall i \in V$$

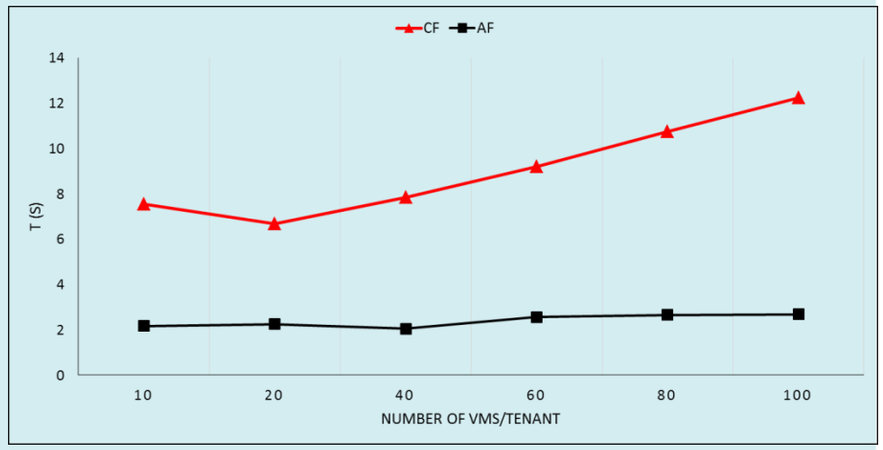
Capacity constraint

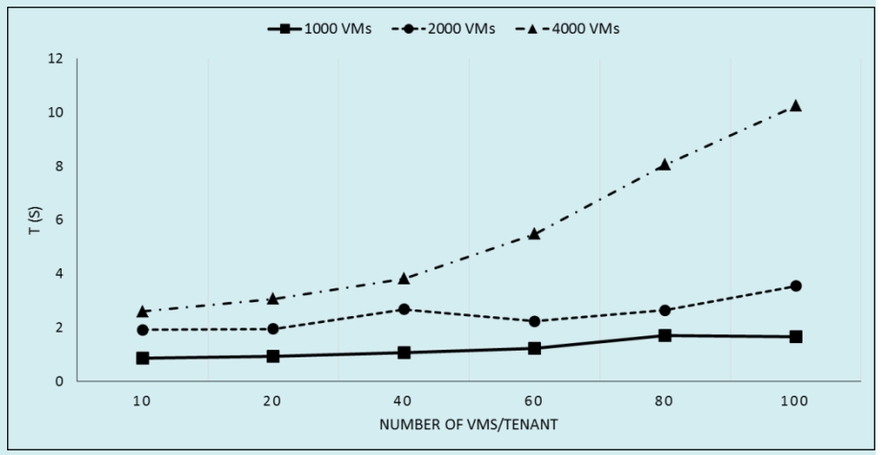
$$\sum_{i \in V} u_{ir}.z_i^h \leqslant cap_r^h \quad \forall r \in R, \forall h \in D$$

$$z_i^h \in \{0,1\} \quad \forall i \in V, \forall h \in D$$

$$\varphi_{ih} \geqslant 0 \quad \forall i \in V, \forall h \in D$$

Results





Future work

- ❖ Knowledge of application workload and traffic pattern
- ❖ VMs allocation is static
- ➔ Dynamic VMs placement and resource allocation
- ➔ Online algorithm

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Hana TEYEB,
E-mail: hana.teyeb@gmail.com