An Online Virtual Machine Placement Algorithm in an Over-Committed Cloud

Siqi Ji*, Ming Da Li, Niannian Ji, Baochun Li
Virtual Machine Placement

- Select the most suitable physical machine (PM) to host each virtual machine (VM).

- It is crucial to balance PM resources among multiple dimensions during the placement and minimize the number of activated PMs.
Resource Over-Commitment

- Over-committed cloud: widely used for solving the wastage problem by allocating more resources to VMs than they actually have.

- Limitation of existing works:
  - Did not consider resource over-commitment in VM placement, which could cause PM overloading.
PM Overloading

- Total resources utilized by VMs do exceed the PM’s actual capacities.
- Memory of the PM is 36GB and it is sold as 72GB:

(a) Packing VMs as tightly as possible.
(b) Setting a 80% threshold for placement.
Our Solution: Min-DIFF

- An threshold-based online VM placement algorithm that considers multiple dimensions of resources:
  - Reduce resource fragmentation
  - Reduce the risk of PM overloading
Min-DIFF

- Threshold-based placement

**Strategy 1:** Place VMs below the threshold:

- PM1
- PM2
- PM3

**Strategy 2:** Place VMs without considering the threshold:

- PM1
- PM2
- PM3
Resource Threshold

- Warning line: providers do not expect the utilization of over-committed PMs is higher than a specific percentage.

- Reserve space for large VMs above the threshold.

\[ T_h^d = \min \left\{ \frac{P M_j^d - L^d}{P M_j^d}, w^d \right\}. \]
Choose the Best PM

- Utilized PMs: Choose the PM that has the largest resource fragmentation reduction.

\[
RF_j = \frac{\sum_{p, p \neq m} (NR_j^p - NR_j^m)}{\sum_{d=1}^{D} NU_j^d}, \quad \delta_{RF_j} = RF_{j\_bef} - RF_{j\_aft}.
\]

- Empty PMs: Choose the most balanced PM after the VM is placed.

\[
RF_{j\_empty} = \sum_{p, p \neq m} (NR_j^p - NR_j^m).
\]
Performance Evaluation

- Schemes for comparison:
  - First Fit algorithm
  - EAGLE [1]
  - Max-BRU algorithm [2]
- Three datasets we generated and one real-world workload Trace.

Performance Evaluation

- Architecture of the simulator:

[Diagram showing the architecture of the simulator with VM requests from workload traces, backlogged requests, a placement scheduler with algorithms, and physical machines (PM 1, PM 2, ..., PM n).]
Performance Evaluation

- If we do not consider the over commitment issue:
  - The number of used PMs and resource fragmentation
Performance Evaluation

- The warning line is 80% along each dimension.

- Resource fragmentation and the percentage of PMs that CPU utilization is higher than 80%
Thank you!

Q&A