Entropy a Consolidation Manager for Clusters

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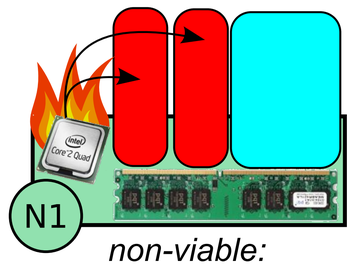
Dynamic consolidation reduces the number of nodes required to host Virtual Machines (VMs). Distributed scientific applications that work in phases require a variable amount of resources. In this situation, we rearrange VMs using live migrations to consider their current requirements. However, the migration process itself can incur a substantial overhead. In the worst case, the VMs' requirements have changed again before the migration completes.

Entropy is a dynamic consolidation manager based on Constraint solving. It is focused on the packing of the VMs and the migration process to reduce both its duration and its impact on performance.

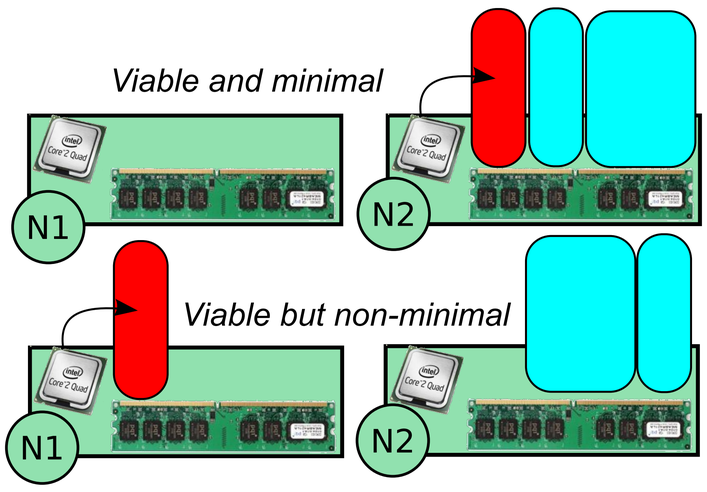
The Virtual Machine Packing Problem

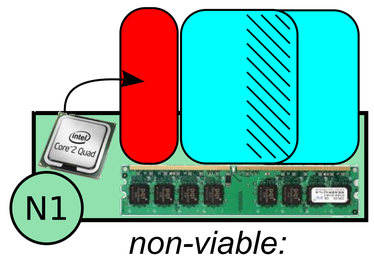
Constraints define a viable configuration:
- ✔ no memory overcommitment,
- ✔ no CPU sharing between active VMs (VMs making a computation).

Entropy computes a viable configuration that requires the minimum number of nodes.



non-viable:
2 active VMs for one CPU

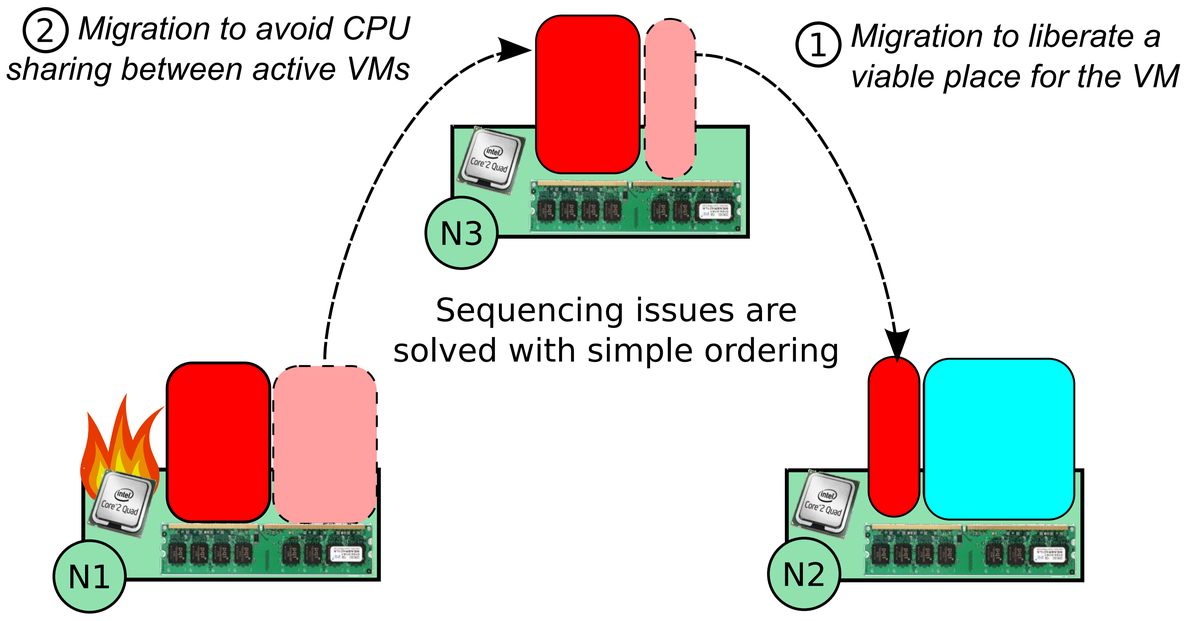




non-viable:
memory overcommitment

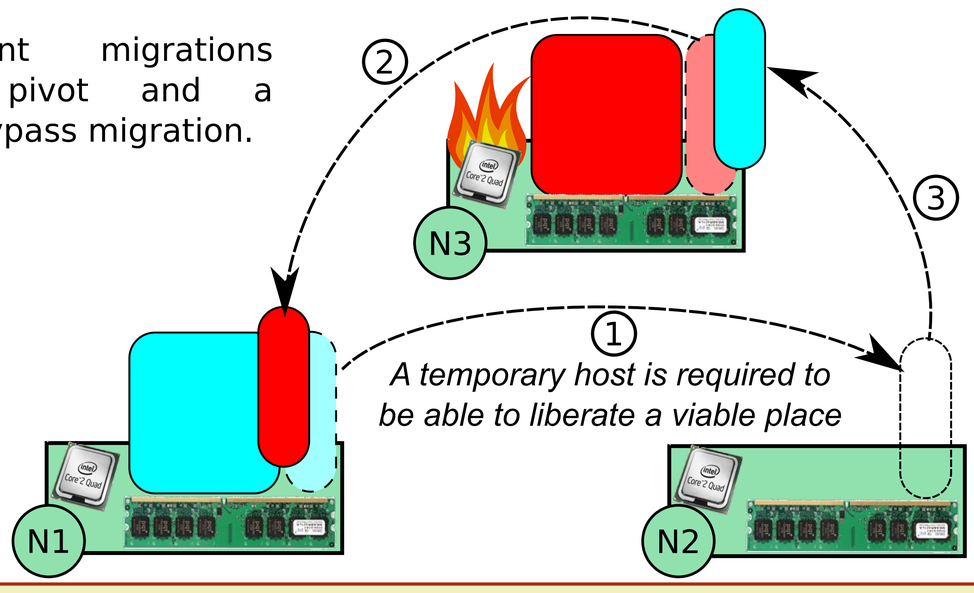
Migration issues

- ✔ Sequencing issues,
- ✔ Inter-Dependant migrations.



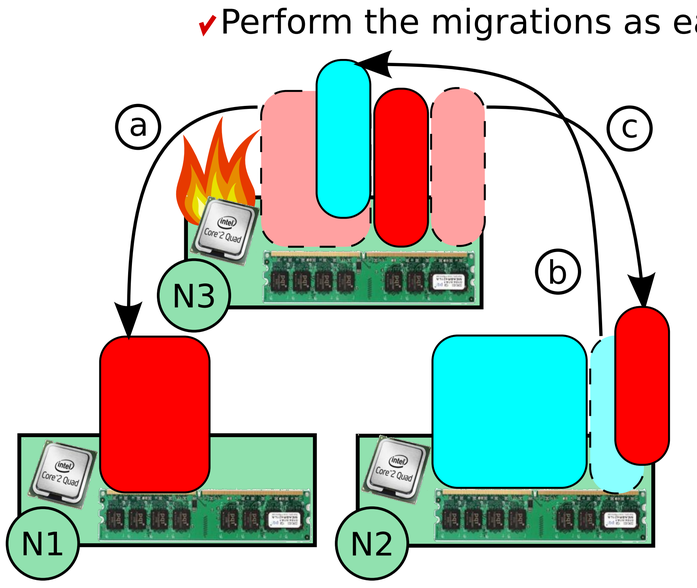
Entropy builds a reconfiguration plan that ensure the feasibility of each migration.

Inter-dependant migrations require a pivot and a preliminary bypass migration.



Our solution: Optimizing the reconfiguration

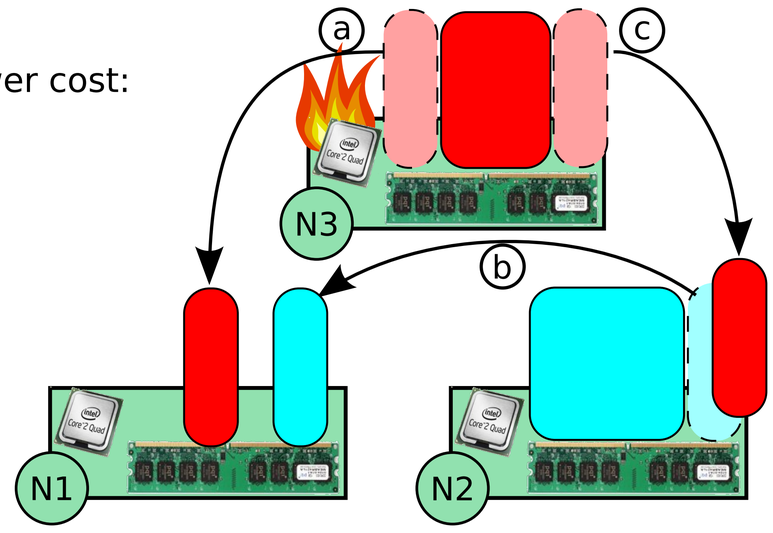
- ✔ Reduce the number of migrations,
- ✔ Maximize the parallelism,
- ✔ Perform the migrations as early as possible,



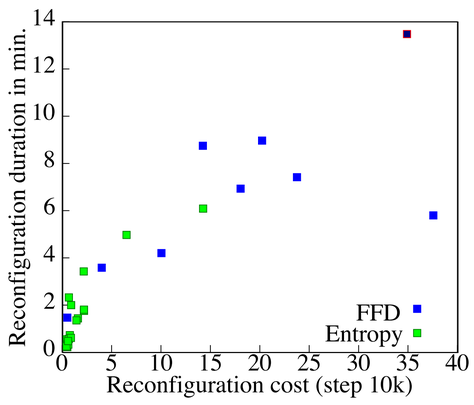
A viable reconfiguration plan:
1- Perform 'a',
2- Perform 'b',
3- Perform 'c'.

Entropy searches for a configuration:
- ✔ which is a solution of the VM Packing Problem
- ✔ implying a reconfiguration cost as small as possible.

Another plan with a lower cost:
1- Perform 'a' and 'b',
2- Perform 'c'.



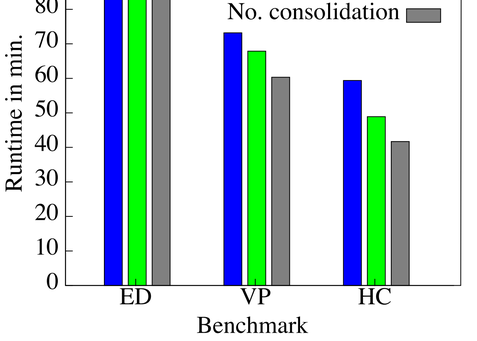
Experiments with the NASGrid Benchmark

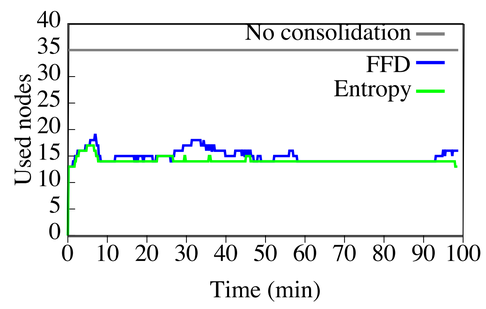


Comparison with a dynamic consolidation based on First Fit Decrease (FFD):
- ✔ Cost: -90%
- ✔ Size: -71%
- ✔ Duration: -74%
- ✔ nb. of configurations consolidated: x2

Comparison with an execution without consolidation:

	FFD	Entropy
CPU/hour consumed	-25%	-50%
Runtime overhead	+20%	+11%





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Homepage

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