SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

The STSM applicant submits this report for approval to the STSM coordinator

Action number: CA15127
STSM title: Alert-Based Disaster Resilience of DC Services
STSM start and end date: 21/07/2019 to 27/07/2019
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PURPOSE OF THE STSM

Several weather-based disasters have caused Data Centre (DC) shutdowns in recent years with intolerable downtime of cloud services. On the other hand, virtualization techniques allow services hosted on DCs to run on Virtual Machines (VMs) that can be migrated between servers within a DC or between DCs. The standard way of VM migration is "offline migration", where the services running on a VM are stopped, the associated VM data (disk, memory and processors states) is migrated from the source server to a destination server and the services are then activated at the destination server. Meanwhile, the "online migration" concept has been proposed where the migration process is conducted in a large enough number of steps such that the service is maintained active in all, except the last, steps and the downtime associated to the last step is negligible.

Recently, an online VM migration strategy was proposed by the 'Politecnico di Milano' team in DRCN 2019 conference for alert-based disaster resilience of DCs, defined as an ILP (Integer Linear Programming) optimization model. The strategy considers scheduling, routing and bandwidth assignment to the migration of VMs towards rescuing DCs within a given alert time. The aim of that strategy is a combination of different objectives: maximizing the number of migrated VMs, minimizing service downtime, minimizing network resource occupation and minimizing migration duration.

The purpose of this STSM is to combine the expertise of Massimo Tornatore and his research team (in inter-DC live virtual machine migration techniques and strategies) with the expertise of Amaro de Sousa (in ILP based and heuristic based solutions techniques for disaster related optimization problems) to address two inter-related problems:

Problem 1: Efficient Online VM Migration for Alert-Based Disaster Resilience

Problem 2: SLA Aware VM Migration for Alert-Based Disaster Resilience

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DESCRIPTION OF WORK CARRIED OUT DURING THE STSM

In the first day of the STSM, Amaro de Sousa made a presentation to Massimo Tornatore research team on his most recent research works on modelling and solving disaster related telecommunication problems. The presentation was focused on the design/upgrade of transparent optical network topologies resilient to the simultaneous failure of its critical nodes.

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Then, the work carried on by discussing how Problem 1 can be modelled and solved both through exact methods and heuristic methods. The aim was to derive better ILP models and good heuristic approaches for Problem 1, as the known ILP model could only deal with small-sized instances.

Finally, the work carried on by discussing how Problem 2 can be modelled and solved both through exact methods and heuristic methods. A preliminary work was already done between Amaro de Sousa and Massimo Tornatore before the STSM and the preliminary work was accessed during the STSM.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

Concerning the work related with Problem 1, during the STSM a new ILP model was developed and tested in a small set of problem instances. The tests showed that the new ILP model can solve problem instances significantly larger than the ones solved by the previously known ILP model. Concerning the heuristic methods, different strategies were discussed. In particular, some strategies known to be efficient for the multi-knapsack problem were identified and are being included in the current heuristics.

Concerning the work related with Problem 2, during the STSM the optimization problem was slightly modified to become more appropriate to practical scenarios. Problem 2 is a restricted version of Problem 1 but takes into account the Service Level Agreements (SLAs) between DC service providers and service clients. An ILP model was derived and tested to the problem.

FUTURE COLLABORATIONS

The joint work developed in this STSM is to continue in the next months. Concerning the joint work on Problem 1, a journal paper submission is envisaged until the end of 2019. Concerning the joint work on Problem 2, a conference paper submission is envisaged in the next few months.