

Service-Aware Orchestration on Distributed Edge Infrastructures

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1. Introduction

Edge computing enables the deployment of latency-sensitive, bandwidth-hungry and safety-critical applications at the edge of the network. Because of their heterogeneity, they may require specific orchestration strategies, based on custom optimization criteria, hardly handled by conventional one-size fits-all approaches.

This thesis presents a novel orchestration approach, where dynamic Service-Defined Orchestrators (SDOs) handle the deployment of specific applications in a distributed fashion. Moreover, it also addresses the problem of coordinating of such a variety of SDOs over the same shared infrastructure, while preserving the overall optimality.

2. Method

Each service provider may define the desired orchestration strategy by means of a set of declarative statements. These are then parsed into an SDO, which handles the lifecycle of the application (Figure 1).

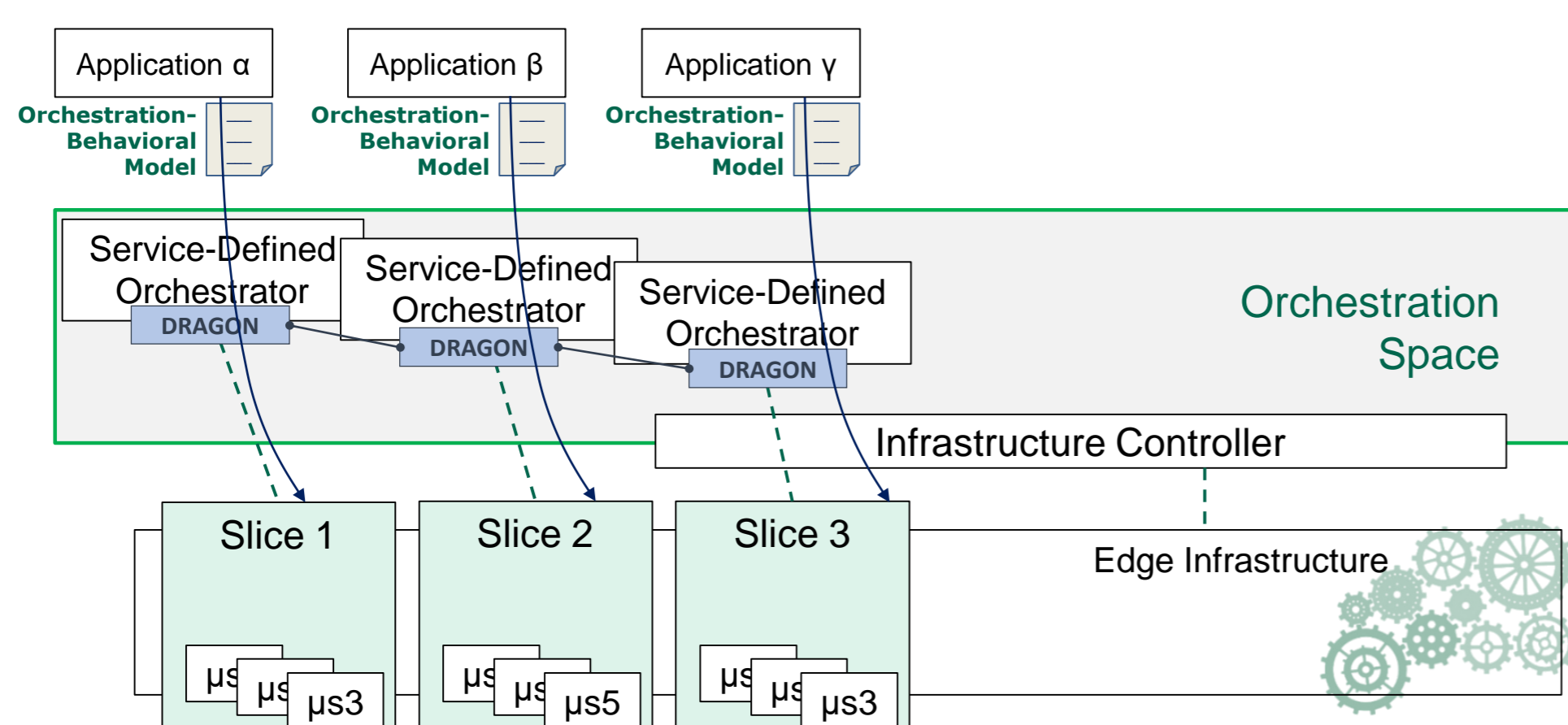


Figure 1. Deployment of heterogeneous applications through service-specific SDOs over an edge infrastructure.

The formalism used to declare service-specific strategies is called Orchestration Behavioral Model (OBM), and it has been exhaustively described in [1].

To coordinate such a variety of SDOs operating on a shared infrastructure, this thesis also proposes DRAGON (Distributed Resource AssiGnment and OrchestrationN - DRAGON) [2], an algorithm that exploits game theory to reach an agreement on how resources have to be assigned among SDOs. DRAGON provides also convergence and performance guarantees.

3. Experiments

Performances have been compared with traditional orchestration approaches through experiments on some reference use cases. Moreover, convergence properties of DRAGON have been evaluated on large scale scenarios (Figure 2).

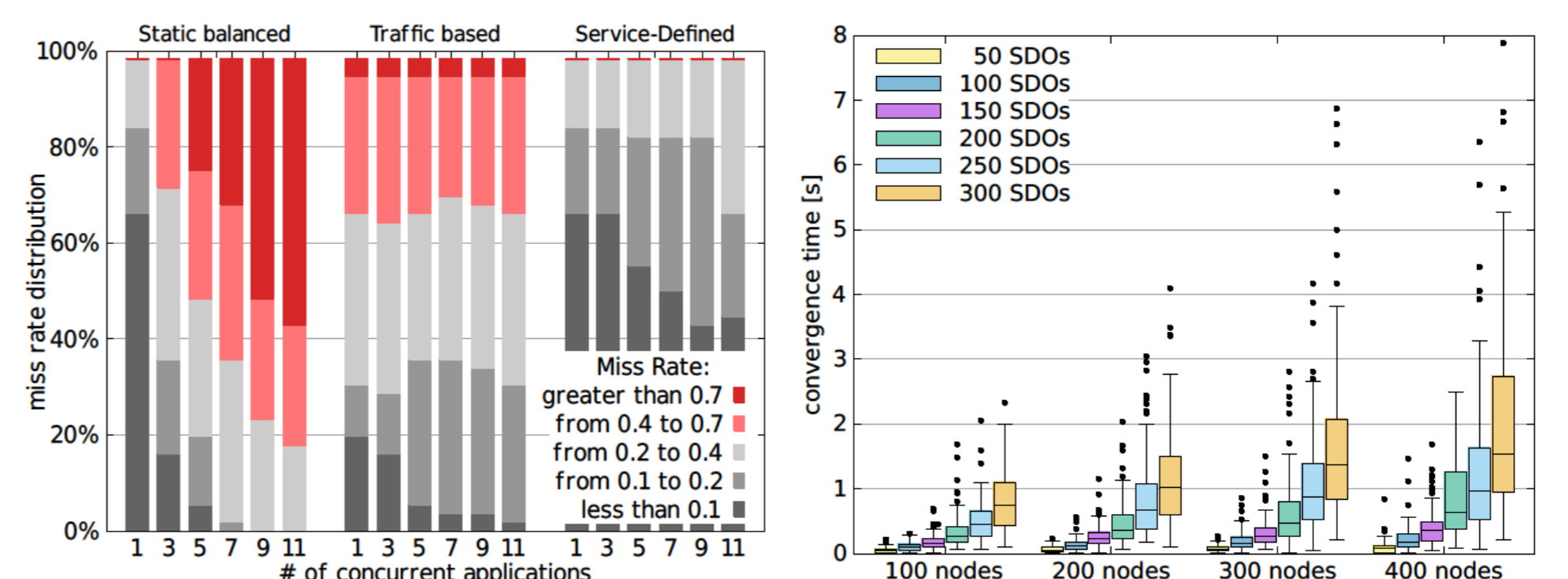


Figure 2. (a) QoE of a content delivery application comparing different orchestration approaches. (b) DRAGON convergence time.

4. Conclusions

This thesis (i) shows how to enable service-specific orchestration strategies, and (ii) defines the algorithms possibly used by infrastructure providers (e.g., telcos) to enable their customers to coexist and interoperate on a shared infrastructure.

5. References

1. Castellano, G., Esposito, F., & Rizzo, F., A Service-Defined Approach for Orchestration of Heterogeneous Applications in Cloud/Edge Platforms. IEEE Transactions on Network and Service Management.
2. Castellano, G., Esposito, F., & Rizzo, F., A Distributed Orchestration Algorithm for Edge Computing Resources with Guarantees. In proceeding of the International Conference on Computer Communications (INFOCOM 2019). IEEE.