# Accepted Manuscript

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PII: S0167-739X(18)30315-7
DOI: https://doi.org/10.1016/j.future.2018.07.039
Reference: FUTURE 4357

To appear in: *Future Generation Computer Systems*

Received date : 14 February 2018
Revised date : 30 May 2018
Accepted date : 17 July 2018

Please cite this article as: L.M. Vaquero, F. Cuadrado, Y. Elkhatib, J. Bernal-Bernabe, S.N. Srirama, M.F. Zhani, Research challenges in nextgen service orchestration, *Future Generation Computer Systems* (2018), https://doi.org/10.1016/j.future.2018.07.039

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ACCEPTED MANUSCRIPT

# Research Challenges in Nextgen Service Orchestration

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**Abstract**

*Fog/edge computing, function as a service, and programmable infrastructures, like software-defined networking or network function virtualisation, are becoming ubiquitously used in modern Information Technology infrastructures. These technologies change the characteristics and capabilities of the underlying computational substrate where services run (e.g. higher volatility, scarcer computational power, or programmability). As a consequence, the nature of the services that can be run on them changes too (smaller codebases, more fragmented state, etc.). These changes bring new requirements for service orchestrators, which need to evolve so as to support new scenarios where a close interaction between service and infrastructure becomes essential to deliver a seamless user experience. Here, we present the challenges brought forward by this new breed of technologies and where current orchestration techniques stand with regards to the new challenges. We also present a set of promising technologies that can help tame this brave new world.*

**Keywords:** NVM; SDN; NFV; orchestration; large scale; serverless; FaaS; churn; edge; fog.

## 1. Introduction

There is a new breed of technologies that are becoming mainstream in current Information Technology (IT) infrastructures. Fog computing aims to partially move services from core cloud data centres into the edge of the network [159]. Thus, edge devices are increasingly becoming an essential part of the IT infrastructure that extends from core cloud data centres to end user devices, allowing some management functions to be offloaded to the vicinity of sensors and other user devices, while heavy analytics can still happen in the cloud, possibly on aggregated data [22]. This is especially relevant for resource-constrained churn-prone devices in the Internet-of-Things (IoT).

The fog has also been propelled by the advent of programmable infrastructures, like Software-Defined Networking (SDN), Network Function Virtualization (NFV) [89, 63], and data centre disaggregation [71, 87, 125]. These have simplified infrastructure configuration for data centre servers, storage, as well as core and edge networks. As a result, the infrastructure is able to

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