

# Master Thesis Summary: *Development, Test and Application of a framework for cloud serverless services*

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## 1 Introduction

The overview of services for the creation of Web Applications is focusing more and more towards a micro services oriented approach, moving away from monolithic structures. The maximum representation of this is with the serverless paradigm, which has found an implementation in the cloud model Function as a Service (FaaS), a model that uses plain simple functions as its main resources. The execution model of traditional servers implies that the application's code is always running, to be ready to serve incoming http(s) requests (internet requests). The FaaS model differs from the latter as each function is executed only in response to an event, obtaining a fine grained usage of the physical infrastructure. In the context of Web Applications an event is an http(s) request, but exist also other types, such as rate events, which are executions programmed for a particular time, or time interval if repeated. The main advantages of this model are: transparent server infrastructure for developers; simplified development, consequence of splitting the code into functions; capacity to scale automatically the number of functions executed, based on the number of requests; cost effectiveness, as only function execution is billed, opposing to the traditional approach, where also idle time is counted. Serverless Framework has emerged as one of the major framework that allows the usage of the homonym paradigm in a simple way. Despite the functionalities introduced by Serverless, the developer must take charge of various operations concerning indirectly the business logic of the application. The proposed framework, named *Restlessness*, was born with the goal of improving the user experience of Serverless, providing a standard project and testing structure, a Command Line Interface and a local Web Interface through which is possible to completely manage the project and with the further goal of minimizing all operations that do not concern directly the application's business logic.

## 2 Methodology

The main goal of the thesis has been to develop the framework from its initial and barely usable implementation, to a software that can be used without problems on real deployed web applications. Part of the development has been spent on creating a productive development workflow, with tools for Continuous Integration and Continuous Delivery, provided by the CircleCi platform and a version control system, provided by the Github platform. The project has then been splitted into two main components, corresponding to the packages provided on the Npm registry<sup>1</sup>: *@restlessness/cli* and *@restlessness/core*.

The *core* package has been developed firstly, as it defines the structure that a newly created *Restlessness* project should have, and also provides all classes and functions allowing the management of the project at a low level, such as the interaction with it on the file system. The management of the project includes the creation of serverless resources, with the main ones being: Endpoints and Schedules, corresponding to serverless functions executed in response to http and periodic or programmed events respectively; Authorizers, functions that perform authorization operation, granting or denying access to functions or other resources; Models: classes modeling resources, primarily database objects; Services, a group of serverless functions.

The latter package is composed by a Command Line Interface and a local Web Interface, providing the main interaction points for the user, and it rely on the *core* package to provides its functionalities. The local Web Interface is composed by a frontend and backend application, with the latter created with the framework itself, primarily for the advantage of a simplified development. All together those components allow: to create a project, to develop it locally and deploying it on the cloud provider platform.

The framework has been designed to be extended by external addons packages, so the next step in the development process has been to provide addons for common patterns, such as database access and authentication. This has been done through the packages *@restlessness/dao-mongo* and *@restlessness/auth-jwt*, respectively for interaction with the mongodb database and for authentication through the Json Web Token standard.



Figure 1: Restlessness main components

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<sup>1</sup>The Node package Manager, it allows publishing and installing Node.js packages

### 3 Application

It has been possible to test the developed framework on real deployed applications, thus allowing to find and correct critical issues. The main test case has been the implementation of the backend application for the project *Spazio alla Scuola*, which is a platform thought by the *Fondazione Agnelli*, a non-profit foundation born in 1966 in Turin. The aim of the project was to provide a concrete support to school leaders for lecture resumption on September 2020, given the health situation on the country due to the SARS-CoV-2 pandemic. The platform, provided as a free service, offers tools to verify the capacity of classrooms and other school spaces, to plan classrooms flows and staggering, in compliance with the distancing measures. The serverless approach, used in conjunction with the *Restlessness* framework, is suited in this particular case because: the number of http(s) requests through the day is variable; the project requires a fast development, so having a framework already providing a project structure and solution for common patterns simplify this process.

The proposed framework provided the speed of development sought, however, due to its early stage of development, some problems arised. In particular the main improvements that have been made to the framework after the application on *Spazio alla Scuola* are: handling of Cold start, which is a delay in the function execution due to initialization operations needed by the cloud provider; creation of a plugin to support the non relational database mongodb in a serverless context, and in particular to avoid the saturation of available database connections; support of multiple services under a single *Restlessness* project.

Addressing those problems led the *Restlessness* framework to be more stable and reliable, both for the described project, being it able to handle 500 thousand requests at its peak and also for other production applications, where it is currently used.

### 4 Conclusions

At the end of this development cycle, the proposed framework has become production ready, however, its development is not completed and the main improvements on its roadmap are: becoming framework agnostic, while at the moment the only supported provider is AWS; proposing a structure for integration testing; integrate all Cli functionalities on the Web Interface and vice versa, to achieve a greater flexibility; to provide additional extensions to extend the framework usability.