Internship offer for Master 2 students - 2025/2026

Improving REST API Coherence through Model-Driven Engineering and OpenAPI Enrichment

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Location: IRISA Rennes - CNRS UMR 6074

Salary: Internship gratification

Duration: 6 months

Keywords: REST API, OpenAPI, Model-Driven Engineering

Context
Nowadays, web applications are ubiquitous and play a crucial role in our daily lives. Behind the scenes, these services rely on an architecture where each functionality is API-ified, meaning that each service is made accessible through **Application Programming Interfaces (APIs)** using standardized protocols and data formats. The **Representational State Transfer (REST)** architecture is by far (around 70%) the most popular approach to building APIs that expose Web services.
However, developing and using a REST API is not a straightforward task. Despite referring to the same REST API, different stakeholders use heterogeneous terms and concepts that are semantically and syntactically different. This impreciseness is harmful as it leads to ambiguity, e.g., developers encounter difficulties understanding business requirements when developing an API. Therefore, **developing accurate and usable REST APIs requires coherence among the three facets we have identified: requirements, code, and documentation.**
Today, the **OpenAPI** standard provides a widespread standardized description of APIs, offering a way to “play” requests/responses to simulate interactions with the API, based on examples provided by developers. However, it has been reported that more than 70% of developers find that web API documentation is often missing, incomplete, incorrect, or outdated. From an industrial point of view, **IBM and Google report several issues with OpenAPI specifications**. Also, **Amazon Web Services (AWS)** provides OpenAPI specifications, but they do not include examples, neither for the expected API request nor for the API response.

Objectives
The goal of this internship is to improve REST API coherence by aligning code, requirements, and documentation. It aims to enrich the **OpenAPI standard** and relies on **Model-Driven Engineering (MDE)** principles to model, verify, and automatically generate the code of any REST API.

The specific objectives of the internship are:

1. Conduct a Literature Review on OpenAPI modeling

- Review existing research efforts and tools related to the modeling and analysis of OpenAPI specifications.
- Pay particular attention to the work of **H. Ed-douibi et al. [3]** on defining metamodels for OpenAPI and integrating them into model-driven workflows.
- Identify current limitations of the OpenAPI standard and highlight research opportunities to address them through modeling.

2. Define a Metamodel for REST APIs
- Extend and refine existing metamodels for OpenAPI (e.g., Ed-douibi's work), incorporating missing concepts such as **roles**, **scopes**, **behavioral constraints**, or **security/privacy annotations**.
- Ensure the metamodel captures both **syntactic** and **semantic** aspects of REST APIs, and is compatible with **OpenAPI 3.x**.

3. Implement the Metamodel Using EMF (Eclipse Modeling Framework)
- Encode the metamodel in **EMF** to enable automated tooling support.
- Leverage EMF's capabilities for **model validation**, **instance generation**, and **transformation**.

4. Model Real REST APIs
- Use the developed metamodel to model real-world REST APIs (e.g., **GitHub**, **Stripe**, **AWS**).
- Analyze how well the enhanced metamodel represents existing OpenAPI specifications and where it adds **expressiveness**, **structure**, or **automation benefits**.

This internship will provide the student with hands-on experience in **model-driven engineering**, **software architecture**, and **web technologies**, with potential extensions toward specification enhancement, tooling, or future research.

We have funding available for a **PhD position following this internship**, in case the candidate is interested and has achieved encouraging results during their internship.

Required skills

- Solid programming skills
- Ability to work autonomously
- Proficiency in both written and spoken English

To apply for this position, please send an email to stephanie.challita@irisa.fr

Environment

The candidate will work in the DiverSE team, common to CNRS (IRISA) and Inria. The DiverSE team is located in Rennes. DiverSE's research is in the field of software engineering. The team is actively involved in European, French, and industrial projects and is composed of 12 professors/researchers, 20 PhD students, 4 post-docs, and 3 engineers. As is a common practice in the DiverSE research team, all source code will be open-sourced using either the GPL or Apache Licenses. This should assist in the technological transfer from academic prototypes to industrial-ready tools. Experimentations to demonstrate the effectiveness of developed tools on real-world issues are actively encouraged and expected.

References

[1] S. M. Sohan et al., "A Study of the Effectiveness of Usage Examples in REST API Documentation," IEEE VL/HCC, 2017.
[2] H. Cao et al., "Automated Generation of REST API Specification from Plain HTML Documentation," ICSOC, 2017.

[3] H. Ed-douibi et al., "Example-Driven Web API Specification Discovery," ECMFA, Springer, 2017.
[4] S. M. Sohan et al., "SpyREST: Automated RESTful API Documentation Using an HTTP Proxy Server (N)," IEEE/ACM ASE, 2015.
[5] **S. Challita** et al., "A Precise Model for Google Cloud Platform," IEEE IC2E, 2018.