

PhD offer in computer science

Adaptive security framework for microservices-based cloud applications

Lab: IRISA/Inria Rennes-Bretagne Atlantique, University of Rennes

Location: Rennes, France

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Keywords: Software engineering, cloud computing, microservices, security

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Context and subject

Microservices are an architectural model in which an application is decomposed into smaller, independent services that communicate with each other. Each microservice is responsible for a specific business functionality and can be deployed, scaled and maintained independently of the other services. This approach to software architecture allows for faster development, easier maintenance, and more resilient systems.

The recent evolution towards microservices-based web applications has led to an increased need for security practices to ensure their confidentiality, availability, and compliance with legal requirements.

Existing approaches proposed in the literature do not take into account contextual information when implementing a security mechanism (traffic encryption, OAuth2.0, OpenID Connect, etc.) to prevent security breaches (unencrypted data, insufficient access control, unauthenticated traffic, etc.) [1,2]. These approaches are rigid and become ineffective when the context of microservices changes. This change may be related to the user or microservice's location, user behavior, the load received on the microservice, interactions between different microservices, etc.

Knowledge of context is crucial to provide more effective security measures tailored to the specific needs of the web application. By being aware of its context, the application can dynamically adjust security measures to respond to the evolving threat landscape, ensuring that sensitive information and resources are protected at all times.

Research questions

The objectives of this PhD can be formulated as the following research questions:

RQ1: What contextual information is likely to affect the security mechanisms of a microservices-based cloud application?

RQ2: How to describe contextual security threats and countermeasures in a cloud application?

RQ3: What are the requirements of an adaptive security framework for cloud applications? How can we achieve it?

RQ4: What types of use cases are suitable for evaluating our adaptive security framework?

In terms of methodology, the PhD will combine the characterization, design, and implementation of a framework for reasoning about the security measures of a cloud application based on context. This will subsequently allow us to provide cloud developers with new security recommendations for their applications.

Application conditions

We are looking for exceptional and motivated candidates for this 3-year PhD. The candidate must have (or be about to obtain) a master's or engineering degree in computer science.

A mastery of scientific English is necessary. Knowledge of French is not required but recommended as the thesis will take place in a French university.

Gross monthly salary: 2051 € (years 1 and 2) then 2158 €

Application

The application must be sent to **Dr. Stéphanie Challita by email: stephanie.challita@inria.fr**, with the following documents:

- A detailed and up-to-date CV,
- A letter of motivation explaining the interest in the scientific aspect of this thesis,
- Grade transcripts, diplomas, ranking, any other documents that can help assess the quality of the candidate,
- One or more letters of recommendation (including that of the Master's internship supervisor),
- Examples of scientific writing or projects (publications, internship or project reports),
- Other documents that the candidate thinks would be useful for the application.

References

1. Nasab, Ali Rezaei, Mojtaba Shahin, Seyed Ali Hoseyni Raviz, Peng Liang, Amir Mashmool, and Valentina Lenarduzzi. "An Empirical Study of Security Practices for Microservices Systems." *Journal of Systems and Software*. April 2023.
2. Ponce, Francisco, Jacopo Soldani, Hernán Astudillo, and Antonio Brogi. "Smells and Refactorings for Microservices Security: a Multivocal Literature Review." *Journal of Systems and Software*. June 2022.