

# Towards Parameterized Distributed Component Model: Formal Model and Implementation

Ludovic Henrio and Christian Perez

LIP, ENS Lyon

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**Advisors:** Ludovic Henrio (CASH) et Christian Perez (AVALON)

**Laboratory:** LIP, ENS Lyon, UMR CNRS-INRIA 5668, 46 allée d'Italie, 69364 Lyon Cedex 07

**Email:** ludovic.henrio@ens-lyon.fr, christian.perez@ens-lyon.fr

## Context

The internship is placed in the context of the design of abstractions for defining parameterized topologies of software components [2] for distributed computing in general, and Cloud/Fog computing in particular.

More precisely, we want to extend the Madeus component model [1] with collective operations and configuration of system of variable size (at least decided at deployment time). Madeus accurately describes the life cycle of each component by a Petri net structure, and is able to finely express the dependencies between components. The overall dependency graph it produces is then used to reduce deployment time by parallelizing deployment actions.

For the moment, it is not possible to describe naturally in Madeus a system with a size that will be chosen at deployment time. Communication patterns in such variable size systems are not possible or very difficult to express.

## Internship Objectives

The objective of this internship is to study the adaptation and possible extensions of the Madeus model to better take into account large component architectures, particularly focusing on architectures of parametric size. More particularly the objective is to design constructs for parametric communication and topologies, either expressible in Madeus or expressed as minimal extension of the model. The first extension to be considered is the ability to trigger not only two sided communications but also communications toward a set of components. The duality between the transmission of control tokens characteristic of the Madeus system and the data transmission aspect will have to be taken into account. In particular, the interplay between data and communication is crucial

in the context of collections of components because the size of the system should be a parameter of the system, or could even be transmitted as data during configuration. This influences the communication patterns, at least concerning the number of targets of collective communications.

The objectives of the internship are at the same time to define sound extensions of the model and to implement the corresponding extension in the Madeus framework (<https://mad.readthedocs.io/>). The internship can thus focus either on theoretical aspects, or on the design and implementation aspects.

## Comments

The internship will be located at the LIP, ENS Lyon, Lyon. This subject may lead to a PhD.

## References

- [1] Maverick Chardet, Hélène Coullon, Dimitri Pertin, and Christian Pérez. Madeus: A formal deployment model. In *4PAD 2018 - 5th International Symposium on Formal Approaches to Parallel and Distributed Systems (hosted at HPCS 2018)*, pages 1–8, Orléans, France, July 2018.
- [2] Clemens Szyperski. *Component Software: Beyond Object-Oriented Programming*. Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA, 2002.