

A Framework for Experimenting with Blockchain-based Distributed Systems

CIFRE PhD - LORIA & iExec

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Blockchain are becoming increasingly important as a core components of distributed systems. Blockchain provides the trust layer that allows direct interaction between peers. Hence, blockchain could be used as middleware to coordinate various components of distributed systems and implement various tasks such as payment, trust, reputation, provenance & traceability, etc.

However, main characteristics of blockchain are still relatively unknown from a performance point of view, but we already know that scalability is the main issue to solve for a wider adoption. In fact , the technology is evolving rapidly to address the scalability issue with the introduction of various form of consensus, such as Proof-of-Stake, side channel, lightning network, sharding, cross blockchain interaction, etc...

Because of this, new methodologies are required to experiment with blockchains in an environment that would allow for reproducibility, configurability and performance evaluation. The topic of this thesis is to propose a framework for experimenting with the various blockchain protocols and middleware, in particular by focusing on the Ethereum blockchain.

The use of virtualization and emulation techniques will be explored: the work on the Distem emulator, targeting other kinds of distributed systems, already showed that they are suitable to achieve experimentation at scale, with controlled heterogeneity of performance (CPU, network, I/O), or controlled fault injection & load imbalance. We will build on and extend these techniques, including exploring automatic or assisted techniques to uncover performance or resilience issues.

Experimentations performed to validate the framework will focus on the evaluation of Ethereum and the interaction with various forms of side chain structures to have a better scalability while ensuring the same level of security and transparency.

PhD work plan

To start with, the current state of the art will be explored, to better understand the current state of performance evaluation around blockchain technologies, on one hand, and the relevant experimentation techniques (simulators, emulators, testbeds).

After that, we will aim at entering a virtuous cycle between the design of an experimentation framework, and experiments on blockchains that will provide interesting insight and drive the design of the framework.

PhD organization

This PhD thesis, funded by a CIFRE grant, will be jointly supervised at both LORIA (Nancy) and iExec headquarters (Lyon). The PhD candidate will spend a majority of the time in Nancy, but is expected to spend about three months per year in Lyon.

Links

- <https://iex.ec/>
- <http://distem.gforge.inria.fr/>

To apply, send CV and cover letter to
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