Visualization and Analysis of Cross-chain Transactions

Project Title	Visualization and Analysis of Cross-chain Transactions
Status	COMPLETED
Difficulty	HIGH

Description

The emergence of blockchain interoperability is reducing the risk of investing in blockchain by avoiding vendor lock-in, leveraging interoperation with off-chain systems, and providing a truly open ecosystem, enabling a network of blockchains. While technical interoperability is practically solved across public blockchains (using relays, sidechains, HLTCs, and notary schemes), there is still a lot of work to be done across private-public blockchains. This is being tackled by Hyperledger Cactus. However, there are **very limited efforts on the value/semantic level of interoperability** - which soon will become a bottleneck for interoperability.

In particular, the **human-challenges** related to the adoption of such technology have received little attention, with few significant contributions to date. Yet, real innovation can be achieved only by adopting a holistic approach. Designing for **blockchain interoperability poses several socio-technical challenges** thus offering a unique opportunity to link the underlying technology with human experience and values.

This project aims to advance the state of the art on understanding blockchain interoperability on the value/semantic layers - In particular, how can someone conjugate **human-centric design, service design, and sustainability to blockchain interoperability?** How can one make informed choices on the best cross-chain synergies? How can someone visualize cross-blockchain transactions?

Learning Objectives

This internship intends to yield a fruitful learning experience, across several dimensions:

- Study the state of the art for blockchain interoperability in the light of the Hyperledger Foundation projects and initiatives, namely Hyperledger Cactus.
- Research three questions: a) what is a sustainable cross-blockchain transaction; b) how can one visualize and understand cross-blockchain jurisdictions, and c) how can one effectively design cross-blockchain services. This may include the development of business logic plugins for Cactus or smart contracts for either Fabric or Besu that provide a direction to answering one or more research questions. You will have the opportunity to write a scientific paper that may have an impact on academia
- Open-source and teamwork: You will learn how to contribute to an open-source project, and also document your work; You will be aware of the main efforts of the Hyperledger technologies, and how blockchain interoperability relates to that; You will interact with the Hyperledger community
- Technical: You will refine your understanding of blockchain technology; You will strengthen your understanding of blockchain interoperability, taking a step forward to become an expert; You will refine your programming skills, both in client-side applications and in chaincode

Useful sources / projects:

https://github.com/hyperledger/cactus

A Survey on Blockchain Interoperability: Past, Present, and Future Trends (2020)

https://arxiv.org/pdf/2005.14282.pdf

HERMES: Fault-Tolerant Middleware for Blockchain Interoperability (2021)

https://web.ist.utl.pt/~ist180970/papers/2021/hermes-middleware-2021.pdf

Elsden, Chris, et al. "Making sense of blockchain applications: A typology for HCI." Proceedings of the 2018 chi conference on human factors in computing systems. 2018.

http://nrl.northumbria.ac.uk/id/eprint/33897/1/Elsden%20et%20al%20-%20Making%20sense%20of%20blockchain%20applications.pdf

Sas, Corina, and Irni Eliana Khairuddin. "Design for trust: An exploration of the challenges and opportunities of bitcoin users." Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems. 2017.

https://eprints.lancs.ac.uk/id/eprint/83765/1/Design_for_trust.pdf

Expected Outcome

- 1) Implementation, testing, and documenting the set of technological artifacts required to answer the research questions
- 2) Scientific paper (or technical report) on the achieved results, that can be used to disseminate the knowledge created on this internship

Relation to Hyperledger

The expected outcome tackles the whole Hyperledger Ecosystem. In particular, the project includes Hyperledger Cactus and possibly Fabric, Besu, and Hyperledger Explorer.

Education Level

Masters or Ph.D. level students are preferred. Experience in scientific research is recommended (but not required).

Skills

Must:

- Willing to contribute to a meaningful mission, in an open-source mentality
- Teamwork skills, as synergies and cooperations with other parts, are needed to successfully complete the project
- Solid understanding of blockchain technology
- Experience with front-end libraries (Angular/React/Vue) + Typescript

Nice to have:

- Experience with User-Centered Design
- Research experience (if you don't, no worries - we can help!)

Future plans

The end of the internship does not need to mean an end to your collaboration. The idea is for the mentee to be connected to Hyperledger's ecosystem, contributing to blockchain interoperability solutions.

Preferred Hours and Length of Internship

Full-time.

Mentor(s) Names and Contact Info

Nuno J. Nunes, Professor at IST and Senior Researcher ITI/LARSyS

Sabrina Scuri, Ph.D. - ITI/LARSyS - sabrina.scuri@iti.larsys.pt

Rafael Belchior, Junior Researcher at INESC-ID; Teaching Assistant and Ph.D. candidate at Instituto Superior Técnico, Universidade de Lisboa: rafael.belchior@tecnico.ulisboa.pt

Mentee

Iulia Mihaiu, Master Student in CyberSecurity at Transilvania University of Brasov - iulia.mihaiu@student.unitbv.ro

Final Report