Offer #2025-09153

Engineer - Collaborative file system over IPFS

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : Temporary scientific engineer

Level of experience : Recently graduated

Context

This engineer position will be in the context of Alvearium challenge (https://project.inria.fr/alvearium/), a project between HIVE, Coast, Magellan and Wide Inria teams. The engineer will be located at Inria Nancy-Grand Est and will be visiting Magellan team at Inria Center of the University of Rennes and the Hive offices in Cannes.

About Hive:

Hive intends to play the role of a next generation cloud provider in the context of Web 3.0. Hive aims to exploit the unused capacity of computers to offer the general public a greener and more sovereign alternative to the existing clouds where the true power lies in the hands of the users. It relies both on distributed peer-to-peer networks and on the encryption of end-to-end data.

About Inria Center of the University of Lorraine:

The Inria Center of the University of Lorraine is one of Inria's nine centers and has twenty project teams, located in Nancy, Strasbourg and Saarbrücken. Its activities occupy over 400 people, scientists and research and innovation support staff, including 45 different nationalities. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institutes, etc.

About Inria Center of the University of Rennes:

The Inria Center of the University of Rennes is one of Inria's eight centers and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence,

technological research institutes, etc.

Assignment

For availability and performance reasons, data is replicated. Several users have to be able to update concurrently the replicas of the same data without losing their modifications. Hive solution relies on IPFS (https://ipfs.io/) and mutable data support is offered by means of the mutable file system API of IPFS. However, there is no support for merging concurrent changes. In the context of Alvearium we proposed using CRDTs (Conflict-free Replicated Data Types) [1] as replication mechanism as they are suitable for end-to-end encryption in a peer-to-peer environment where data will be decrypted only at the receiver side and conflicts can be resolved locally. There is therefore no need to decrypt data during data transmission as it is the case for centralised architectures where servers require un-encrypted data in order to perform merging. There are two main families of CRDTs: state-based and operation-based [1]. They differ in the way payloads are defined, i.e., how the updates are shared. A payload under state-based CRDT contains the whole data, while the payload under operation-based CRDT carries only a single update.

In [2] an operation-based set CRDT was developed over IPFS. The goal of this engineer position is to develop an operation-based file system CRDT whose specification can be inspired from [3,4].

The engineer will closely work together with a PhD student on this topic.

[1] M. Shapiro, N. M. Preguic?a, C. Baquero, and M. Zawirski. “Conflict-Free Replicated Data Types”. In: 13th International Symposium on Stabilization, Safety, and Security of Distributed Systems, SSS 2011. Oct. 2011, pp. 386–400. doi: 10.1007/978-3-642-24550-3_29.

[2] Quentin Acher, Claudia-Lavinia Ignat, Shadi Ibrahim:
Quantifying the Performance of Conflict-free Replicated Data Types in InterPlanetary File System. DICG@Middleware 2023: 19-24

[3] Mehdi Ahmed-Nacer, Stéphane Martin, and Pascal Urso. 2012. File system on CRDT. https://arxiv.org/abs/1207.5990

[4] Vinh Tao, Marc Shapiro, Vianney Rancurel. Merging semantics for conflict updates in geo-distributed file systems. SYSTOR 2015: 10:1-10:12

Main activities

- Study of literature on CRDTs (1 months)

- Study CRDTs for file systems (2 months)

- Design of an operation-based file system CRDT with merging semantics that satisfy user intentions (6 months)

- Implementation of the proposed CRDT over IPFS (9 months)

Skills

Engineering and/or Master 2 degree in Computer science / Applied mathematics with an experience in computer networks.
Theoretical expertise: distributed systems, P2P networks

Good collaborative and networking skills, excellent written and oral communication in English
Good programming skills
Strong analytical skills

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration

From €2692 gross/month depending on experience and qualifications

General Information

- **Theme/Domain :** Distributed Systems and middleware
  Software engineering (BAP E)
- **Town/city :** Villers lès Nancy
- **Inria Center :** Centre Inria de l'Université de Lorraine
- **Starting date :** 2025-10-01
- **Duration of contract :** 12 months
- **Deadline to apply :** 2025-08-15

Contacts

- **Inria Team :** COAST
- **Recruiter :**
  Ignat Claudia-lavinia / claudia.ignat@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.