A propos du centre ou de la direction fonctionnelle

The Inria Rennes - Bretagne Atlantique Centre is one of Inria's eight centres 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.

Contexte et atouts du poste

This PhD thesis will be in the context of a collaboration between HIVE and Myriads and Coast Inria teams. The PhD student will be located at Inria Center of the University of Rennes and will be visiting team Coast at Inria Nancy-Grand Est 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, on the encryption of end-to-end data and on blockchain technology.

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.

About Inria Nancy - Grand Est:

The Inria Nancy - Grand Est center is one of Inria's eight 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.

Mission confiée

Recently, there is a growing trend toward highly distributed storage solutions by storing and sharing data across geo-distributed connected devices from the edge of the network to large scale data centres. An appealing solution – which we are exploring within the Inria-Hive collaborative framework – is utilizing the available storage and compute resources of connected devices (mobile/desktops) across the world to form a P2P storage system that provides data storage and sharing in a cost-efficient way. However, this requires to deal with several issues including node failures, node availabilities (churns), how to guarantee data availability and avoid data loss, etc.

Erasure coding (EC) has been progressively used in storage systems to provide high data availability with relatively less storage and energy cost compared to replication. For example, EC has been deployed in data analytic systems [1, 2, 3, 4] and in-memory storage systems on cached (hot) data [5]. EC can be an ideal candidate for large scale peer-to-peer storage systems (exploits parallel read and write of data, involves large number of nodes in storing and repairing data). However, unlike previous efforts where EC is mainly used for achieved data in P2P system [6, 7], performing EC on the critical path of data access (which is the case in this project) in large scale P2P storage system (to store hot and frequently accessed data) poses many research challenges on how to ensure high data availability and meet data and node dynamicity, and on how to provide cost-effective and heterogeneity-aware data repair.

This PhD thesis will address the problem of how to provide cost-efficient yet reliable data management when deploying erasure codes (EC) in large scale trusted peer-to-peer cloud storage systems.

References:


Principales activités

- As a first step, we will investigate new data placement strategies that can ensure high data availability under frequent failures and node unavailabilities. We will start by exploring how to initially place the data while considering the performance of data retrieval (location-aware, upload bandwidth of storage nodes) and the availability of data (fast data repair to avoid data loss in case of multiple failures and node unavailabilities “churns”).

- Data comes with different format and has different access patterns (write once read many, periodically read, hot and cold, etc.). In addition, P2P systems are highly dynamic (nodes availabilities, churns, the contributed storage and bandwidth of the nodes vary with time, etc.). Therefore, data should be re-encoded (e.g., using wide-strip for cold data) and re-placed considering the dynamicity of both data and participating nodes. To facilitate that, we will make use of machine learning and probabilistic models to predicate node availabilities and study how to use the role of nodes, the contributed resources of the nodes and the incentive and awarding mechanisms which are used in the system to classify and estimate the performance of storage nodes.

- To cope with the high number of repair jobs due to lost or temporarily unavailable data, we will design data repairs orchestrator (centralized/decentralized scheduling framework) that ensures cost-effective and efficient data repair jobs by considering the location of data, availabilities of nodes, heterogeneity of the network bandwidth, etc.

Compétences

- 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

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- Partial payment of insurance costs

Rémunération

Monthly gross salary amounting to:
- 1982 euros for the first and second years and
- 2085 euros for the third year