Intern + Ph.D. Thesis Position 2024

Title: GTTP: Global Tracking Transfer Protocol.

Host laboratory: LIP, ENS de Lyon, 46 allée d'Italie, Lyon, France

Advisors:

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External Collaborators: The thesis will be carried on within a collaborative ANR project with the Inria and Sentiens.

Starting Date: As soon as possible, after January 2025. The thesis can be preceded by a Master internship.

Keywords: Geolocation, Privacy, Security, Networking, Distributed Systems.

Description.

Geolocation-the process of identifying the geographical position of an entity (an object or a user) from its network identity, is essential to the efficient operation of many modern organizations. Reliable geolocation can optimize industrial processes, enhance safety, reduce travel, costs, and losses, increase profitability, and enable new value-added services. From online services such as streaming and e-commerce to ICT infrastructure, including wireless networks and edge computing, geolocation increasingly underpins modern services. Given its critical role in this ecosystem, geolocation requires high performance across multiple dimensions. Unfortunately, different applications impose distinct requirements on geolocation: tracking systems demand scalability, broad coverage, low cost, and energy efficiency to support billions of objects and users with diverse characteristics and values; real-time services require low latency to satisfy stringent client expectations; and user-centered services impose strict privacy protections. However, current geolocation infrastructure fails to meet these comprehensive requirements, often proving unreliable, limited in scope, non-scalable, and non-interoperable, largely due to isolated advancements in the field.

In previous work, we have studied the usability and privacy tensions that Multi-Party Relay (MPR) architectures introduce for their users [2] [1]. Our findings reveal that existing IP geolocation approaches (*e.g.*, frequently updated databases) are insufficient for MPR users. Building on the insights from this work, we aim to develop a trusted third-party architecture that enables users to prove their location to services without compromising their identity. This architecture will incorporate short-lived location tokens, potentially using blind-signed tokens similar to those in recent privacy-focused systems, to facilitate secure location verification. In this Ph.D. thesis, the candidate will work toward designing a novel geolocation architecture, laying the foundation for an open, unified, and privacy-preserving geolocation and tracking framework. This work involves addressing complex research challenges to meet the diverse demands that modern services place on geolocation. Specifically, the thesis will define the interfaces and protocols for orchestrating interactions between location providers and location consumers. Foundational services, including identity verification, location discovery, and basic token services, will be designed in detail. Based on an initial risk analysis and study of protection mechanisms, enhanced protocols and global, resilient services—such as secure location verification—will be developed. Additional services, like automatic notifications (*e.g.*, when a tracked asset moves), will also be considered. Following an initial functional and risks analysis, the design will undergo iterative improvements, and the final architecture will be rigorously evaluated through qualitative analyses and quantitative assessments (via simulation and experimentation) of the core functional elements. This

research will result in a robust framework that advances the capabilities of unified geolocation infrastructure, meeting the high standards required for privacy-preserving and efficient geolocation in a connected world.

Candidate Requirements.

- The candidate should have completed a qualifying program by the starting date of the thesis.
- Comfortable speaking English or French (French is not required).
- Good understanding of computer networks protocols and systems (preferably both)
- Good proficiency with at least one programming language, preferably Golang or Rust.

What to submit. An up to date CV, university transcripts, and a letter of motivation clearly stating what the motivations to work on the described subject. One or (preferably) two recommendation letters are also welcome and strongly encouraged.

References

[1] S. Flynn, F. Bronzino, and P. Schmitt. Internet localization of multi-party relay users: Inherent friction between internet services and user privacy. *arXiv preprint arXiv:2307.04009*, 2023.

[2] M. Trevisan, I. Drago, P. Schmitt, and F. Bronzino. Measuring the performance of icloud private relay. In *International Conference on Passive and Active Network Measurement*, pages 3–17. Springer, 2023.