Network monitoring and troubleshooting from within the browser: a data-driven approach

About the research centre or Inria department

Inria is a national research institute dedicated to digital sciences that promotes scientific excellence and transfer. Inria employs 2,400 collaborators organised in research project teams, usually in collaboration with its academic partners. This agility allows its scientists, from the best universities in the world, to meet the challenges of computer science and mathematics, either through multidisciplinarity or with industrial partners.

A precursor to the creation of Deep Tech companies, Inria has also supported the creation of more than 150 start-ups from its research teams. Inria effectively faces the challenges of the digital transformation of science, society and the economy.

Context

This position is open in the Diana project-team at Inria Center at Université Côte d’Azur, in the frame of the WEMON project funded by the Academy of Excellence “Networks, Information, and Digital Society” of Université Côte d’Azur. The WEMON project is a collaboration with the Ermine team at Inria Rennes.

The overall objective of the DIANA project-team is to design, implement and evaluate advanced networking architectures. To do so, the team works to provide service transparency and programmable network deployments in the context of both wired and next generation wireless cellular networks. The team’s methodology includes advanced measurement techniques, design and implementation of architectural solutions, and their validation in adequate experimental facilities. Recent contributions of the team include: Enhanced Transport-Layer Mechanisms for Multi-Access Edge Computing-Assisted Cellular Networks, Benchmarking Mobile Networks from the Viewpoint of Video Streaming QoS, Introducing Fidelity in Network Emulation, and Enhanced Ray Tracing Techniques for Accurate Estimation of Signal Power.

Assignment

The objective of the WEMON project is to develop a data-driven light-weight solution for network monitoring and diagnostics, a solution able to estimate the performance of the network, both mobile and fixed, and troubleshoot it in case of service degradation. By relying on measurement data freely available within the browser (e.g., data on page rendering), this solution has the advantage of passively monitoring the network without the need to actively probe it as with existing monitoring solutions (e.g., Speedtest), thus saving network resources and ensuring continuous monitoring of the network. The solution will be embedded in a web extension and will integrate statistical learning models that transform the passive web measurements into network performance estimators (e.g., download and upload speed) and classify the network anomalies when they occur according to their origins. We will study the feasibility of the approach by collecting data through controlled experiments in the lab, calibrating the learning models and making the web extension public.

Main activities

We are working at Inria (a collaboration between the Diana team and the Ermine team at Inria Rennes) on a project to monitor the network at almost no cost from within the browser. We do that by leveraging the wealth of measurement data available within the browser. With the help of controlled experiments and machine learning, we tune the network performance (e.g., bandwidth and delay), browse the web, and collect web performance data in network conditions that we control. With the help of this data, we calibrate models allowing us to bridge the web performance data to network conditions, then we use the models built with the help of supervised learning to estimate network performance using only web performance data as input. This earlier work has allowed us to prove the feasibility of the approach, however, in a limited scenario consisting of emulated wired links, chrome browsers on desktops, and the network metrics of download speed, latency and packet loss. We plan in this project to give this work a new dimension and aim at reaching an effective solution for network monitoring and troubleshooting that we can validate in more realistic scenarios and make available to end users by the end of the project (always in the form of a web extension).

First, we aim at extending the study to laptops and mobiles with wireless connectivity and evaluate the feasibility of the approach in more realistic scenarios, including both emulated and real network accesses.

Second, we aim to go beyond the performance estimation problem to develop network troubleshooting solutions able to classify the main types of network anomalies that one can face, and this is again using the data collected within the browser.

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. 500 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

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
Third, we will be evaluating the sensitivity of the approach to different contexts and to different web content characteristics and network protocol details.

Lastly, we will focus on the statistical learning problem needed to build and maintain our models, and study how they can be best produced and updated in a real deployment, using measurement data collected in the devices and the feedback of end users.

Skills
- Strong knowledge in network protocols, measurement and programming, in data analysis, and in machine learning
- Excellent publication record

Benefits package
- Subsidised 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 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
- Contribution to mutual insurance (subject to conditions)

Remuneration
Gross Salary: 2746 € per month