

Internship proposal 2023 - Hopcast

Title: Injection strategies for cellular traffic offloading over D2D communications

Profile: Master 2 or engineering school

Advisors: Marcelo Dias de Amorim (marcelo@hopcast.fr) and Farid Benbadis (farid@hopcast.fr)

Location: Paris (Agoranov Incubator), but remote is also accepted

Dates: February 2023 → July 2023

Company

Hopcast is a start-up whose goal is to deeply transform content distribution to mobile devices. Hopcast is the result of a 10+ year-long collaboration between Thales, CNRS, and Sorbonne Université around the broad topic of mobile data offloading and device-to-device communications. Hopcast's unique selling point is to efficiently orchestrate direct communications between mobile users toward efficient, inclusive content distribution on the Mobile Internet. Hopcast offloading technology provides opportunities to save data and energy to better serve end users and content providers. We are convinced that our technology will be a game changer for content providers. The company was founded in February 2022 and is currently hosted at Agoranov incubator in Paris, France. Hopcast has received investment from CNRS Innovation and Bpifrance.

Internship topic

Context

Nowadays, most of the internet traffic involves centralized servers in the cloud. Although cloud architectures have demonstrated their interest, they exhibit severe pitfalls: important overhead in the case of proximity services, significant carbon footprint due to unnecessary long routes, limited control on end-to-end data routes and consequently amplification of the digital divide. In addition, the profound changes that our society is undergoing will define the way people will consume digital content. Hopcast responds to such a immense challenge with the "Internet of Proximity".

Hopcast is an inclusive, low-cost, green content distribution network beyond the edge. Hopcast's technology allows mobile devices (generally mobile phones - *smartphones*) to exchange content via direct communications (called D2D for *device-to-device*) in an efficient manner. Direct communications are possible thanks to links established directly between mobile terminals, without any intermediate equipment, e.g., by using state-of-the-art technologies such as Wi-Fi Direct and Bluetooth. These technologies are available in off-the-shelf terminals and are ready to be exploited.

Device-to-device communications are not new, but previous offers failed in their mission because they never solved the control plane matchmaking problem. Indeed, the critical issue is to determine *when* two devices are nearby and *whether* they have any content to exchange. Hopcast solves this problem thanks to its patented *orchestration* technology. The principle is to trigger direct data transfers at the right time and only if the mobile terminals have content to exchange. Hopcast separates the control and the data planes, exploiting a global state of the mobile terminals and content, which leads to much higher efficiency than fully decentralized solutions.

Internship's specific topics

In a content distribution system relying on device-to-device communications, the centrality of a terminal is directly linked to its ability to distribute content to a greater number of recipients. Identifying the terminals to which content

should be “pushed” is an important step in maximizing the traffic offload rate. This innovation program focuses on the identification of these terminals.

In this internship, the candidate will be in charge of designing, evaluating, and experimenting algorithms to select the most appropriate subset of devices to serve as seed nodes. The challenge here is to find an appropriate tradeoff between number of seeds and overhead on the cellular channel. The work will involve analysis of real-world data and hands-on testing of the proposed solutions.

Most likely, the intern will rely on, among others, machine learning techniques and state-of-the-art mobility models to achieve the target goals.

Expected skills

The following skills are required:

- Advanced Python programming
- Interest in data visualization
- Knowledge in machine learning
- Critical thinking

Although not required, the skills below are welcome:

- JavaScript programming
- Kotlin programming

Conditions

The intern will receive a monthly allowance of €1,000.00 (one thousand euros).

References

1. M. Waqas et al., “A Comprehensive Survey on Mobility-Aware D2D Communications: Principles, Practice and Challenges,” *IEEE Communications Surveys & Tutorials*, vol. 22, no. 3, pp. 1863-1886, thirdquarter 2020
2. F. Rebecchi et al. “Data Offloading Techniques in Cellular Networks: A Survey,” *IEEE Communications Surveys & Tutorials*, vol. 17, no. 2, pp. 580-603, Second quarter 2015
3. C. Bertier et al., “Modeling Realistic Bit Rates of D2D Communications between Android Devices”, *ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems (MSWiM 2019)*, Nov 2019, Miami Beach, United States.
4. F. Rebecchi et al. “Circumventing plateaux in cellular data offloading using adaptive content reinjection”, *Computer Networks*, pp.49-63, vol. 106, September 2016.