

# Application BASTRI

## Fiches Equipes

### AGORA (SR0836XR)

AlGorithmes et Optimisation pour Réseaux Autonomes  
AGORA (SR0767PR) □ AGORA

**Statut:** Décision signée

**Responsable :** Hervé Rivano

**Mots-clés de "A - Thèmes de recherche en Sciences du numérique - 2023" :** A1.2.1. Reconfiguration dynamique , A1.2.3. Routage , A1.2.4. Qualité de service, évaluation de performances , A1.2.5. Internet des objets , A1.2.6. Réseaux de capteurs , A1.3.6. Fog, Edge , A1.5.2. Systèmes communicants , A1.6. Efficacité énergétique , A3.3.3. Analyse de données massives , A3.4.1. Apprentissage supervisé , A3.4.2. Apprentissage non supervisé , A3.4.3. Apprentissage par renforcement , A5.10.3. Planification , A5.10.6. Flottes de robots , A7.1. Algorithmique , A8.2. Optimisation

**Mots-clés de "B - Autres sciences et domaines d'application - 2023" :** B3.4.3. Pollution , B6.2.2. Radio , B6.2.3. Satellites , B6.2.4. Optiques , B6.3.2. Protocoles , B6.3.3. Gestion des réseaux , B6.4. Internet des objets , B7.2. Déplacements intelligents , B8.1.2. Réseaux de capteurs , B8.2. Ville connectée

**Domaine :** Réseaux, systèmes et services, calcul distribué  
**Thème :** Réseaux et télécommunications

**Période :** 01/04/2018 -> 31/12/2025  
**Dates d'évaluation :** 17/03/2020

**Etablissement(s) de rattachement :** INSA LYON  
**Laboratoire(s) partenaire(s) :** CITI

**CRI :** Centre Inria de Lyon  
**Localisation :** Centre de recherche Inria de Lyon  
**Code structure Inria :** 121011-0

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### Présentation

Smart city is a constantly reshaped concept, embracing the future of dense metropolitan areas, with references to efficient and sustainable infrastructure, improving citizens' quality of life and protecting the environment. A consensus on the Smart City philosophy is however that it will be primarily achieved by leveraging a clever integration of Information and Communication Technologies (ICT) in the urban tissue.

Indeed, ICTs are enabling an evolution from the current duality between the real world and its digitized counterpart to a continuum in which digital contents and applications are seamlessly interacting with classical infrastructures and services. Smart Cities are often described by the digital services that they provide, which are inherently dependent on dense measurements of the city environment and activities, the collection of these data, their processing into information, and their redistribution. The networking infrastructure plays therefore a critical role in enabling advanced services, in particular the wireless infrastructure supporting high user density and mobility.

From a wireless networking viewpoint, the digitization of cities can be seen as a paradigm shift extending the Internet of Things (IoT) to a citizen-centric model in order to leverage the massive data collected by pervasive sensors, connected mobiles or fixed devices, and social applications.

The Agora research team aims at contributing to the following consequent challenges of data collection wireless networks.

- The deployment of dense networks is challenged by the scale of the problems and the versatility of the environment, with consequences on the optimization of the placement of both components and functionalities.
- Data collection and distribution communication protocols, designed for IoT network architectures, need a coherent rethinking to face issues on both saturated cellular networks and multi-hop networks unable to cover large areas.

### Contact

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### En savoir plus

- Site de l'équipe
- Site sur [inria.fr](http://inria.fr)
- Site du responsable
- Derniers Rapports d'Activité : 2017 , 2018 , 2019 , 2020 , 2021 , 2022 , 2023

### Documents sur la structure

- Intranet
- Privés

### Décisions

- 12790 (03/04/2018) : création
- 14583 (09/12/2020) : prolongation
- 15179 (13/12/2021) : prolongation

### Localisation

- **Adresse postale :** Centre de recherche Inria de Lyon  
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- Exploiting the data carried by the network opens new questions on the network deployment and usage, by understanding the spatio-temporal dynamics of the users, and on in-network computations in order to reduce the traffic load or enhance the quality of the data.

## Axes de recherche

### Wireless network deployment

In the following years, the team will address challenges in the three following directions. We will develop optimization models and heuristics for **network component deployment**, with a specific focus on wireless sensor networks for monitoring environmental phenomenon. We will investigate the impact of **network function deployment** enabled by their virtualization on the performances of radio access networks and professional mobile radio. We will also develop and experiment **self-configuration and self-healing protocols** applied to human free deployment.

### Wireless data collection and dissemination

In this axis, we will investigate challenges related to the three following network architectures. We will analyze the performances and provide regulation mechanisms for an **efficient support of M2M devices on cellular networks**. Of course **multi-hop networks** will be addressed with a focus on protocols for supporting self-organization and opportunistic communications. We will combine our expertise in this two architectures and consider **hybrid networks**, that we foresee as the relevant solution for supporting dense and dynamic topologies.

### Wireless network data exploitation

In this axis, we focus on the spatio-temporal characteristics of the network usage and data collected in the three following directions. **Mobile data** are analyzed to understand the coupling between users activity and the network usage. **Data aggregation** is investigated with the objective to have the most efficient and sober usage of wireless communications. Finally **distributed sensor calibration** will exploit the wireless network to improve on the reliability of the collected data and ultimately improving on the cost/quality trade-off a wireless sensor networks.

## Relations industrielles et internationales

At an international level, the team has major established relationships with Shanghai Jiao Tong University (China, on wireless sensor networks), University of Waterloo and Ecole Polytechnique de Montreal (Canada, on mesh network optimization and wireless sensor networks), CTTC and Universitat Politècnica de Catalunya (Spain, on sensor and vehicular networks), University of São Paulo (Brasil, on DTN), Politecnico di Torino and CNR-IEIT (Italy), III institute in Taiwan. These collaborations have led to the publication of joint works and to the submission of international collaborative projects. Additional international collaborations include those with Universidade Federal de Minas Gerais (Brasil), Universidad Carlos III (Spain), Instituto Superiore Mario Boella (Italy), and Qatar Mobility Innovation Center (Qatar).

A collaboration has started with the University of Yaoundé (Cameroun, PhD of Rodrigue Domga Komguem), with the University of Sousse (Tunisia, PhD of Yosra Zguira) and the University of Cluj (Romania, PhD of Mihai Popescu).

Moreover, we are following the work of several teams abroad which are addressing close or related topics. For networking protocol related issues, the list includes Aalto University, Hong Kong University of Science and Technology, KTH, ETHZ. Concerning networking issues in Smart Cities, some very high profile teams are the Future Cities group of Trinity College Dublin and the Hamilton Institute, Ireland, as well as King's College London. Many teams are working on infrastructure optimization, but one can cite, in particular the Politecnico the Milano and Stony Brook University. Although we might not be competing upfront with team, we are interested by the work about Smart and Digital Cities led at the MIT Senseable City Lab 3 and IBM Dublin.

From an industrial perspective, we have a long lasting bilateral collaboration with Orange Labs Meylan about wireless sensor networks. More recently, a collaboration with Orange Labs Paris on the analysis of mobile phone data has started, leading to the ABCD ANR project (2013-2016) and the PIA Adage project (2016-2018). The collaboration between Inria and Alcatel-Lucent, embodied in the ALu/Inria common lab, is another of our main industrial collaboration contexts. Many of the members of Agora were part of the SelfNet "Action de Recherche" in the first phase of the common lab. In the second phase, we were actors of the definition of the AdR Green built around the Socrate and Urbanet teams. In this context, we develop our research on the optimization of the energy consumption of cellular networks by leveraging our experience on both wireless sensor networks and network design and provisioning. The end of this second phase is approaching and the future is under discussion, in particular after Alcatel-Lucent being acquired by Nokia. We hope to be involved in an research action about 5G and IoT. We were involved in the Idefix ANR project (2013-2016) led by Orange Labs and with ALu/Nokia. A follow-up project has been submitted.

We also collaborate with the SME Rtone on visible light communications in smart cities. This collaboration funds the CIFRE PhD thesis of Alexis Duque (2015-2018), and it is focused on three main objectives: i) the proposal of a VLC

communication architecture for smart city services; ii) the design and evaluation of a MAC layer protocol for VLC, and iii) the use of VLC for indoor localization purposes. We recently started a collaboration with the SME Traqueur, with a focus on data collection in hybrid wireless sensor networks, where long-range and short-range communication technologies coexist. This collaboration takes place for now in the context of the DGA CLOTHO project (2016-2018).