

UBIquity and MOBility for Time Sensitive Networking

UbiMob TSN

Context

The industrial digital transition with the integration of the Internet of Things and mobility in Industry 4.0 are driving Time Sensitive Networking (TSN) for real-time communications. Developed by the IEEE802.1 group, they concern wired Ethernet technology. In order to overcome these limitations and make mobile devices requiring real-time communications, we propose in this thesis to extend the TSN/Ethernet concepts to wireless technologies (WTSN), and in particular to 5th generation cellular networks (5G) designed for Ultra Reliable Low Latency Communication (URLLC). For the first time, the concept of multi-technology redundancy (5G and TSN) will be considered from end to end. This thesis work will rely on simulation for formal validation and on a demonstrator based on the SMART UHA mobile robot project of the IRIMAS Institute.

Work plan and provisional schedule

The organization of this thesis work is divided into two periods of 18 months each.

During the first period, you will appropriate the subject through a state of the art, the definition of the specifications of the 5G network and TSN. You will also proceed to developments and validations in simulation on the basis of the tools retained after the analysis of the literature. Finally, the developments will be transposed on laboratory targets (test-bed) with the aim of a future integration on [SMART-UHA robots](#). You will also be involved in some related research projects from Offenburg University collaborating with leading industrial partners.

Experimentation activities with SMART-UHA and the writing of the PhD thesis will cover the remaining 18 months. These will conclude with the PhD student's thesis defense.

Scientific dissemination (writing of articles) is planned throughout the thesis, to allow you to have more feedback before your final defense.

Methodology and technology

The approach we want to follow to achieve TSN / 5G integration involves work on:

- Data flows. This concerns the possibility of hot-standing URLLC links/channels on several relays (gNodeBs),
- Signaling flows. Requires the conceptualization and integration of configuration flows (CUC/CNC) common to TSN and 5G,
- Implementing the mapping between 5G QOS parameters (5Gi) and TSN traffic planning/ hot booking,
- Implementing configuration on Smart UHA test equipment using and potentially extending open source system elements,
- System optimization, including operational guidelines and requirements.

Scholarship

A scholarship is granted for 3 years (usual duration of a doctoral thesis in France). The salary will be around 1750€ net per month. This scholarship is financed 50% by the Région Grand Est (F) and 50% by the ivESK of Offenburg University (D). During this thesis work you will stay half of the time in France (Mulhouse or Colmar) and the other half in Germany (Offenburg). The German PhD supervision will be organized via the Freiburg University.

The start date of the thesis is expected in October or November 2022.

Qualifications and Requirements

The position requires:

- 1) A Master's degree in Electrical or Computer Engineering, Computer Science, or a related discipline,
- 2) Excellent writing, communication and presentation skills in English,
- 3) Good knowledge in:
 - Machine learning,
 - Networking and cellular communication,
 - Good coding skills in Python and C, and excellent analytical capabilities.

To Apply

For all applicants:

- 1) **Send** per Email to GrandEstPhDApplication@Gmx.fr **your CV, a cover letter**, copy of **your diplomas and transcripts of records** indicating your exam results since your Bachelor's degree. The Email subject must be: **PhD Application from First-name NAME** (*this last written in UPPERCASE*),
- 2) Participate to an **interview** by video or face-to-face.

For selected applicants:

- 3) Be available for a **test on the skills** required for the outcomes requested in qualifications and requirements. This test will take place in face-to-face.

Calendar

- Applications are open until August 15, 2022.
- Interviews will take place from August 22 to 25.
- Skills tests will take place from September 2.