Research project offer

Location : ISAE SUPAERO, Toulouse, France	
Department : Department of Complex Systems Engineering (DISC)	
Research group : Communication Networks (RESCOM)	
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OFFER DESCRIPTION	
Title : Towards wireless communication for smart factories	
Proposed duration and period : 6 months (March-September 2021)	
Context (max 10 lines)	Industrial Internet of Things (IIoT) and Industry 4.0 focuses heavily on inter-connectivity, automation, autonomy, decentralized decision-making, and real-time data. Wireless communication systems are beneficial for many obvious reasons, including enabling flexibility and reducing wiring costs as well as enabling mobility. Recent advances in 5G and IEEE 802.11 (WiFi 6) wireless connectivity technologies in providing low latency and high reliability have generated significant interest in extending Time-Sensitive Networking (TSN) capabilities over wireless. However, given the stochastic nature of wireless communications, enabling TSN capabilities that are interoperable and compatible with existing wired TSN standards is challenging.
Objectives and work (max 20 lines)	The main goal of this project is to investigate the capabilities of wireless Time-Sensitive Networking over 5G or Wi-Fi 6, combined with DetNet (Deterministic Networking) to fulfill the requirements of Industry 4.0 and Industrial IoT. The approach consists in the definition of a simulation scenario for a smart factory use case and its implementation in the OMNeT++ network simulator. The simulation approach allows on one hand modelling the main components participating to the communication, as well as the mechanisms handling the exchange of messages and on the other hand evaluating the performance of the communication infrastructure according to the applications needs. The following outcome is so expected: • Provide detailed technical reports on state of the art • Develop a network simulator in OMNeT++ • Evaluate the network performance and identify (i) the impact of wireless connectivity on the communication as well as (ii) a possible network configuration for enhancement.

Bibliography:

[1] IEEE Official Website of the 802.1 Time Sensitive Networking Task Group: https://1.ieee802.org/tsn/ accessed 05.11.2021

[2] D. Cavalcanti, S. Bush, M. Illouz, G. Kronauer, A. Regev, and G. Venkatesan, "Wireless TSN–Definitions, Use Cases & Standards Roadmap"Avnu Alliance, pp. 1–16, 2020.

[3] A. Larrañaga, M. C. Lucas-Estañ, I. Martinez, I. Val, and J. Gozalvez, "Analysis of 5G-TSN integration to support industry 4.0", in2020 25th IEEE International Conference on Emerging Technologies and Factory Automation (ETFA), vol. 1. IEEE, 2020, pp. 1111–1114.

[4] A. Nasrallah, A. S. Thyagaturu, Z. Alharbi, C. Wang, X. Shao, M. Reisslein,and H. ElBakoury, "Ultra-low latency (ULL) networks: The IEEE TSN and IETF DetNet Standards and Related 5G ULL research,"IEEE Communications Surveys & Tutorials, vol. 21, no. 1, pp. 88–145, 2018.

[5] IETF Deterministic Networking Working Group, "RFC 9023 Deterministic Networking (DetNet) Data Plane: IP over IEEE 802.1 Time-Sensitive Networking
(TSN),"https://datatracker.ietf.org/wg/detnet/about/" accessed 05.11.2021.

Possibility to continue with a PhD (Yes/No) : Yes (if funding)

REQUIRED APPLICANT PROFILE AND SKILLS	
Study level (tick possible choices)	■Undergraduate students (3rd or 4th year) ■ Master students (1st or 2nd year) ☐ PhD students
Required profile and skills	Good background on computer networks and TCP/IP stack Programming languages skills: C/C++, Java, Python Good understanding of operating systems (UNIX) Good level of spoken and written English
Other useful information	None