KU LEUVEN

ESAT / Departement of Electrical Engineering
M-Group

Making Connectivity Work Reliably in a Diverse Range of Environments

Aleksandr Ovechkin, Tim Claeys, Jonas Lannoo, Dries Vanoost, Guy Vandenbosch, Davy Pissoort

1. MSCA ITN SAS Introduction

Marie Skłodowska-Curie Actions Innovative Training Network (MSCA ITN) is the European funding aimed to help Early-Stage Researchers to boost their future career. SAS (Safer Autonomous Systems) is one of those projects.

In the near future, Artificial Intelligence will be introduced in many systems with the aim to make them intelligent **autonomous systems**. Applications will cover many aspects of the everyday life of an ordinary man/woman. However, a major concern is: can we fully **TRUST** those systems in terms of their **SAFETY?**

How can people trust such a novelty as a self-driving car or an unmanned aerial vehicle? That is where the SAS-project comes in!

Safer Autonomous Systems

2. SAS: Goal & Objectives

The **goal** of SAS is to achieve safer autonomous systems by training and teaching young researchers in this field. This will be achieved through an interactive approach where **safety is the key element** during all the phases of the development process and the lifecycle of an autonomous system.
There are three main objectives which are divided between the work packages (WPs):

- To **integrate** guaranteed **safe behaviour** directly into the **architecture/design** of the autonomous system (WP1)
- To **prove** by model-based safety-analysis techniques that the **behaviour** of an autonomous system **remains safe** under all possible conditions (WP2)
- To **ensure** that the safety-assurance strategies that combine the architectural/design measures with the evidence allow to **have trust in the autonomous system**, which is very likely to be learning and evolving (WP3)

This approach will be applied **to industry-driven application** case studies in **companies** such as:

CNH INDUSTRIAL, JAGUAR, LAND ROVER, naio Technologies, SICK Sensor Intelligence. (made in Germany), BOSCH Robert Bosch GmbH, RH MARINE, AIRBUS, equinor, A HORIBA COMPANY MIRA, portablemedical TECHNOLOGY LTD

Research work of each early-stage researcher (ESR) will be performed with the help of the following **universities/research organizations**:

Fraunhofer, TECHNISCHE UNIVERSITÄT KAISERSLAUTERN, KU LEUVEN, LAAS CNRS, UNIVERSITY of York

3. ESR5 Objectives/Results

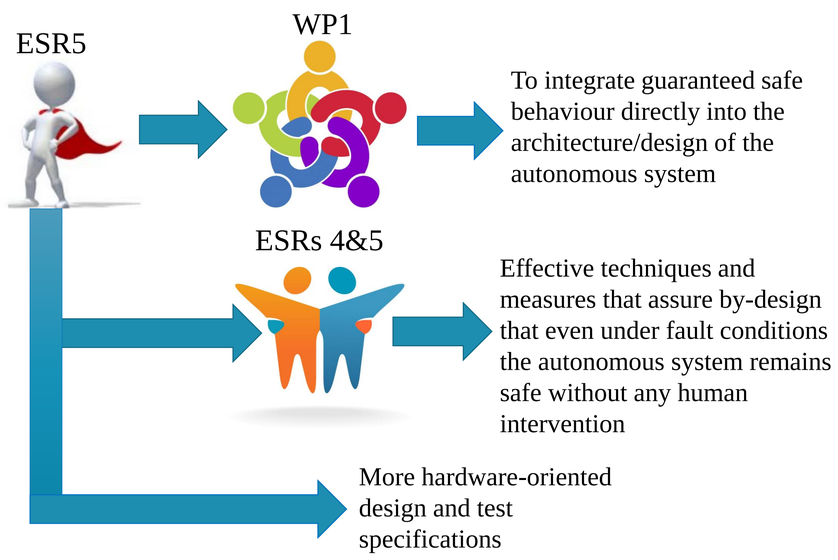
Key objectives:

- Increase the robustness of different wireless communication protocols for different types of EMI, ageing, thermal stress, etc.

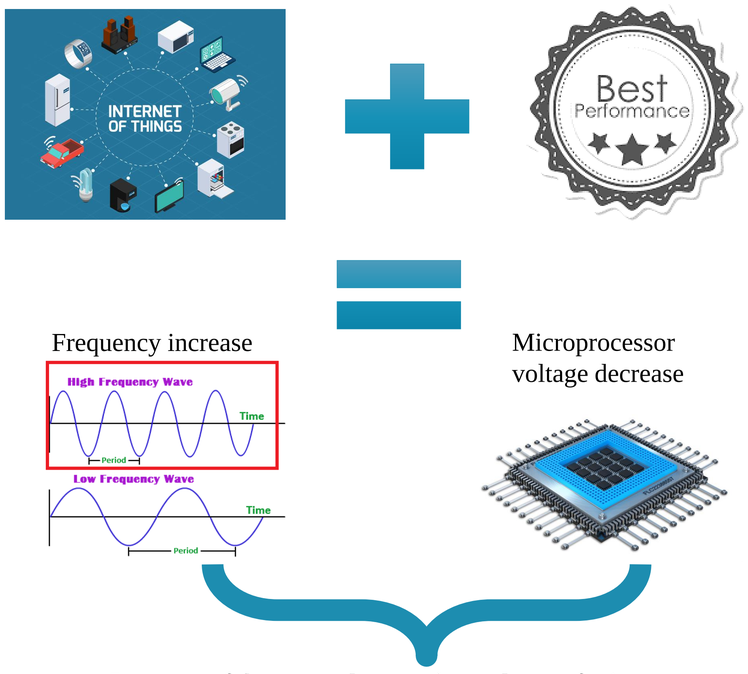
Expected results:

- Novel software and/or hardware-based techniques and measures
- Dependable wireless connectivity that is fault-tolerant or even fault-operational under diverse types of environmental stress

4. ESR5 place within the project



5. Importance of ESR5



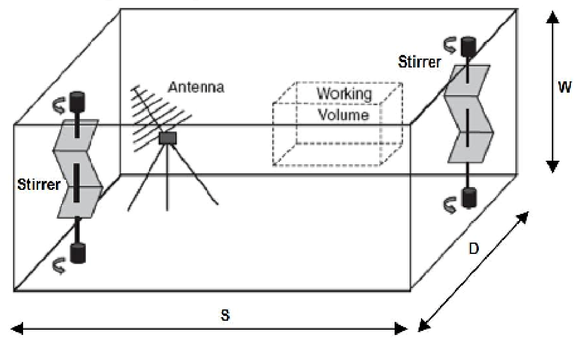
Increase of the **normal operating voltage** of microprocessor controllers while their **rated voltage remains the same, leads to the increasing susceptibility to EMI**

It is of paramount importance for an autonomous system that it is immune to external factors to ensure safety. One of the main external factors is the **electromagnetic environment** of the autonomous system, in other words, dependability in electromagnetic interferences.

Moreover, autonomous systems (like e.g. self-driving vehicles) will be very often interconnected to each other or other systems (V2V, V2X). Hence, they heavily rely on wireless communication to work dependably at every moment!

6. ESR5 Used Methodology

Main tool: Two **reverberation chambers** located at KU Leuven Bruges Campus.



In the working volume (where the electromagnetic field is uniform), different wireless communication protocols (like used in autonomous systems) should be tested in a harsh electromagnetic environment. Wireless communication protocols to be tested:

5G, Bluetooth SMART, WiFi, LoRa, ZigBee, sigfox

Within the project, ESR5 will create a **methodology** by performing a **"harsher than real-life" electromagnetic environment, over the full spectrum (from 0 Hz up to ten's of GHz) to find out the most robust wireless connection protocol capable to receive/transmit as much information ("noiseless information") as possible and, if applicable; new methods should be implemented to increase the dependability of such protocols.**

7. ESR5 Possible Applications

Results of this research work can be implemented in the following fields where autonomous systems will appear soon:

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Safer Autonomous Systems

The SAS team:

m·group

Author contact:
KU Leuven Bruges Campus, Spoorwegstraat 12, 8200 Bruges, Belgium
http://etn-sas.eu/
https://iiw.kuleuven.be/brugge/m-group
aleksandr.ovechkin@kuleuven.be