UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

itee PhD information technology electrical engineering

DIETI UNINA

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Methods and Tools for Test Automation and Failure Prevention in Mixed Criticality Systems

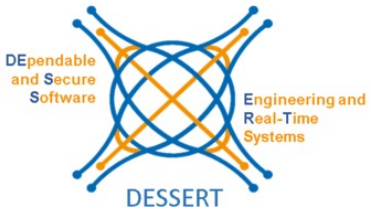
Tutor: Marcello Cinque

Cycle: XXXVII Year:2022/2023

itee PhD information technology electrical engineering

My background

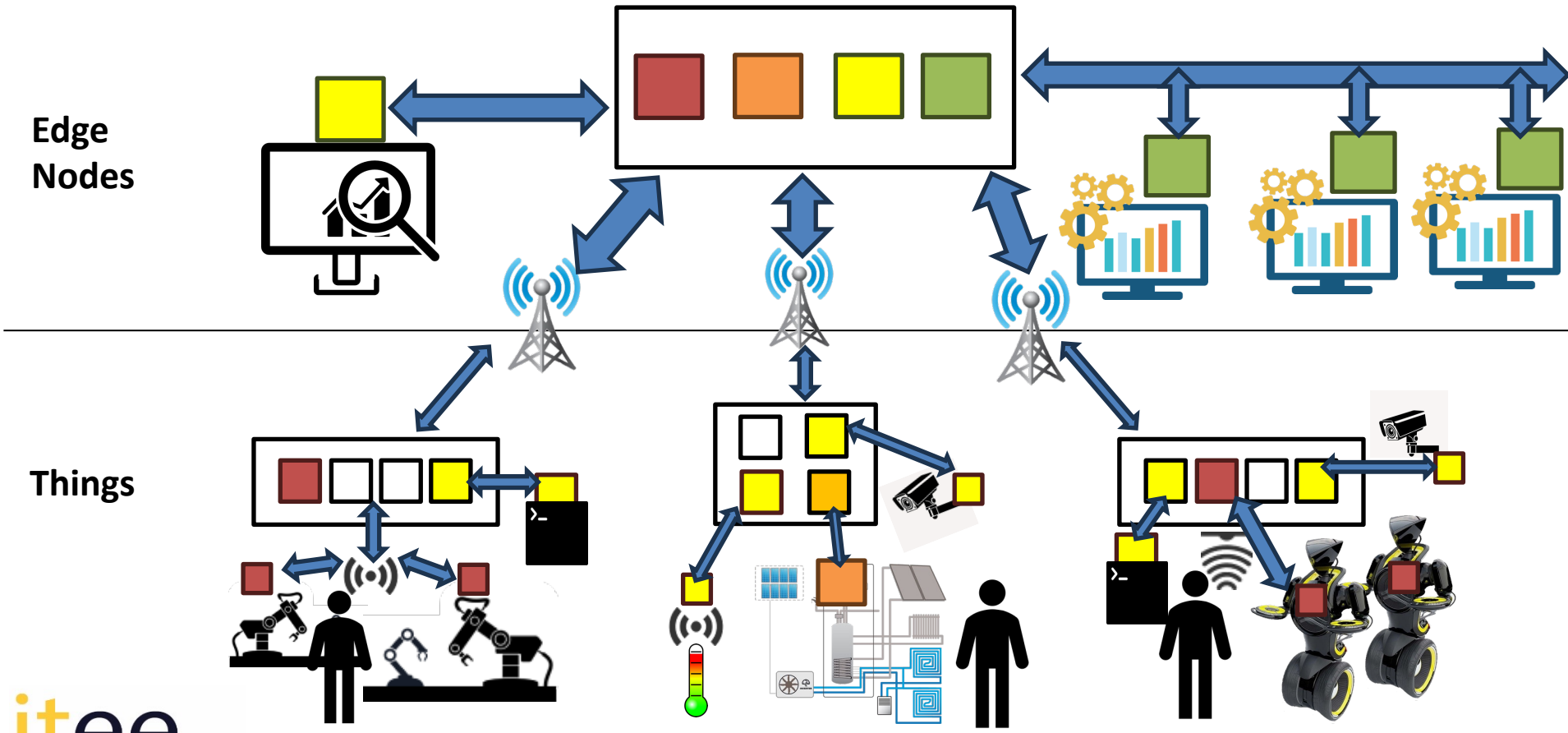
- MSc degree in Computer Engineering (October 2021)
- Research group: DESSERT
- PhD start date: 01/11/2021
- Scholarship type: CINI



Research field of interest

Criticality is the mapping of the failure of a component (either software or hardware) with the impact on the whole system and environment safety

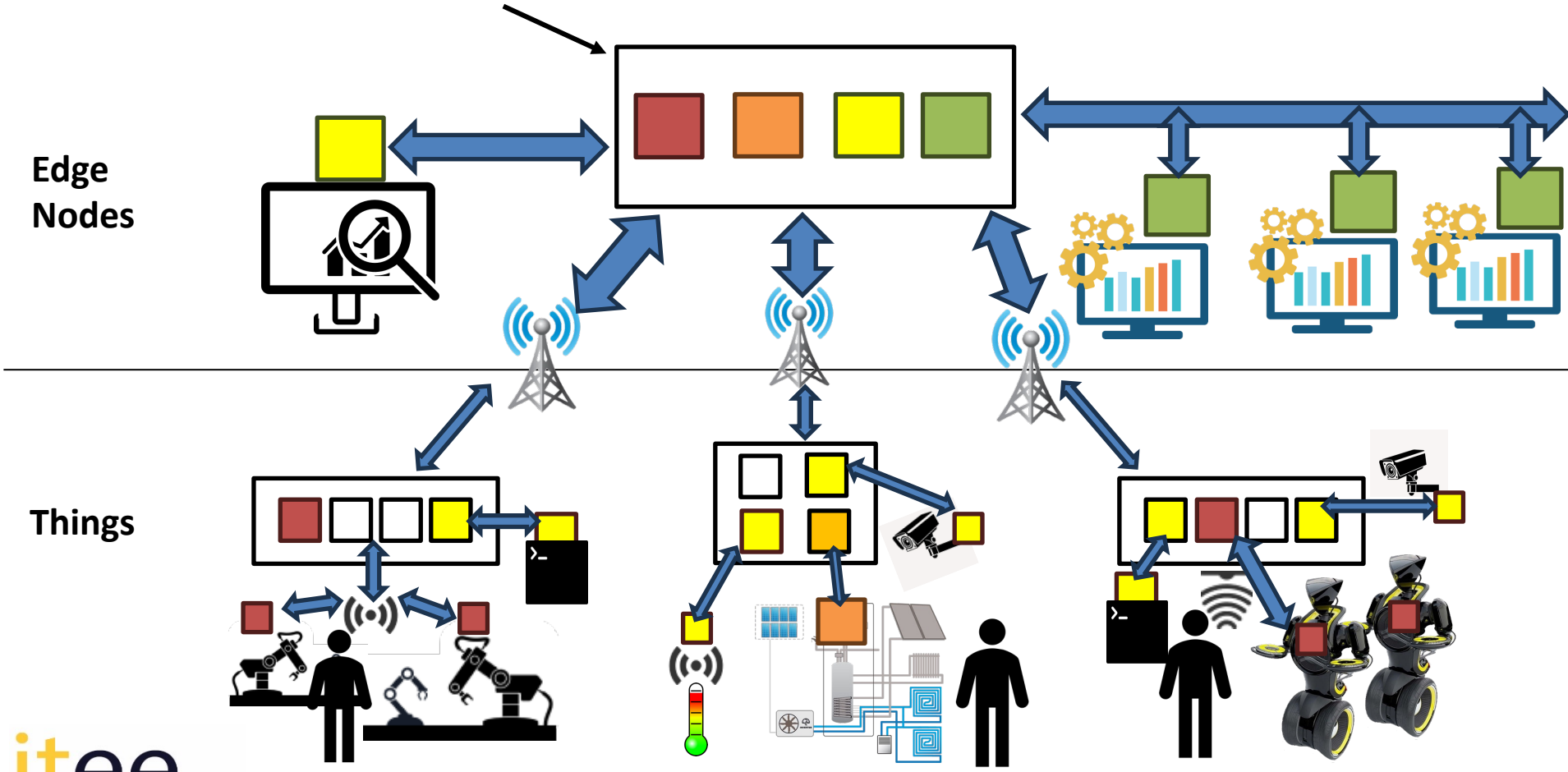
High-criticality, …, Low-criticality



Research field of interest

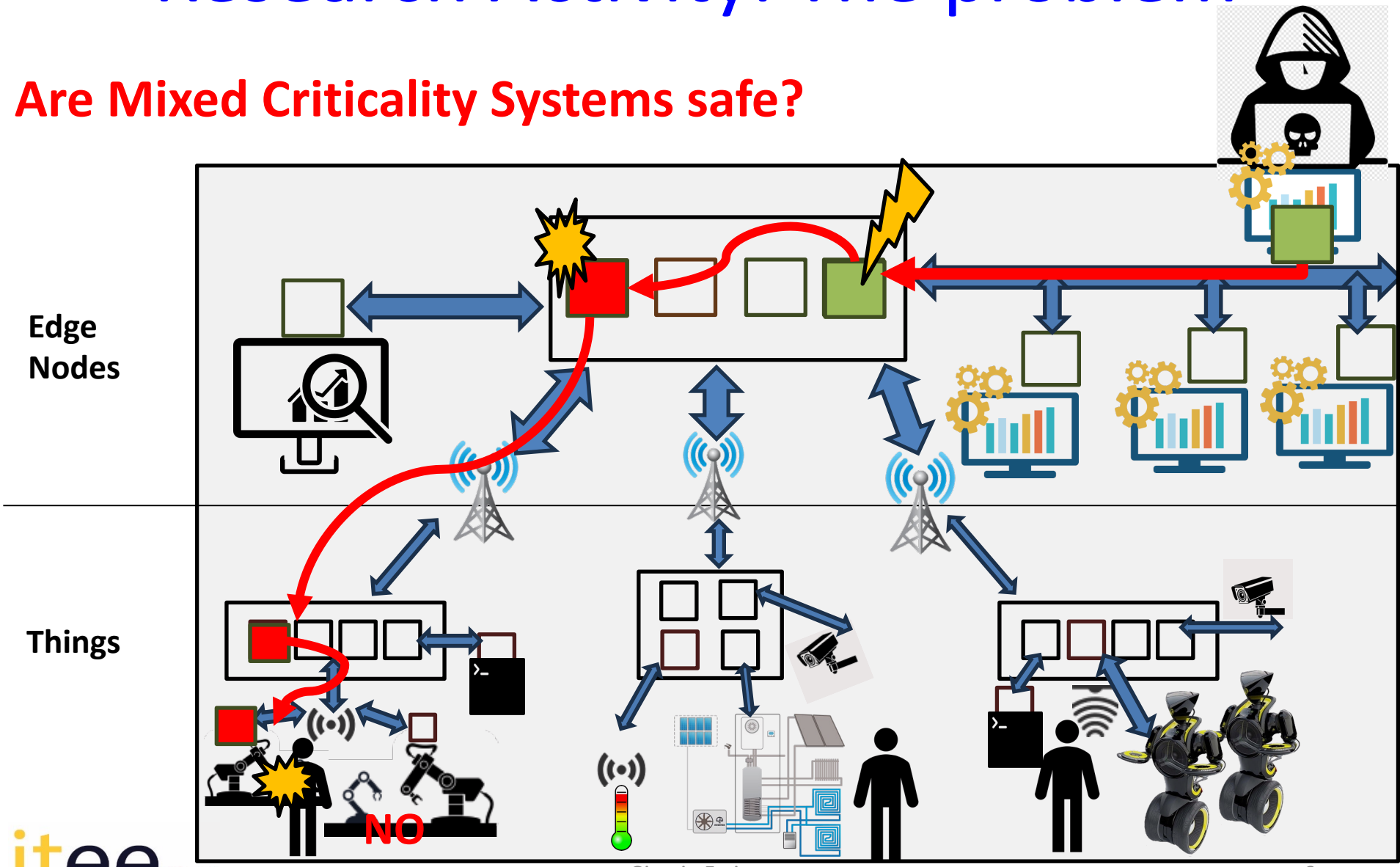
Mixed Criticality Systems:

- consolidate multiple applications into the same system, possibly with different criticality levels
- to reduce design and production costs of the systems



Research Activity: The problem

Are Mixed Criticality Systems safe?



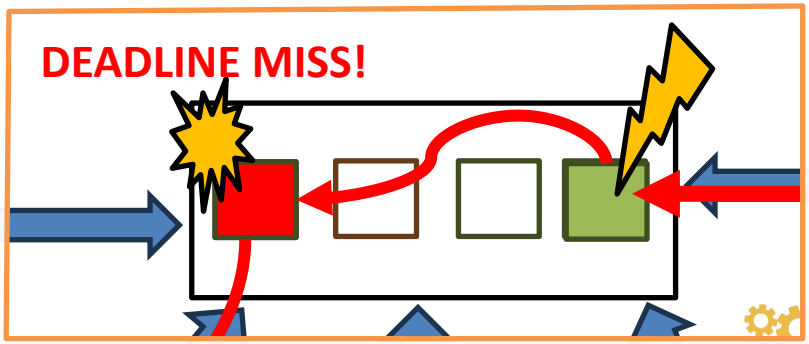
Research Activity: Overview

Are Mixed Criticality Systems safe?

Edge Nodes

Things

- **Problem**



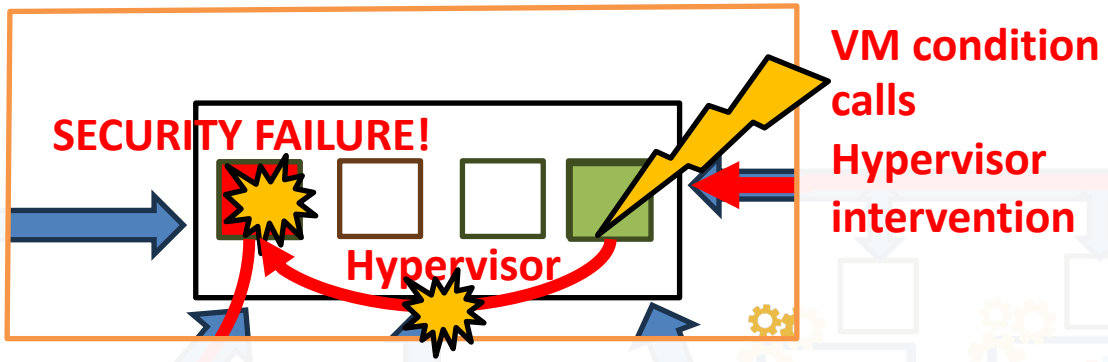
- **Solution** [P1]
  - We provide a **dection/regulation approach to mitigate the interference**
  - We provide a workload for exclusive archs, i.e., **LLC exclusive bomb**
  - We prove that the **queue occupancy** is a good observable indicator of the memory access interference
- **Methodology**
  - Detect the error state to prevent failures, i..e, deadline miss
  - Mitigate the error state

Research Activity: Overview

Are Mixed Criticality Systems safe?

Edge Nodes

- **Problem**



  - **Hypervisor intervention** involves a change in a **most privileged mode** ***-> hypervisor security can jeopardize the isolation of the hosted virtual machines***
  - **Testing hypervisor intervention is not a negligible task due to the difficulty of building valid test-cases**

Things

- **Solution** [P2]
  - We propose IRIS, a **record and replay** framework to **automate the test-case generation** to test hypervisor intervention.
- **Methodology**
  - «Record and replay» to move across hypervisor states
  - «Record and replay» to have valid test cases to mutate

Research Activity: Objectives

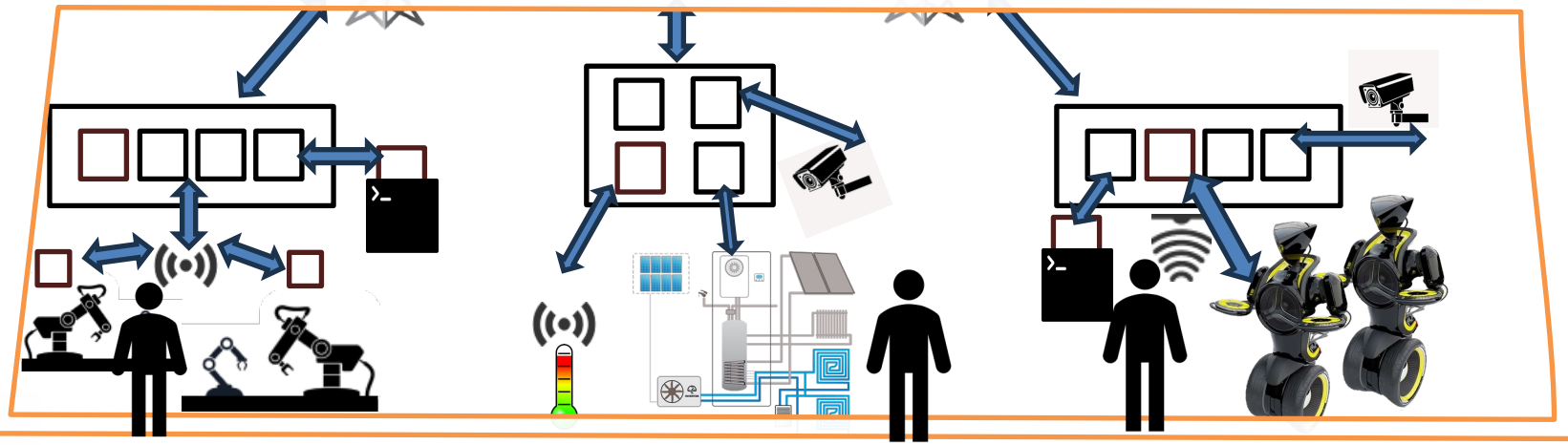
Are Mixed Criticality Systems safe?

Edge Nodes

- In the last year, my focus **moves to the security and safety of the things**, i.e., IoT devices
- Due to the **connected nature of IoT devices**, a vulnerability in any of the applications can spread on the interacting devices

1) How do we detect such a spread as close to the start as possible?
2) How do we mitigate the failures to avoid escalation, i.e., new spread?

Things



Summary of study activities

- **Ad hoc PhD courses / schools**
  - IoT Data Analysis
  - Verification and Validation of Automated Systems' Safety and Security
- **Conferences / events attended**
  - The 53rd Annual IEEE/IFIP International Conference on Dependable Systems and Networks, DSN

Products

[P1]	*"Enabling memory access isolation in real-time cloud systems using Intel's detection/regulation capabilities",* ***G. Farina**, G. Gala, M. Cinque, G. Fohler* ***Journal of Systems Architecture**, JSA, published, 2023, indexed by Scopus*
[P2]	*"IRIS: a Record and Replay Framework to Enable Hardware-assisted Virtualization Fuzzing",* *C. Cesarano, M. Cinque, D. Cotroneo, L. De Simone**, G. Farina**,* *The 53rd Annual IEEE/IFIP International Conference on Dependable Systems and Networks, **DSN**, published, 2023, indexed by Scopus*
[P3]	*"Partitioned Containers: Towards Safe Clouds for Industrial Applications",* *M. Barletta, M. Cinque, L. De Simone, R. Della Corte, **G. Farina**, D. Ottaviano,* *The 53rd Annual IEEE/IFIP International Conference on Dependable Systems and Networks-Supplemental Volume, **DSN-S,** 2023, indexed by Scopus*