

# C2Link and GNSS jamming margins

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## Anti-drone struggle

- London Gatwick airport 2019: The airport was blocked several days because of a drone flying in the surroundings.
- Drones represent a threat for sensible areas (airport, nuclear plants, ...).
- The main anti-drone defense tool is jamming.
- **Pb:** Impact of jamming on drones receiver is not monitored, leading to potential collateral victims in case of jamming.

## Illegal civil GNSS jamming struggle

- Nantes 2017: The airport was blocked several hours because of a low cost GNSS jammer (PPD) switched on inside a parked car.
- **Pb:** GNSS receiver facing PPD jammer resiliency is not monitored whereas requirements are expected to be adopted in the coming years.





# Objectives

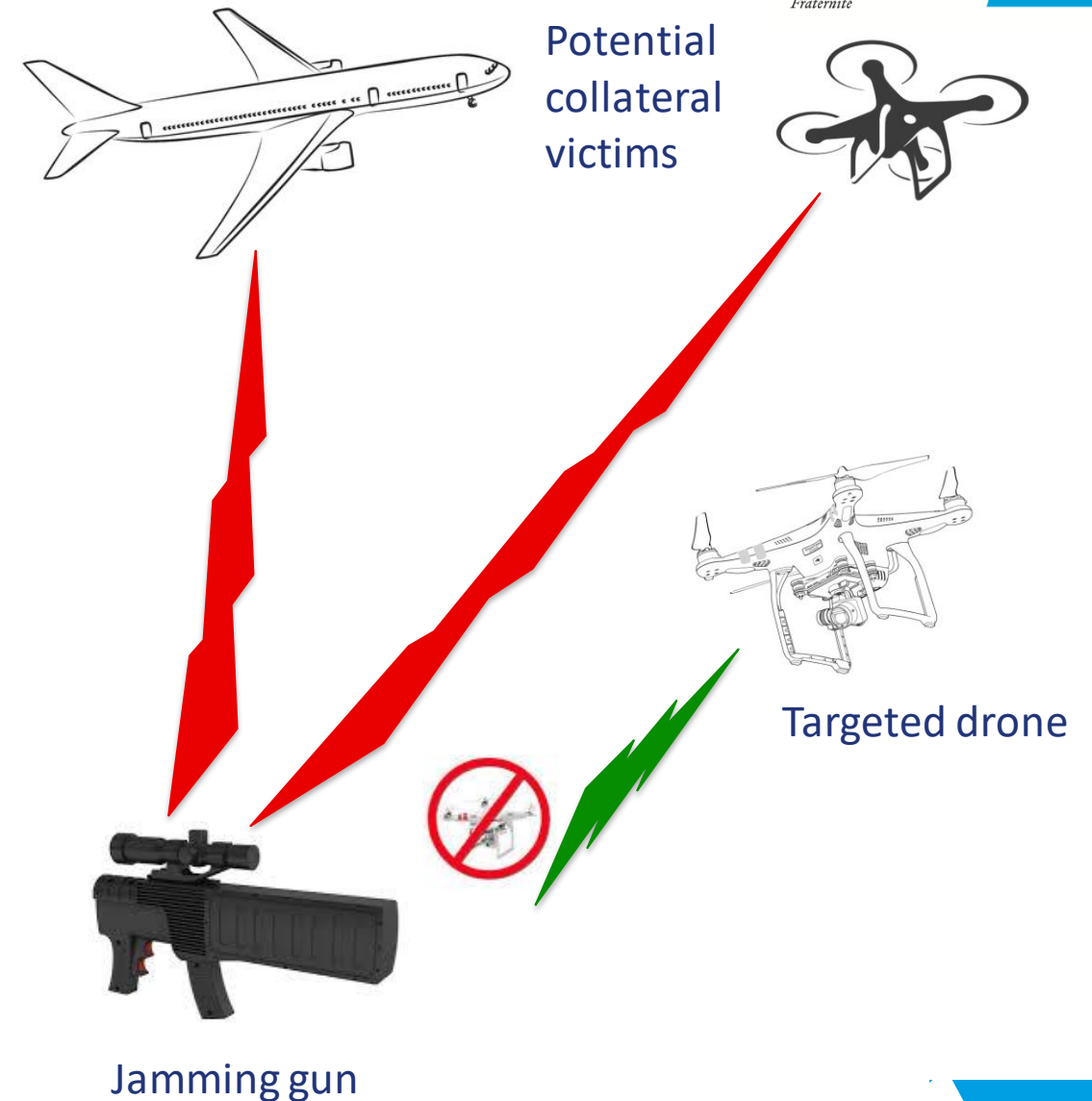
## GNSS link budget operating margin:

1. Considering a jamming situation and a particular satellite constellation, what is the minimum distance between the jammer and the GNSS receiver so that GNSS safety requirements remain respected ?

2. What is the impact of PPD jammers on GNSS receiver ?

## C2Link link budget operating margin:

3. Considering a jamming situation, what is the minimum distance between the jammer and the receiver so that C2Link safety requirements remain respected ?

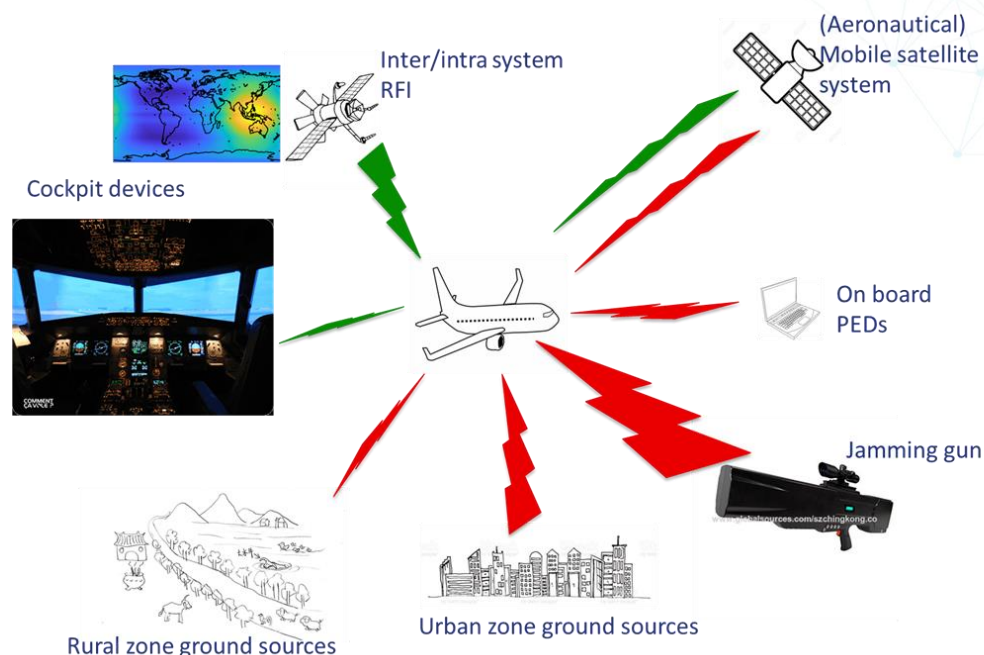




# Tasks and results

- **Objective 1: GNSS jamming protection zone.**
  - Analyze of the receiver sensibility to respect requirements.
  - Analyze of the impact of all interference sources.
  - Calculation method for protection area.
- **Objective 2: Assessing the impact of low-cost jammer.**
  - Low-cost jammer impact cannot be modeled as a white noise as it is usually the case when it comes to GNSS interferences.
  - Proposition of a mathematical model on pseudorange and carrier phase measurement.
- **Objective 3: C2Link jamming protection zone**
  - Development of a C2Link receiver.
  - Impact of interferences on the receiver: prediction, validation.
  - To be continued.

## Interference situation in the L1 band



GNSS low-cost jammer



# Publications calendar

## November 2020:

- Contribution to ICAO SARPS on GNSS interference mask.

## March 2021:

- Contribution to RTCA DO235C MOPS: Minimum requirements for L1/E1 receiver.

## September 2021:

- ION GNSS+: From ICAO GNSS interference mask to jamming protection area for safe civil aviation operation.
- ION GNSS+ (co-author): In-band RFI GNSS L5/E5a mask definition.

## September 2022:

- ION GNSS+: Modeled and Observed Impact of Chirp Jammers on GPS L1C/A Receivers
- ION GNSS+: GPS L1C/A, GPS L5 and Galileo E1 C/N0 acquisition thresholds.
- ION GNSS+ (co-author): Research for the L5/E5 interference hot-spot in Europe.
- DASC: Analysis of the resiliency of C2Link receivers in presence of wide-band interferences.

## Journal papers (to be submitted by september 2022)

- Evaluation of GPS L1C/A receiver performance in presence of chirp PPD.
- GNSS L1 ICAO interference mask derivation.