Achieving reduced latency and energy efficiency in Direct-to-Satellite LoRaWAN communications

ROLLAND Florian
PhD student, EDMITT, LAAS-CNRS
frolland@laas.fr

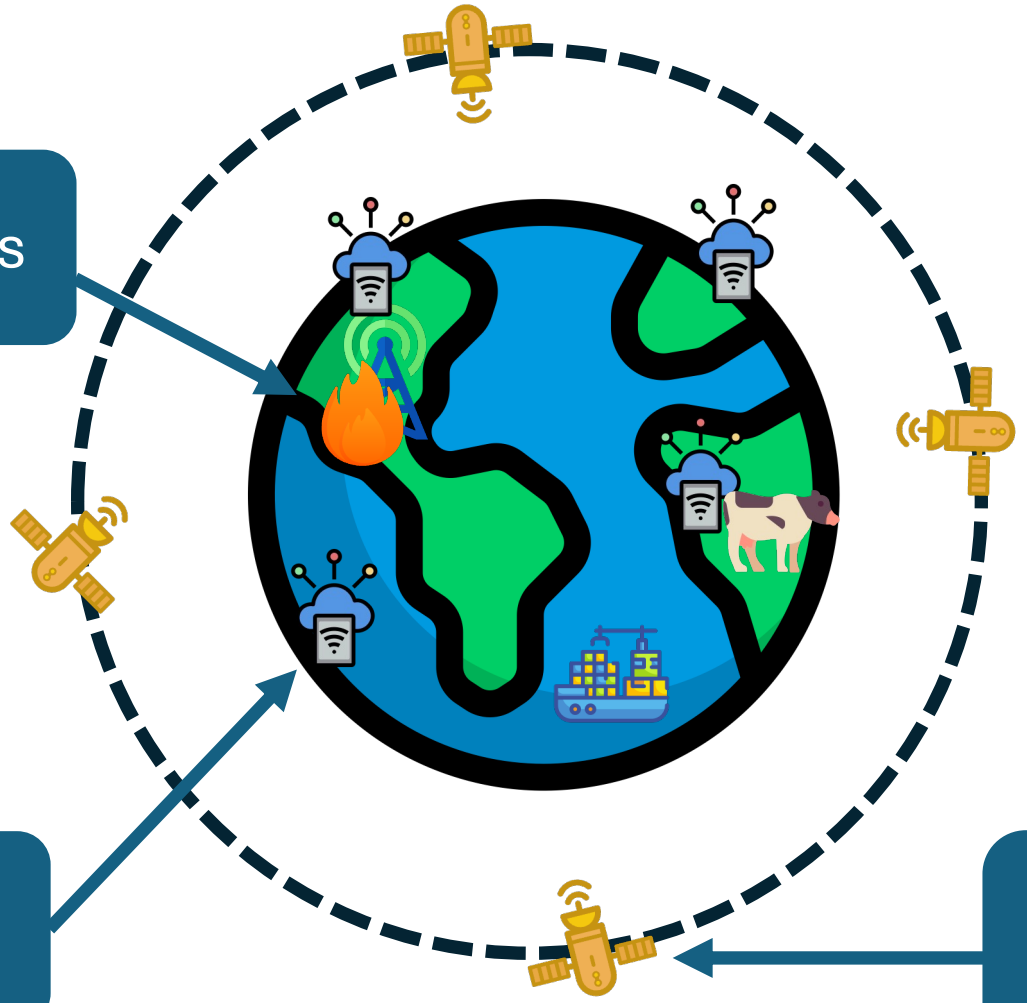
ZHOU Zheng
Post doctoral, LAAS-CNRS
zzhou@laas.fr

BERTHOU Pascal
Thesis director, LAAS-CNRS
berthou@laas.fr

ACCETTURA Nicola
Co-thesis director, LAAS-CNRS
naccettura@laas.fr

Summary

Introduction



Natural Disasters

Inaccessible Areas

DtS IoT devices are deploying everywhere

Low Earth Orbit (LEO) Satellite in sparse constellation

Introduction

Key information in our **DtS** context:

- **Pure Aloha Scheme**
- **Transmit First**

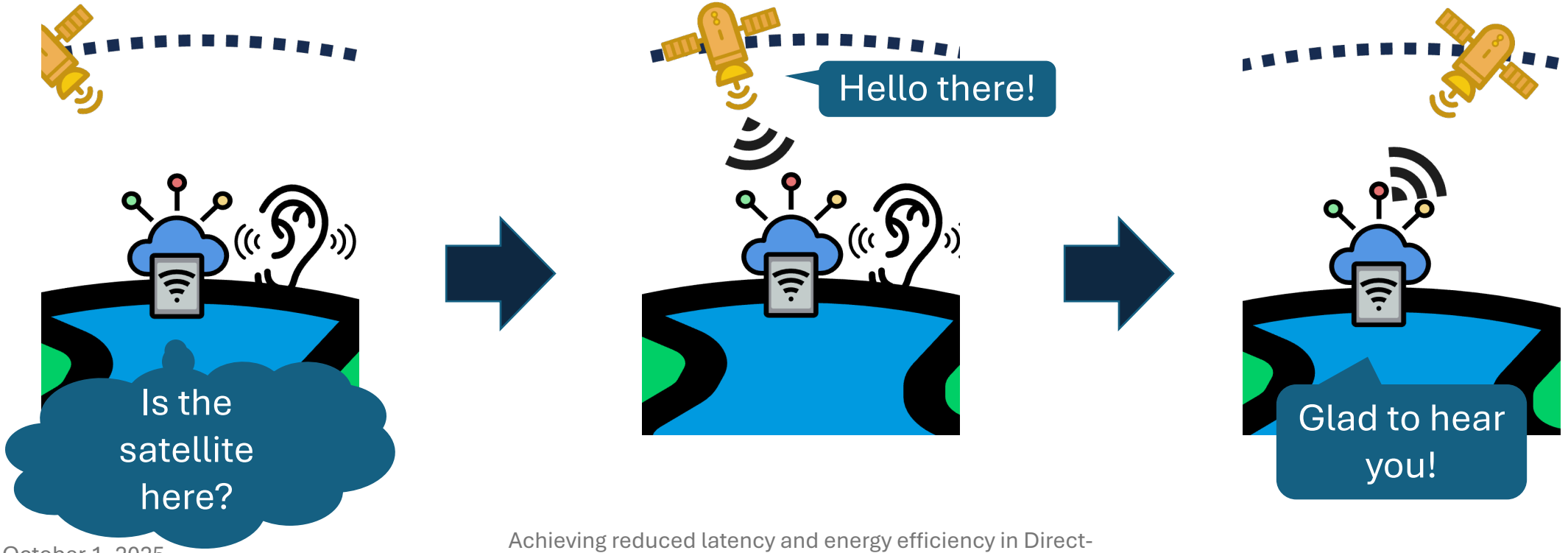
Introduction

Drawbacks of LoRaWAN

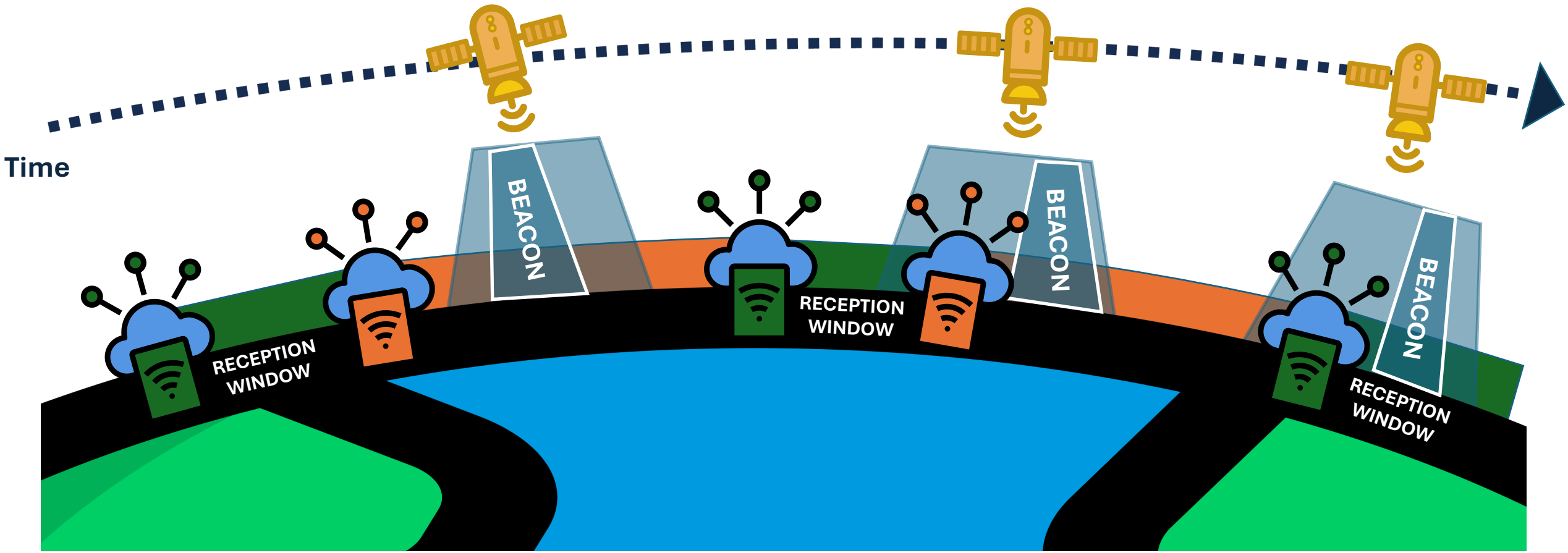
No satellite for receive

Introduction

Towards energy efficient networks



Network Scenario



Network Scenario

A single LEO satellite

- Trajectory based on the Two-Line Element (TLE) data of Iridium 7.
- The satellite completes its orbit in **100.3 minutes**.

The gateway on board **sends a** Beacon Reserved **packet every 128s**.

Wake-Up strategy

- Turn the radio **On and Off** periodically.

Reception Window is set to 130.12 s.

The **Sleeping Time** varies from 0 to 400 s.

A Single End Device

- **Randomly placed** on the ground
- Registered by **Activation By Personalization** (ABP).

Wake-up strategy applied to catch the Beacon Reserved packet to **save energy**.

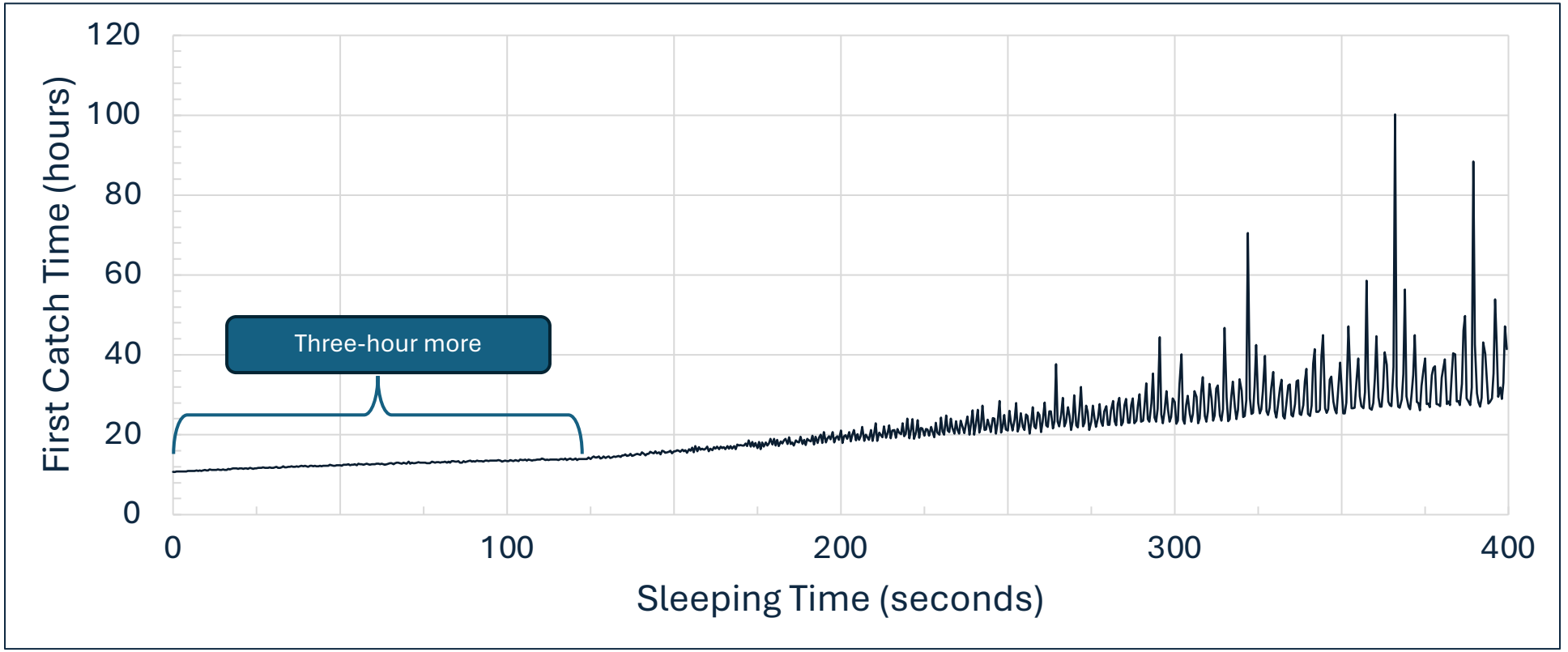
About the simulation

- Ad-hoc Python-based simulations.
- **4000 simulation** scenarios, obtained by **varying the position** of the end device and the **delay before it turns on**.

For each scenario, **800** specific values of the **Sleeping Time** were run.

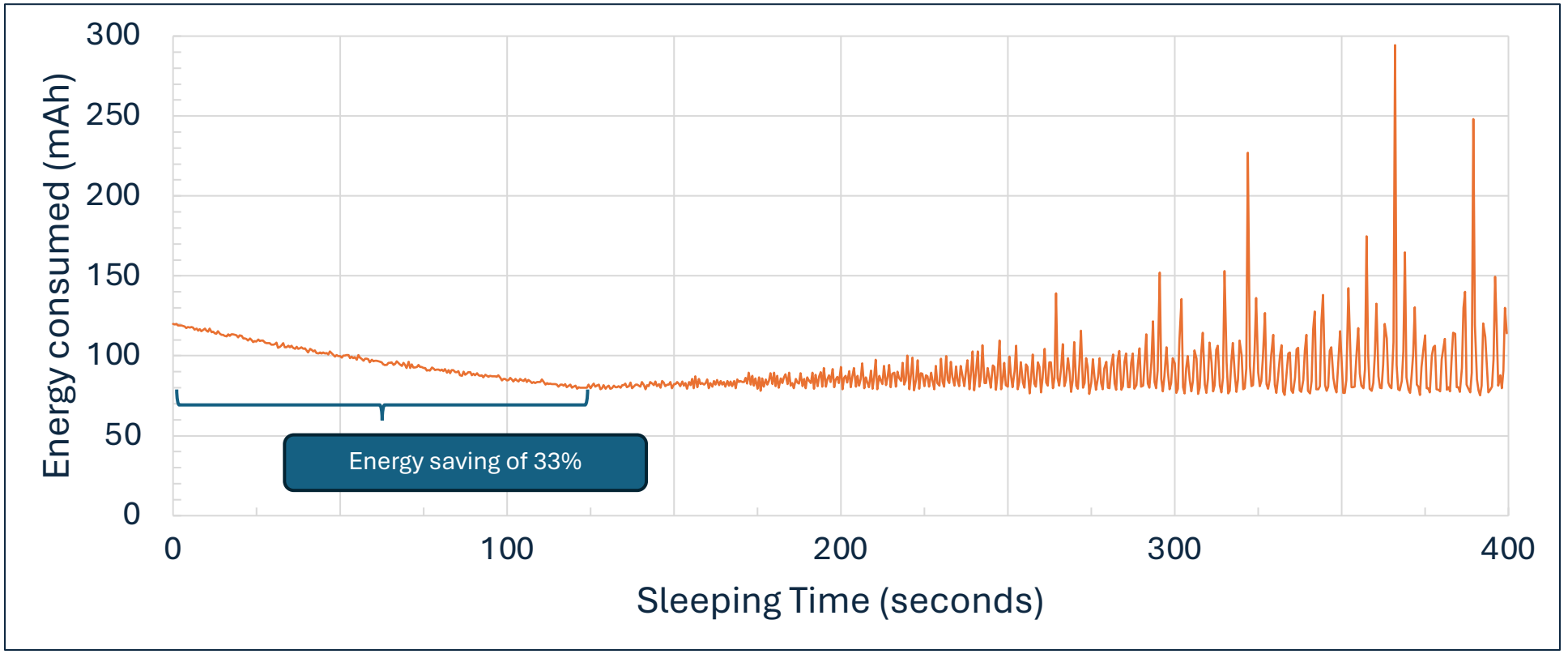
Simulation Result

The First Catch Time for a **Reception Window** of 130.12s

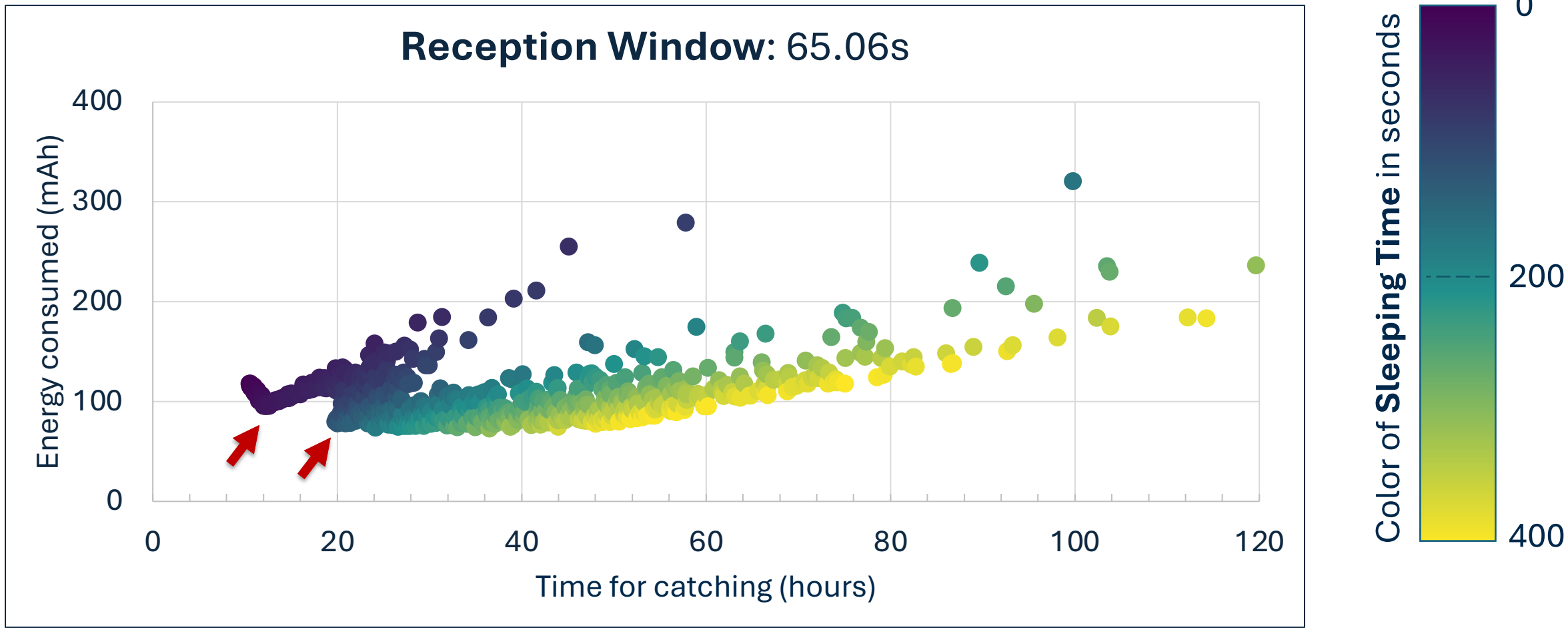


Simulation Result

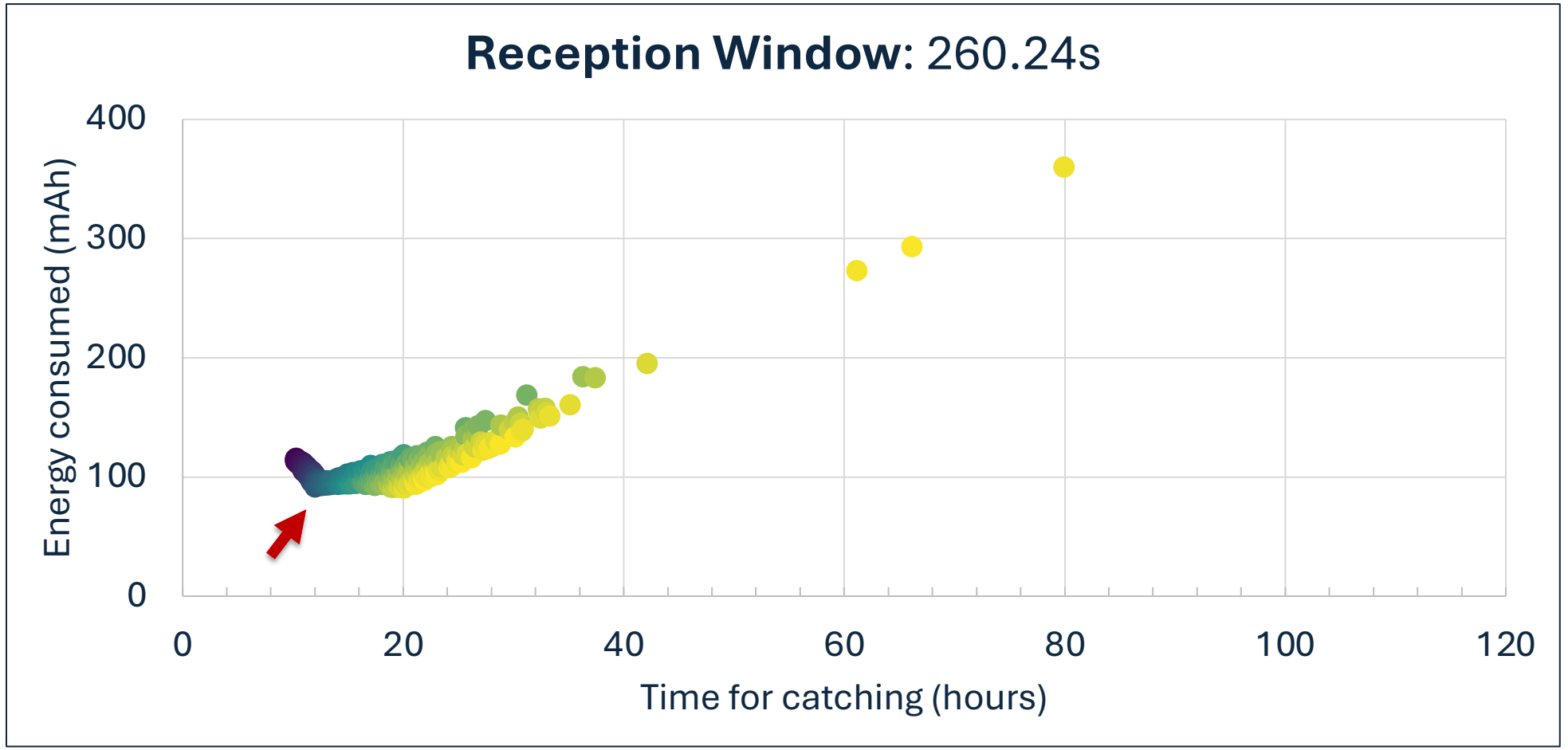
The Energy Consumed for a **Reception Window** of 130.12s

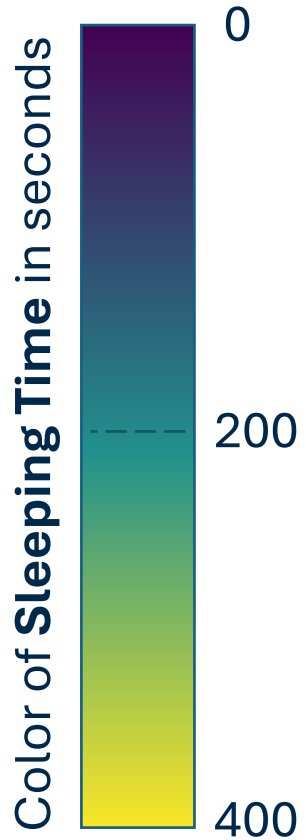


Simulation Results



Simulation Results





Conclusion

- The wake-up strategy saves a 33% of the energy required.
- It’s still competitive with a continuous listening

Future Work::

- Analysis with **LEO constellations**.
- Comparison with “**transmit first” policy**.

Thanks for your attention !