Cubesats: a low cost opportunity for IoT satellites

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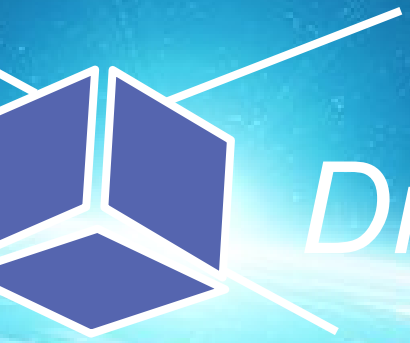
Didier Donsez, Alban Gabillon



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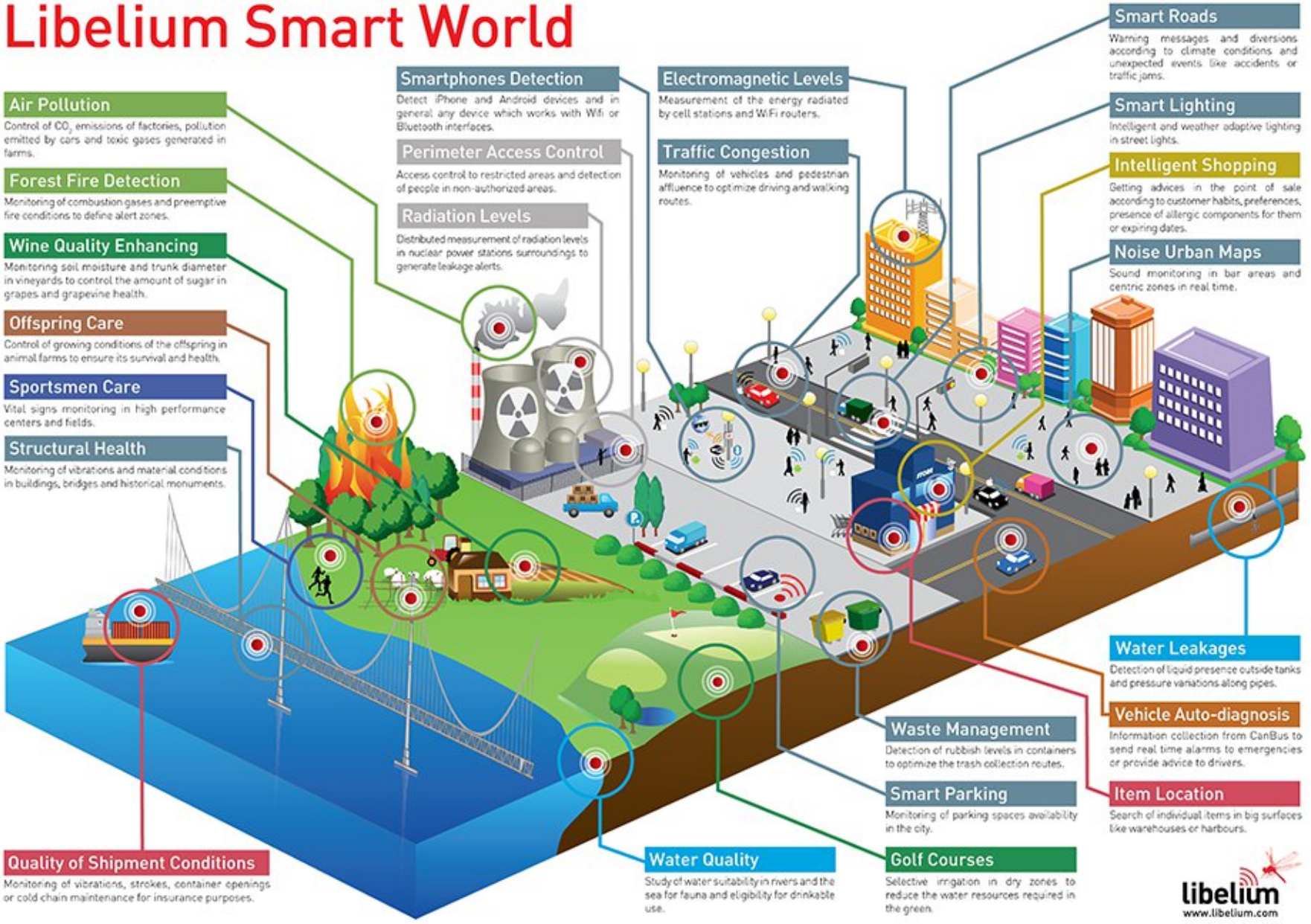
Outline

- Internet of Isolated Things
- Sat-IoT and Low-Power Global Area Neworks
- CSUG
- The ThingSat Project
- Field tests

The Internet of Things

All of you know that !



Low-Power and Long Range WAN

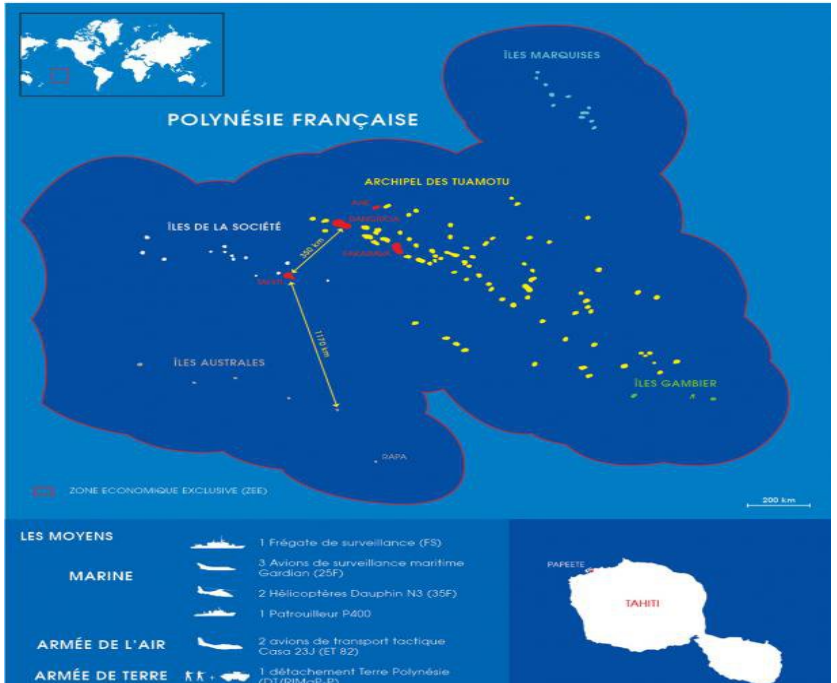
- LoRa/LoRaWAN
- Sigfox
- NB-IoT and LTE-M (3GPP)

covers most of the (previous) IoT use cases

The Internet of Isolated Things

IoT networks cover only a few part of the Earth
deserts, oceans, pole regions, unpopulated areas are “not” connected to the global web

Examples:

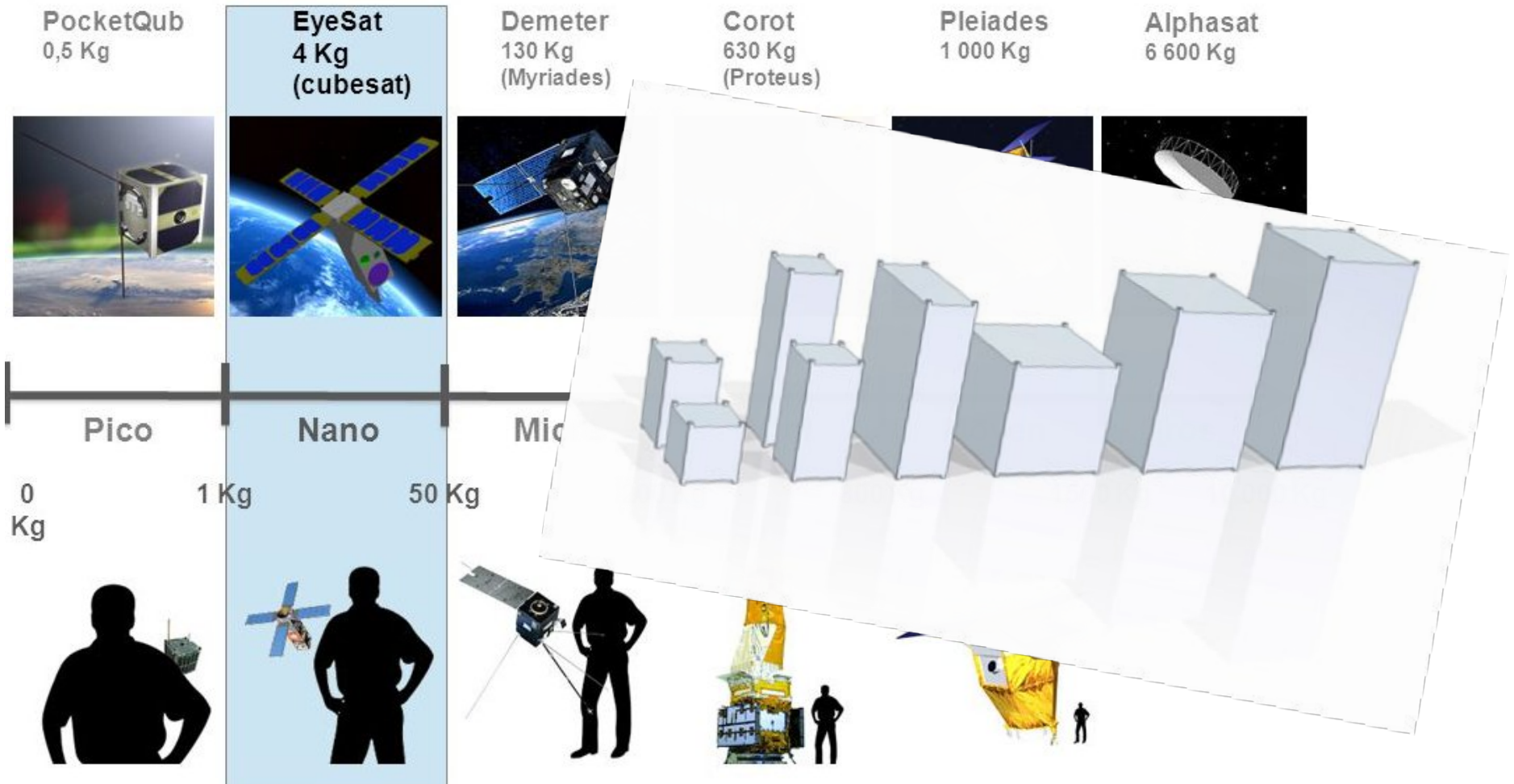


Sat-IoT & LPGAN (i)

- Principle
  - “Fat” Satellite constellation relays messages from/to alone ground objects.
- Satellite-IoT
  - Since more than 10 years
  - Messaging services, Geo-Location services
  - Terminal drawback : cost, energy, subscription
  - Operators : Iridium, Eutelsat, Orbcomm, Argos, Inmarsat, Rock7, ...

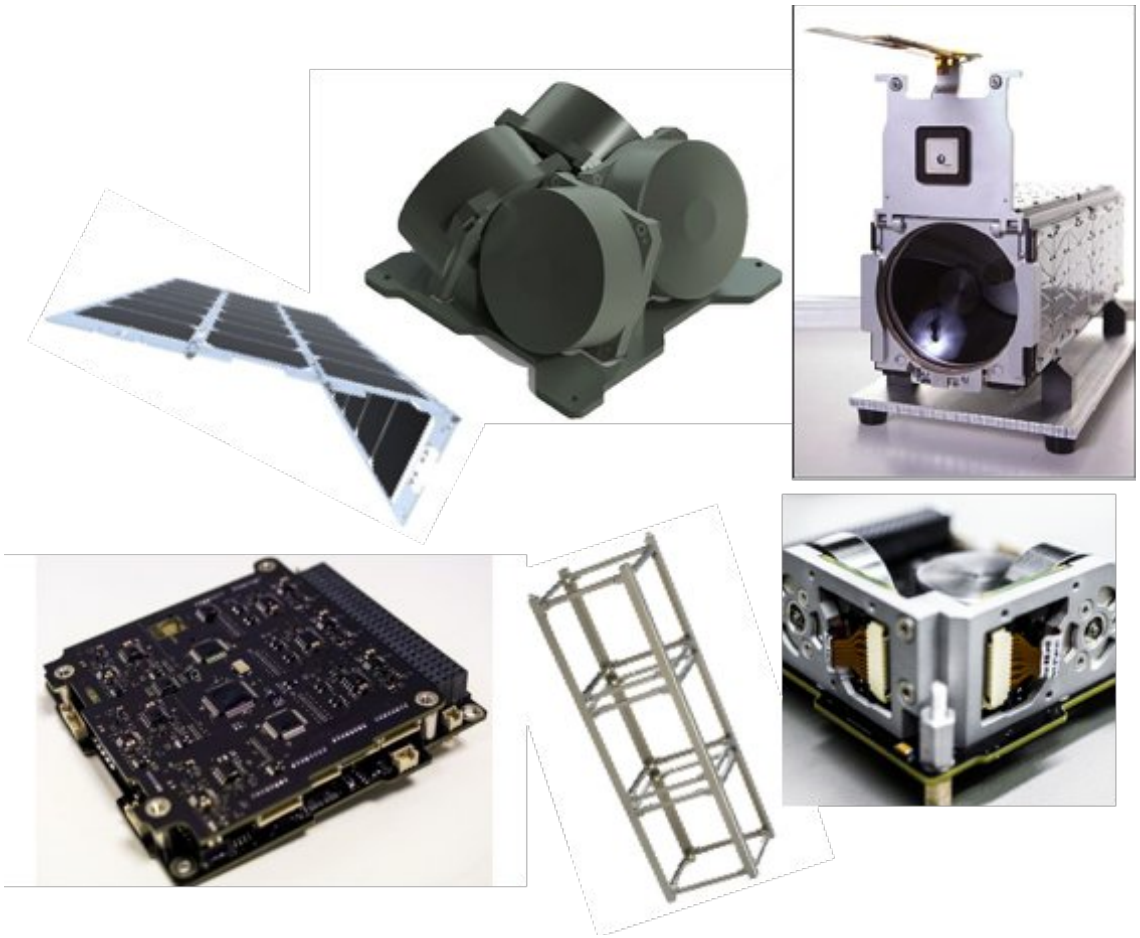
Sat-IoT & LPGAN (ii)

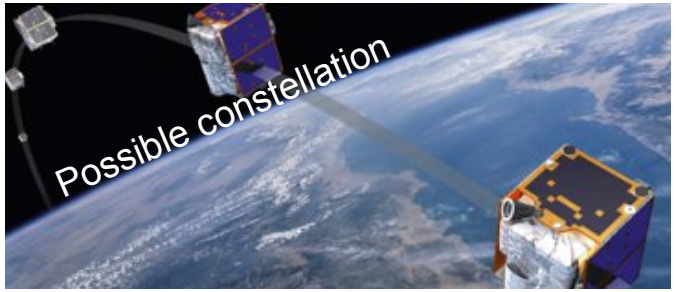
- “New space” & Cubesats
  - Agile and “affortable” LEO satellites



Interest of cubesats

- Component “off the shelf” (Standardized)
- Time development reduction
- Cost reduction





Costs: From 500 k€ for 1U to 5 M€ for 1U

Sat-IoT & LPGAN (iii)

- LPGAN (Low Power Global Area Networks)
  - Goal
    - Affortable low power terminals
    - Affortable subscription
  - “Affortable” cubesats constellations

LPGAN Players (Large companies and Startups)

- Kinéis (Sigfox+CLS+...)
- Lacuna Space
- Astrocast
- Kepler Communications
- KNL Networks
- Karten Space
- Fleet Space
- Myriota
- Hiber
- Xingyun
- Blink Astro
- Analytical Space
- Hongyan
- ... and many more using (nano)satellites in LEO orbits

and us !!!

us is **CSUG**

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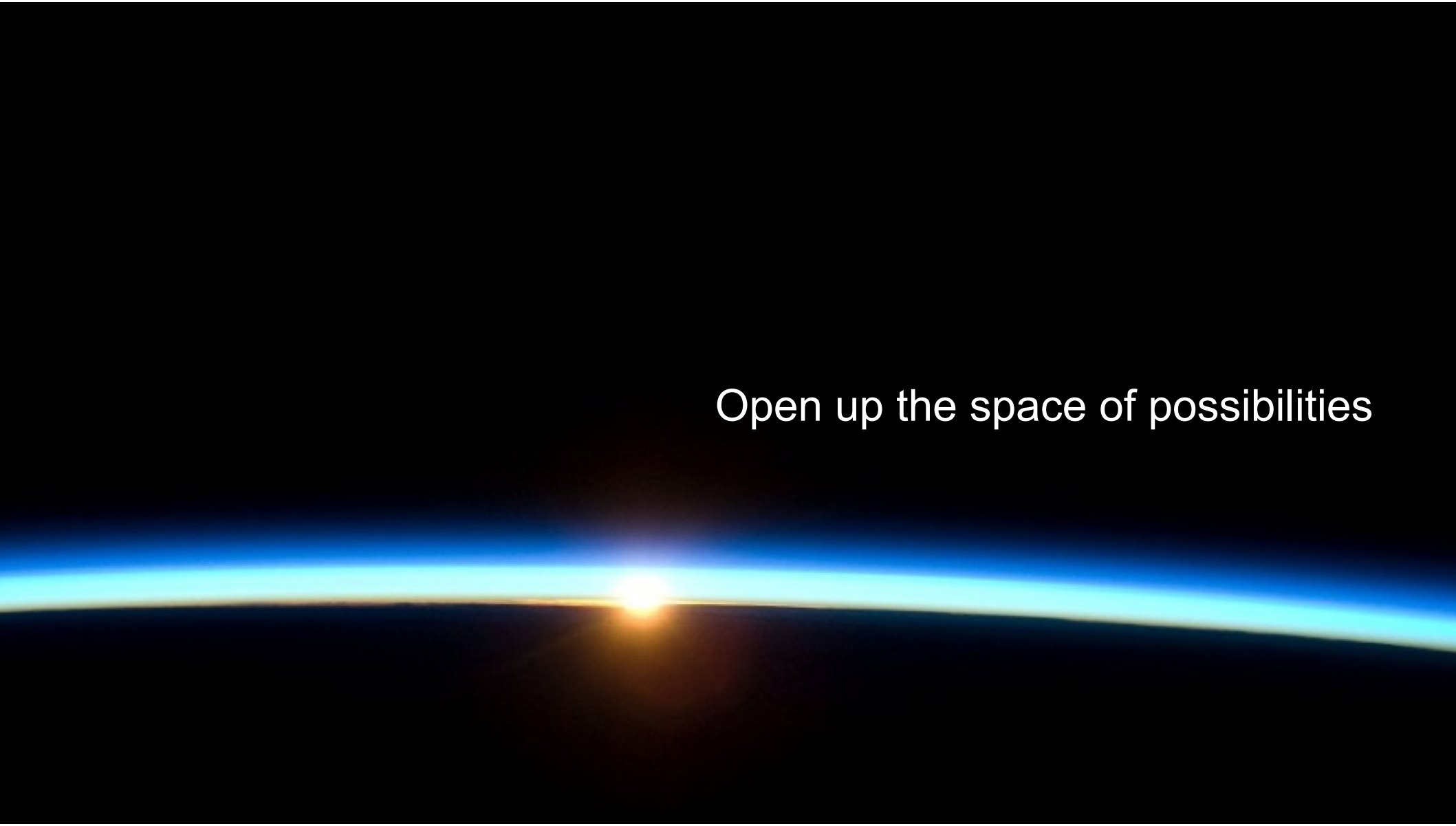


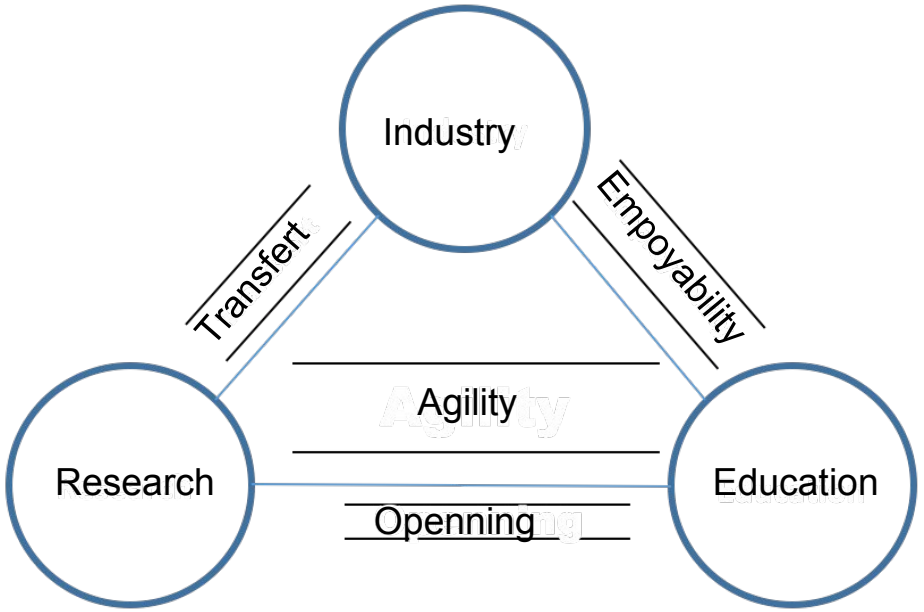
From miniaturised payloads to uses

Application domain

Earth Observation
Space weather
QKD

Prospectives 2020

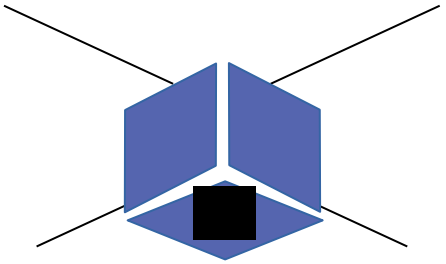
IOD/IOV
Communications
Exobiology



AMICAL Sat: Q2 2019
ATISE: 2021
NanoBOB: TBD
NanoCARB Collaboration: 2021

LORAGAN: 2022
ESA D3S WFAI: 2023-2026
Blob in Space: 2024

The ThingSat project



Goals

1) Testing LoRa-based modulation for

- ground station ←→ cubesat communications
- end-point ←→ cubesat communications

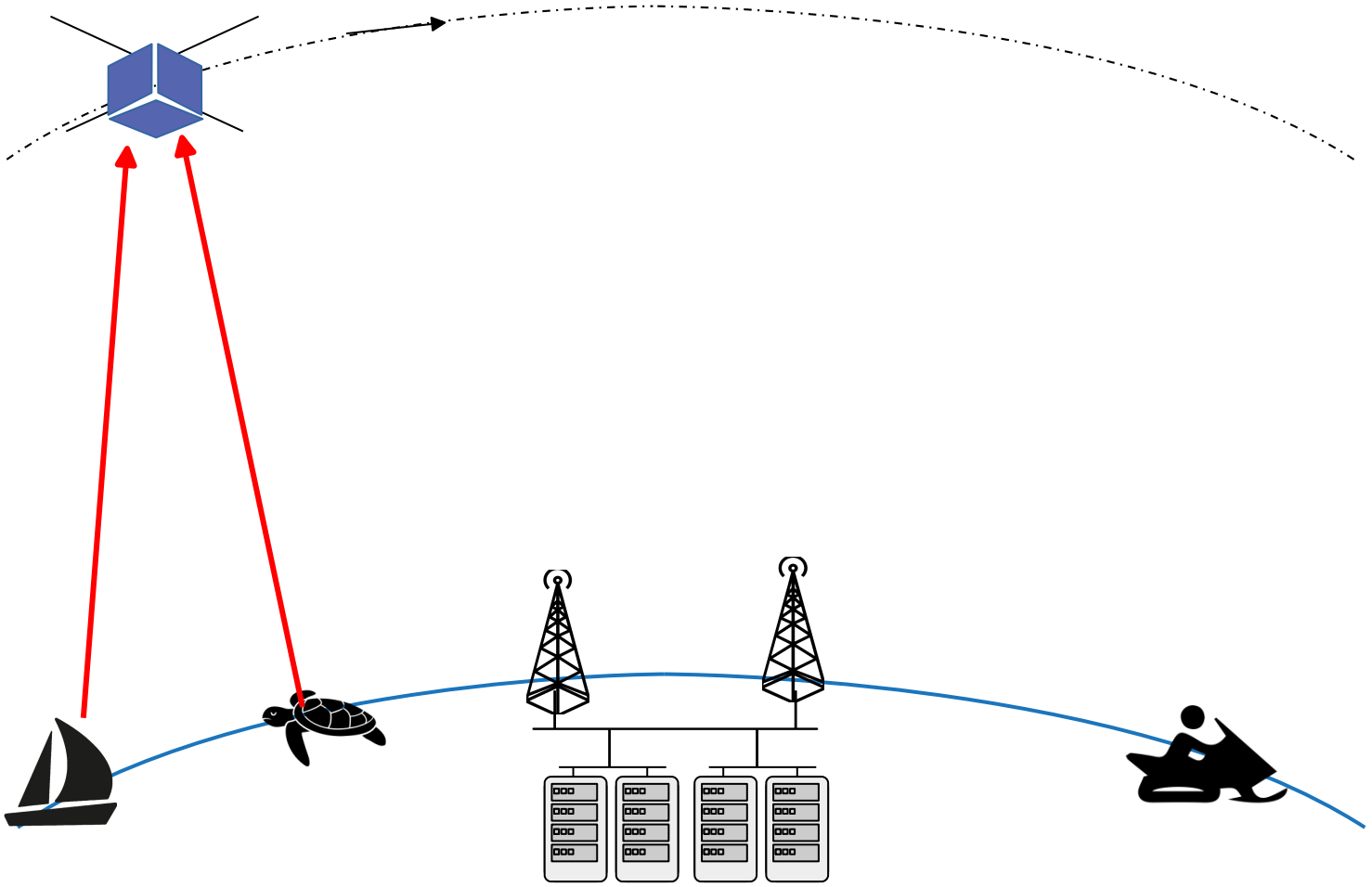
2) Testing applications

- delay tolerant networks EP ←→ CS ←→ GS
- multi-lateration of EP
- clock distribution
- track and monitor “zombie” satellite

Communication principles

Delayed Tolerant Network

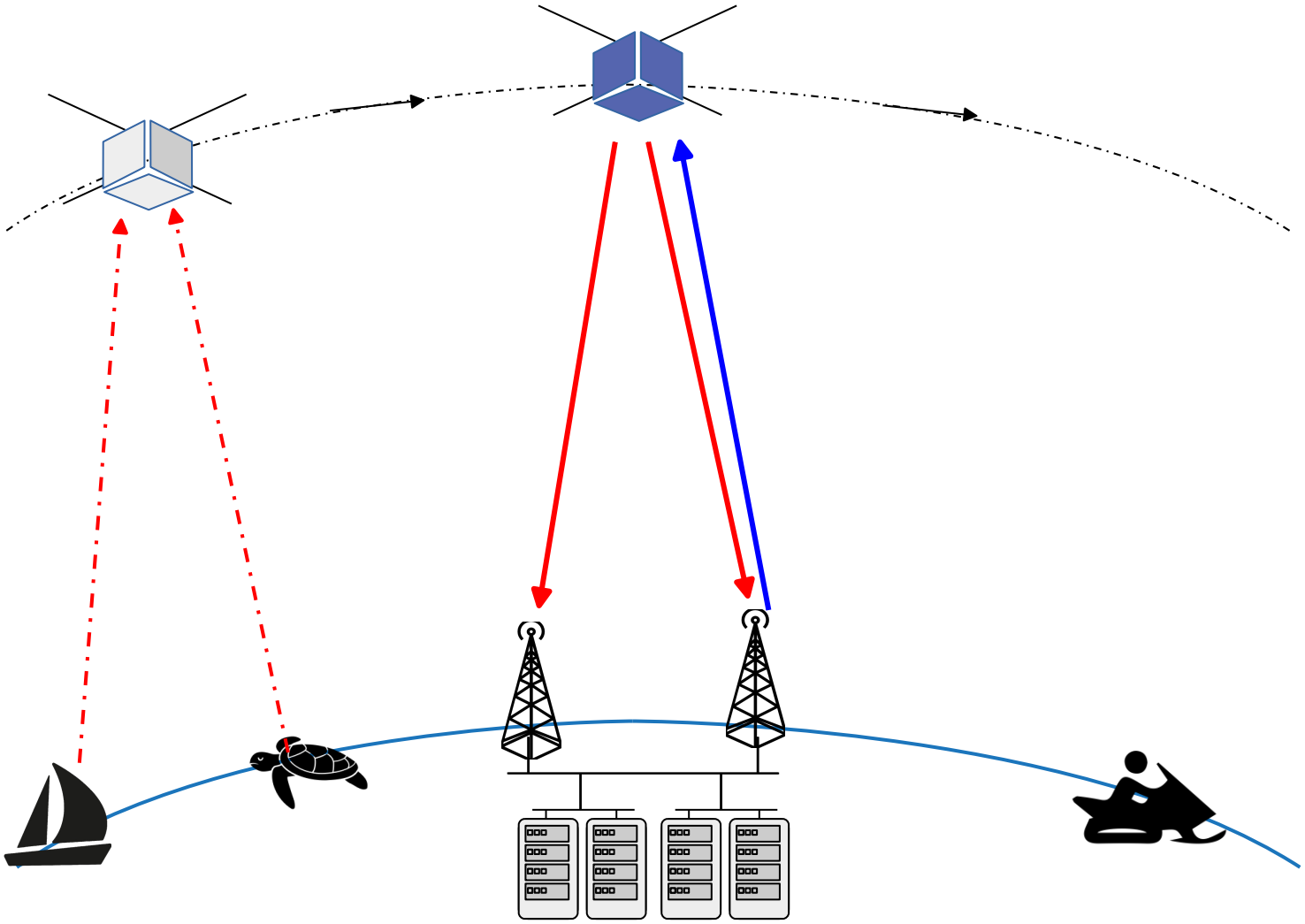
How does it work : Store & Forward LoRa frames



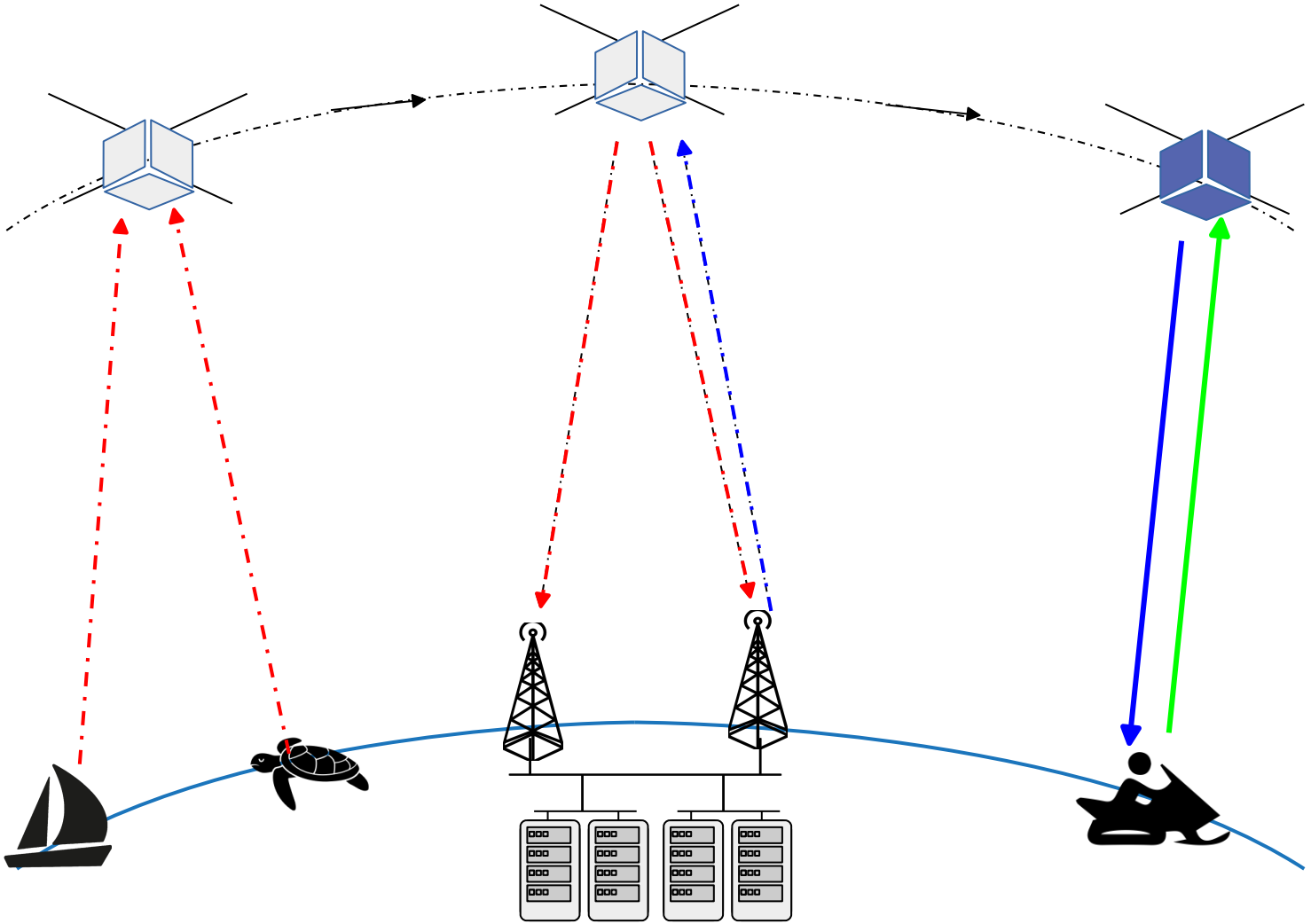
Communication principles

Delayed Tolerant Network

Cub-Sat is a data « mule »



Communication principles
Delayed Tolerant Network



Communication principles

Delayed Tolerant Network

How it work : Store & Forward LoRa frames

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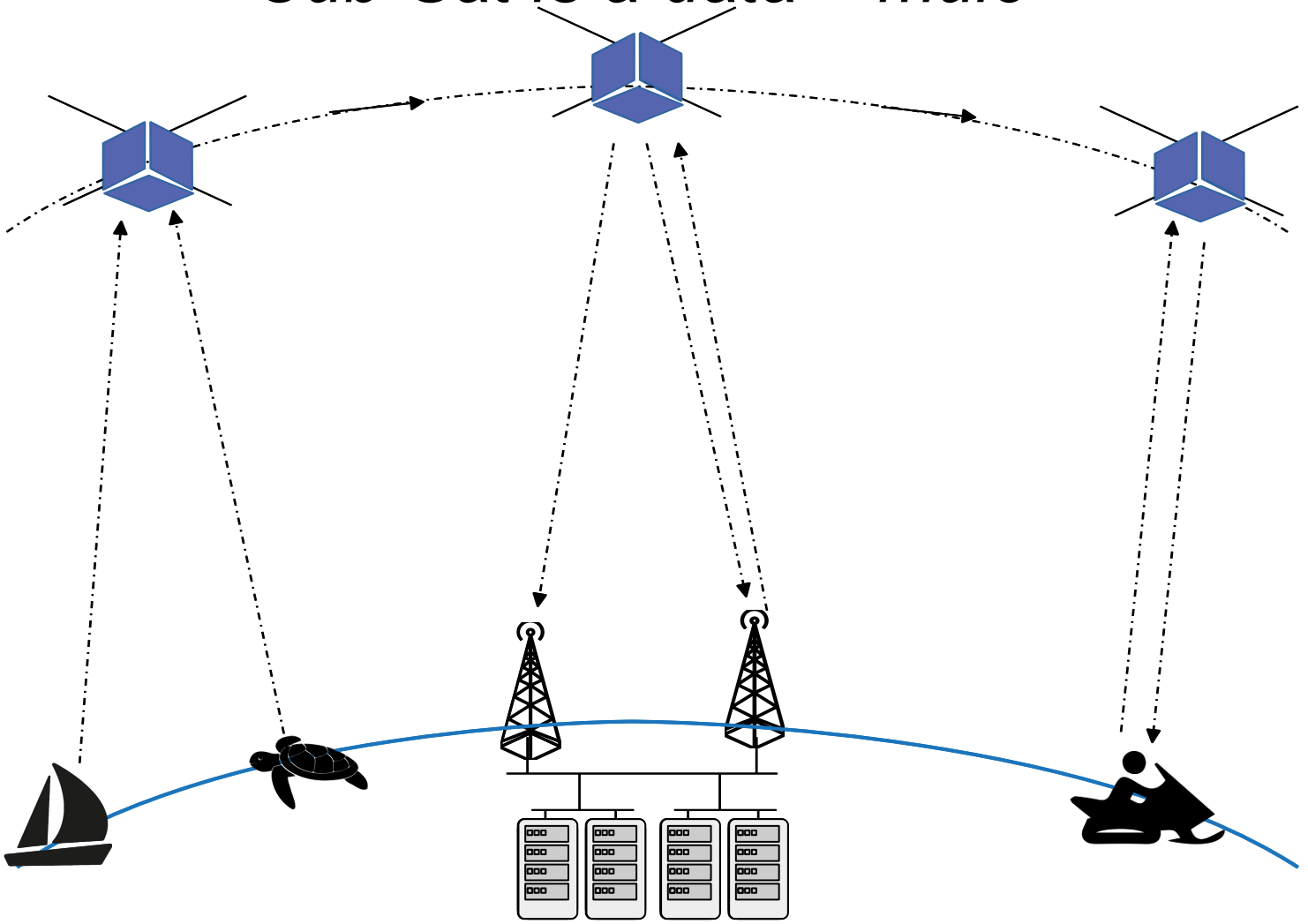
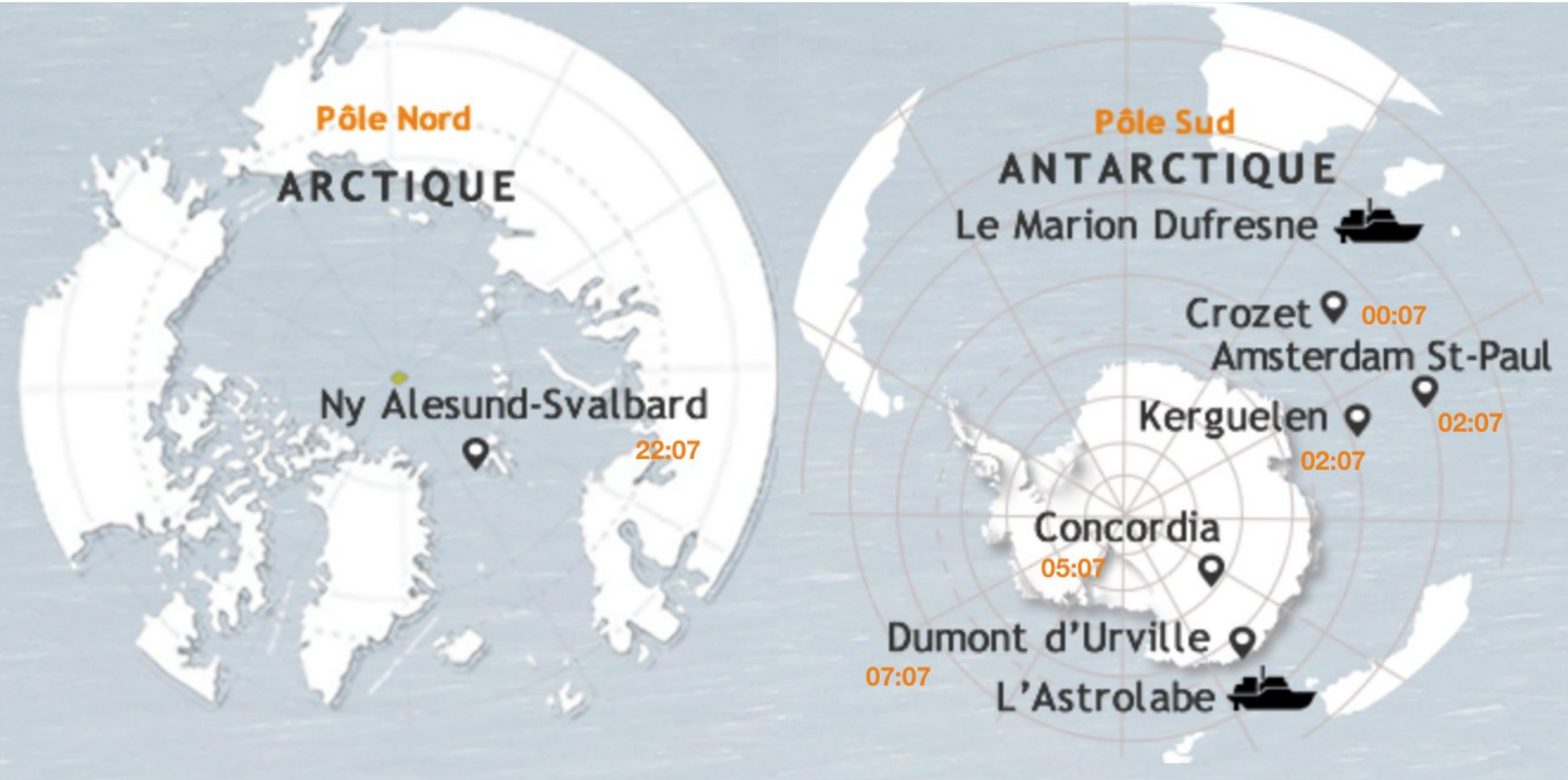


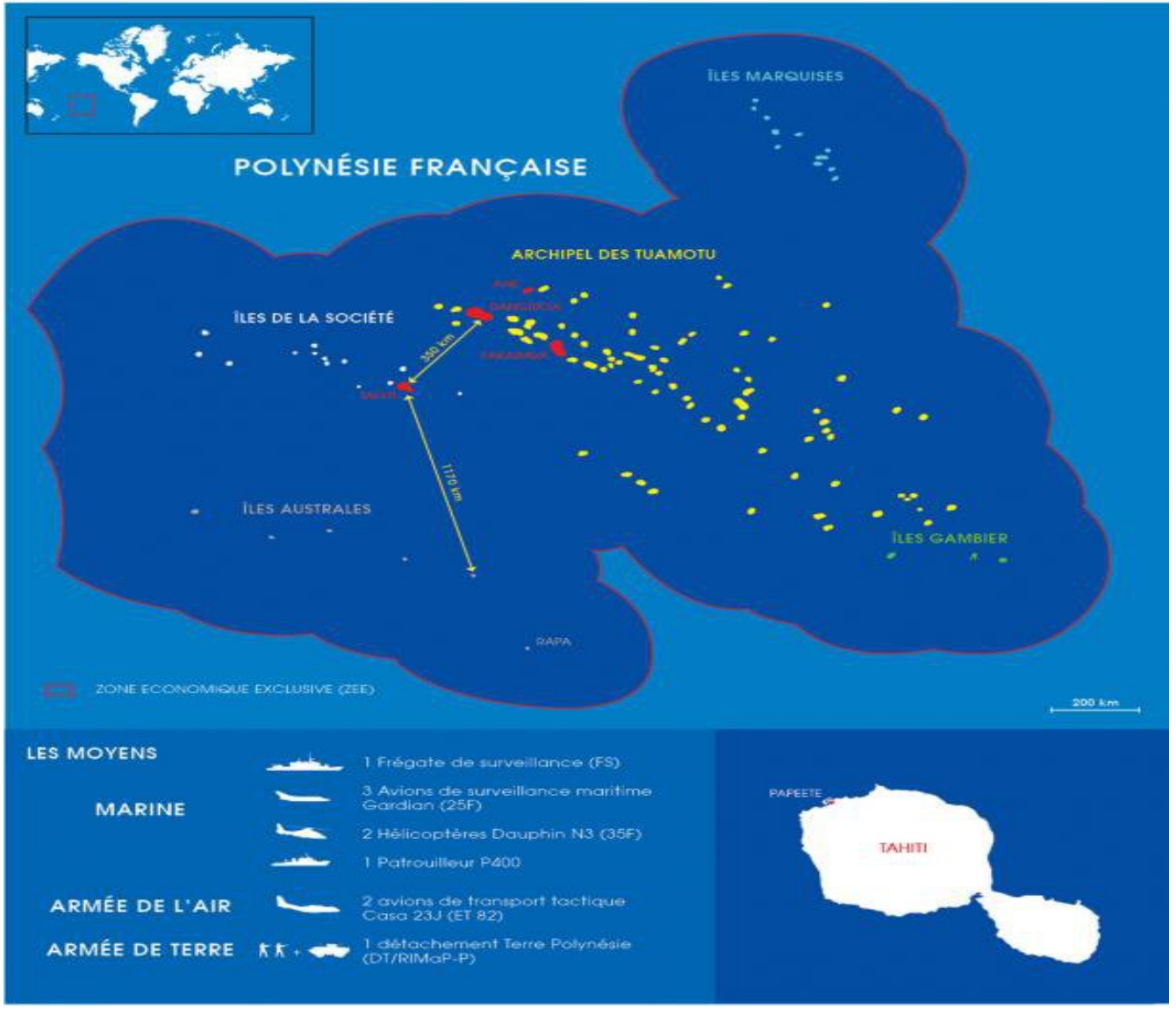
Planned field tests and use cases

- Col du Lautaret
  - Alpine ecology/biologie
- Svalbard (Spitzberg)
  - Rescue operation
  - Scientific instrumentation
- Polynésie Française (Pacific ocean)
  - ZEE (Exclusive Economic Zone): 5 millions km²
  - Fish farming, Tide-gauge
- Air liquide
  - Helium bottle tracking (pressure, temperature, …)

IPEV


Pôle Nord
ARCTIQUE
Ny Ålesund-Svalbard
22:07
Pôle Sud
ANTARCTIQUE
Le Marion Dufresne
Crozet
00:07
Amsterdam St-Paul
02:07
Kerguelen
02:07
Concordia
05:07
Dumont d'Urville
07:07
L'Astrolabe

ZEE Polynésie Française
5 millions de Km2



Conclusion & Perspectives

- Looking for funding a 1U or 2U ThingSat cubesat
- Targetting a launch into orbit on Q1 2021
- Toward free and open-source community
  for LPGAN technologies (SW/HW)
- Toward an open community of users
  - end-points owners
  - low-cost ground station owners

Soon on github.com/ThingSat and www.ThingSat.space

Q & A

Grenoble NewSpace week

From payload ▷ to uses

May 14 to 17, 2019

Grenoble, France

Industrial & tech day // Scientific workshops
Student workshop // Public conference //

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One session dedicated to IoT satatellite

More information and program : www.c

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