deployment and mapping in remote areas

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Who am I

Luka Mustafa - Musti (MEng)

- electronics, telecoms, hardware hacking, ...
- Institute IRNAS Rače (non-profit development)
- Shuttleworth Foundation Fellow
- University College London: PhD student

Also active in :

- HAM radio S59DXX
- wlan slovenija

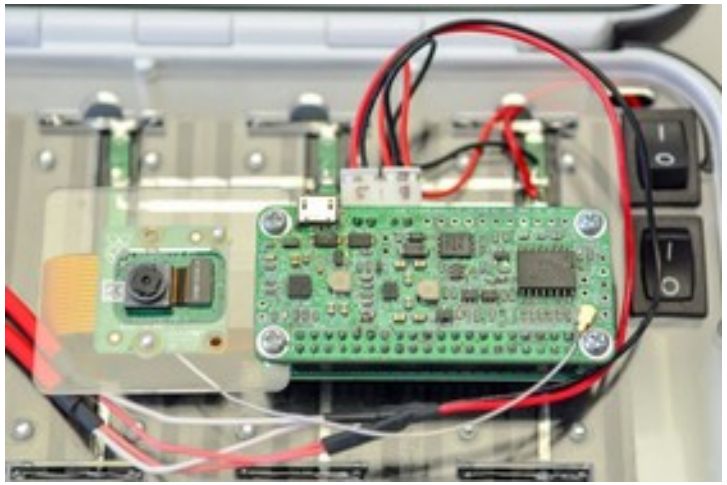
We build future-proof hardware!

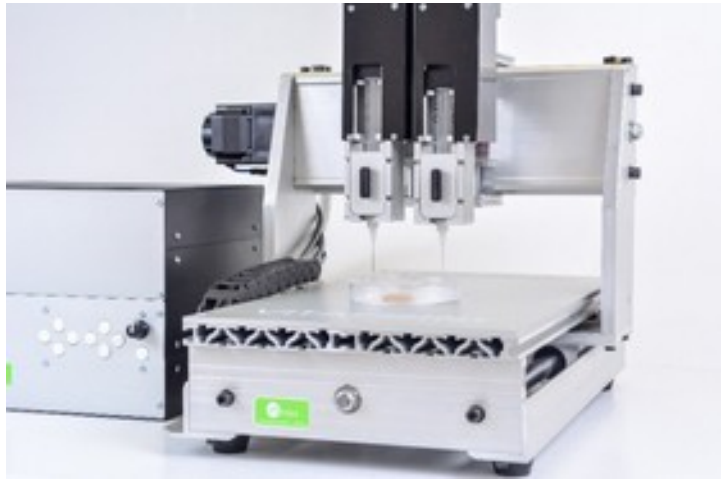
Open hardware development

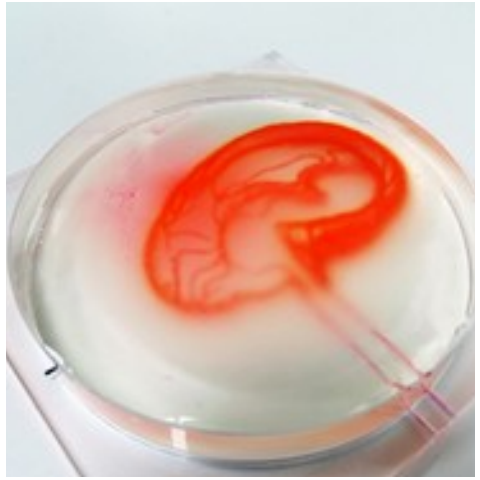
Prototyping and manufacturing

We work together to rapidly develop well-tailored and cost-effective solutions for industry and science.

Projects





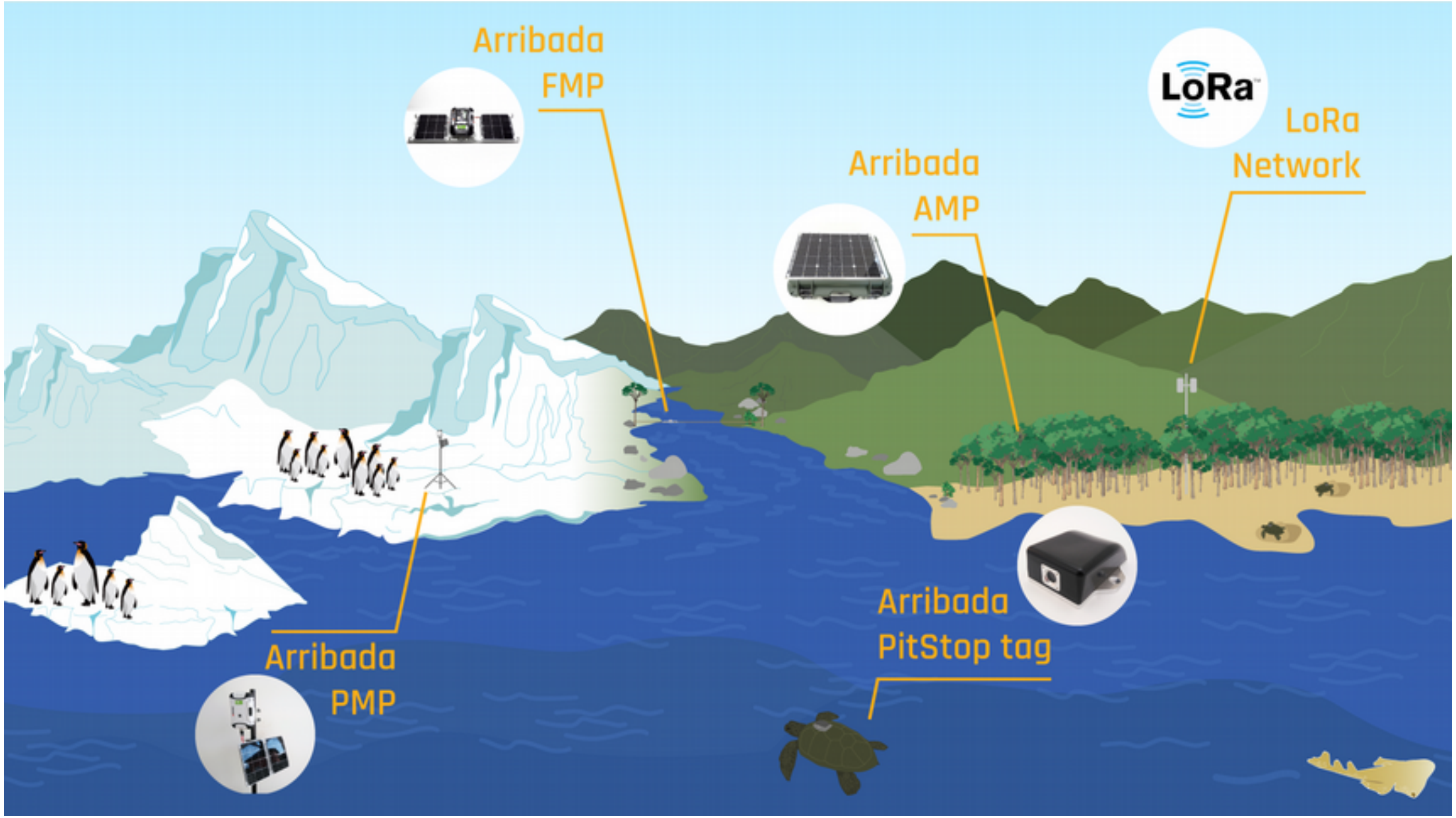


Presentation outline

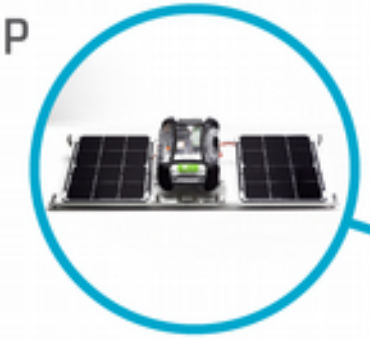
1. Motivation
2. Technical solution
3. Implementation
4. Future-use

Animal conservation

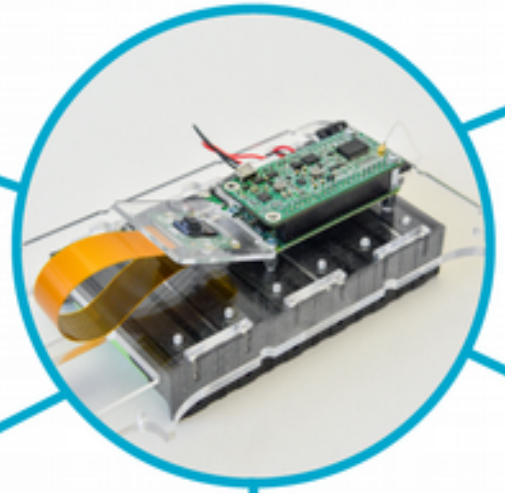
- Why, how...


Arribada
FMP
LoRa
LoRa
Network
Arribada
AMP
Arribada
PitStop tag
Arribada
PMP

PiRA Zero



Arribada FMP



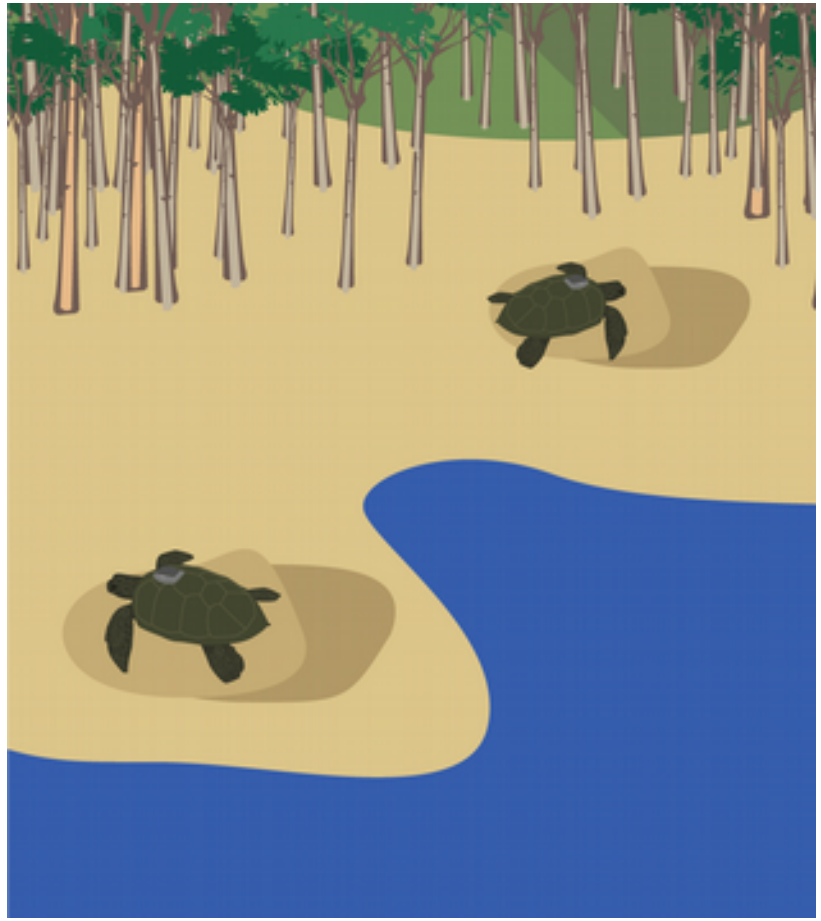
Arribada AMP

Arribada PMP

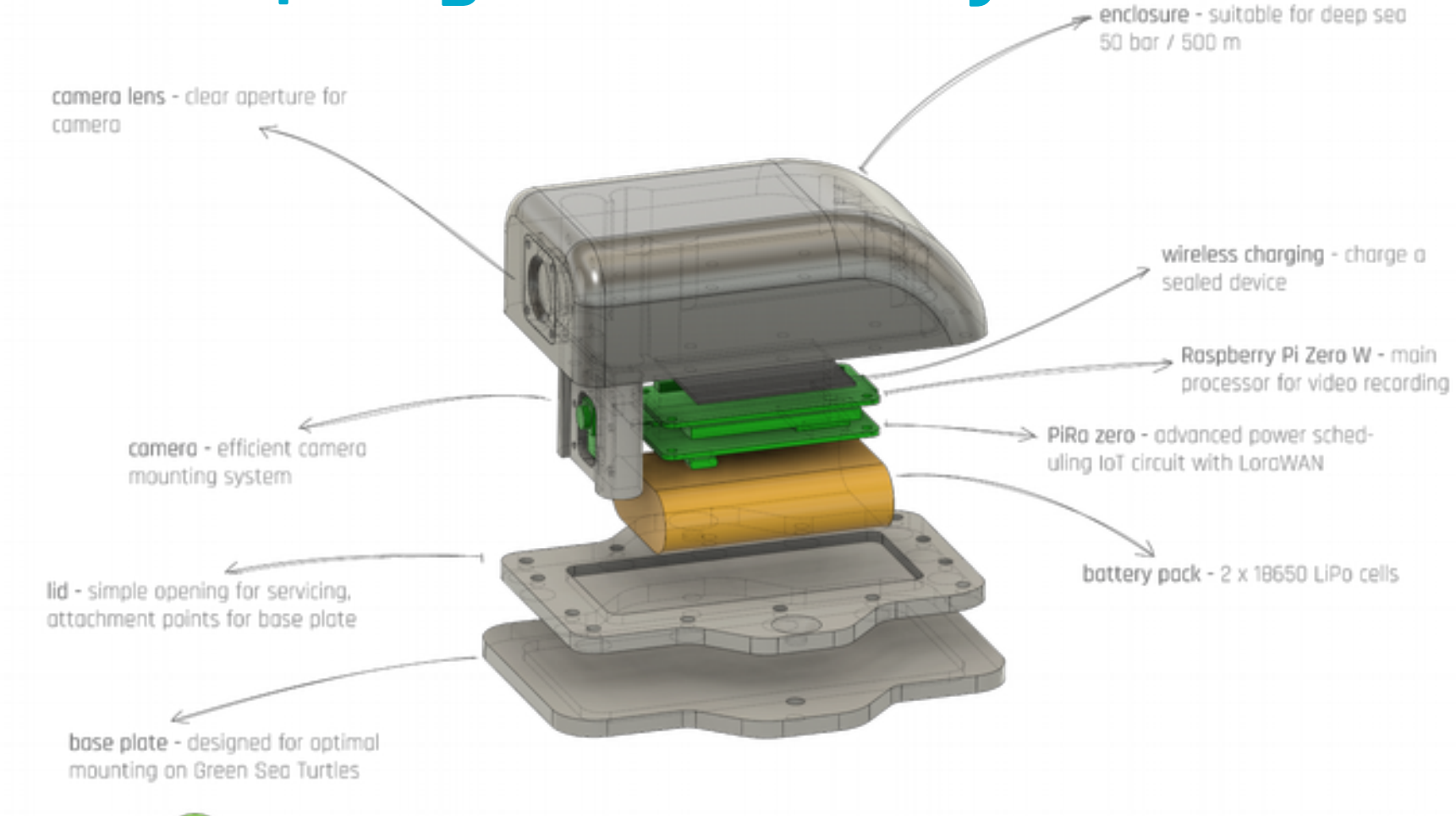
Arribada PitStop tag

Solarcast

Arribada Turtle PitStop tags

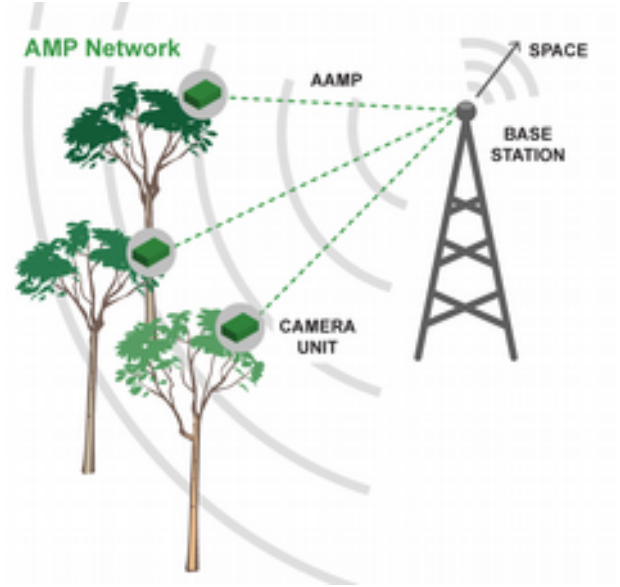


Turtle PitStop tag disassembly



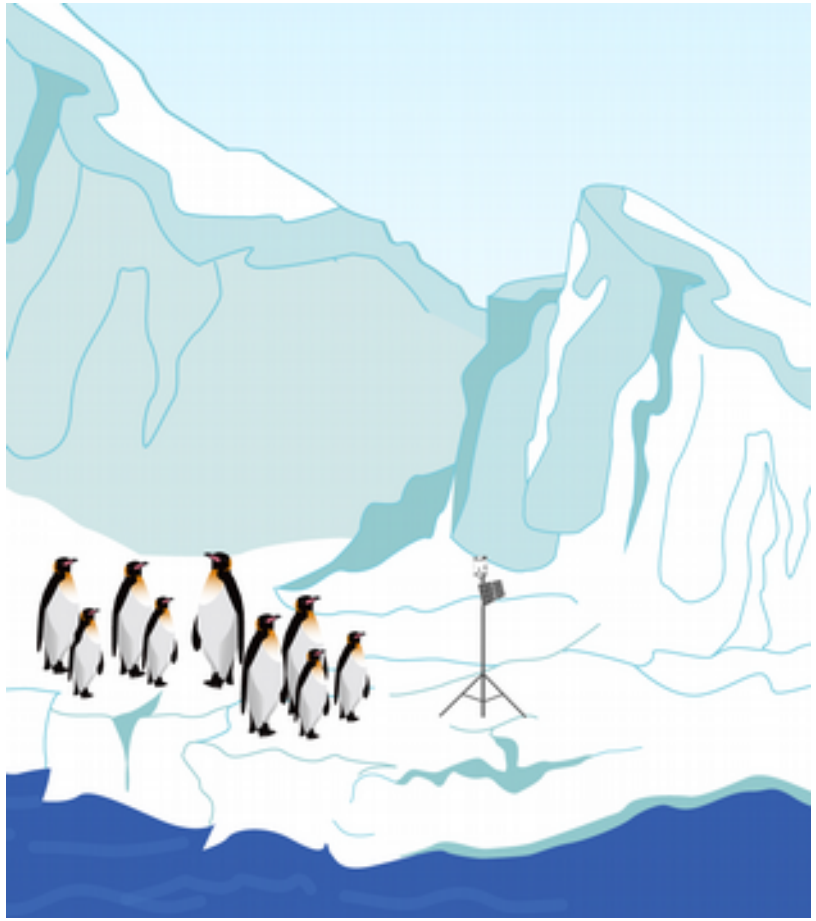
Developed by irnas for ARRIBADA initiative using cutting edge technologies by

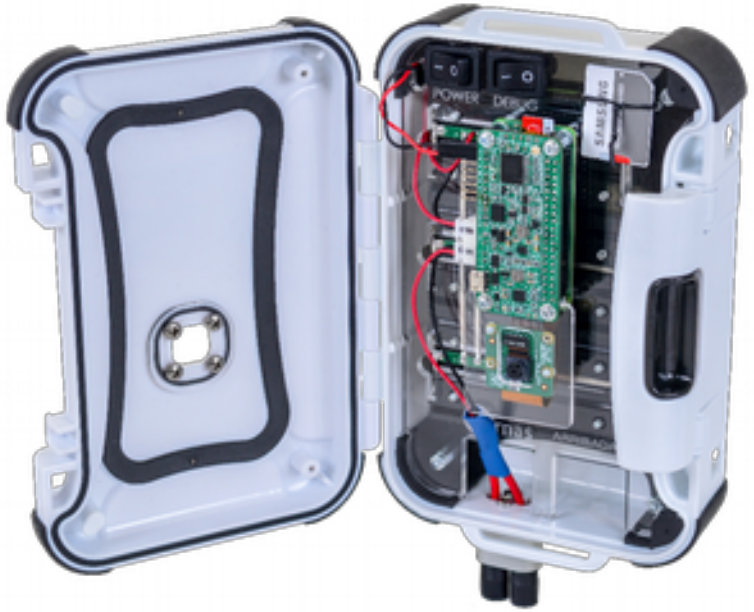
Arribada AMP in Peru



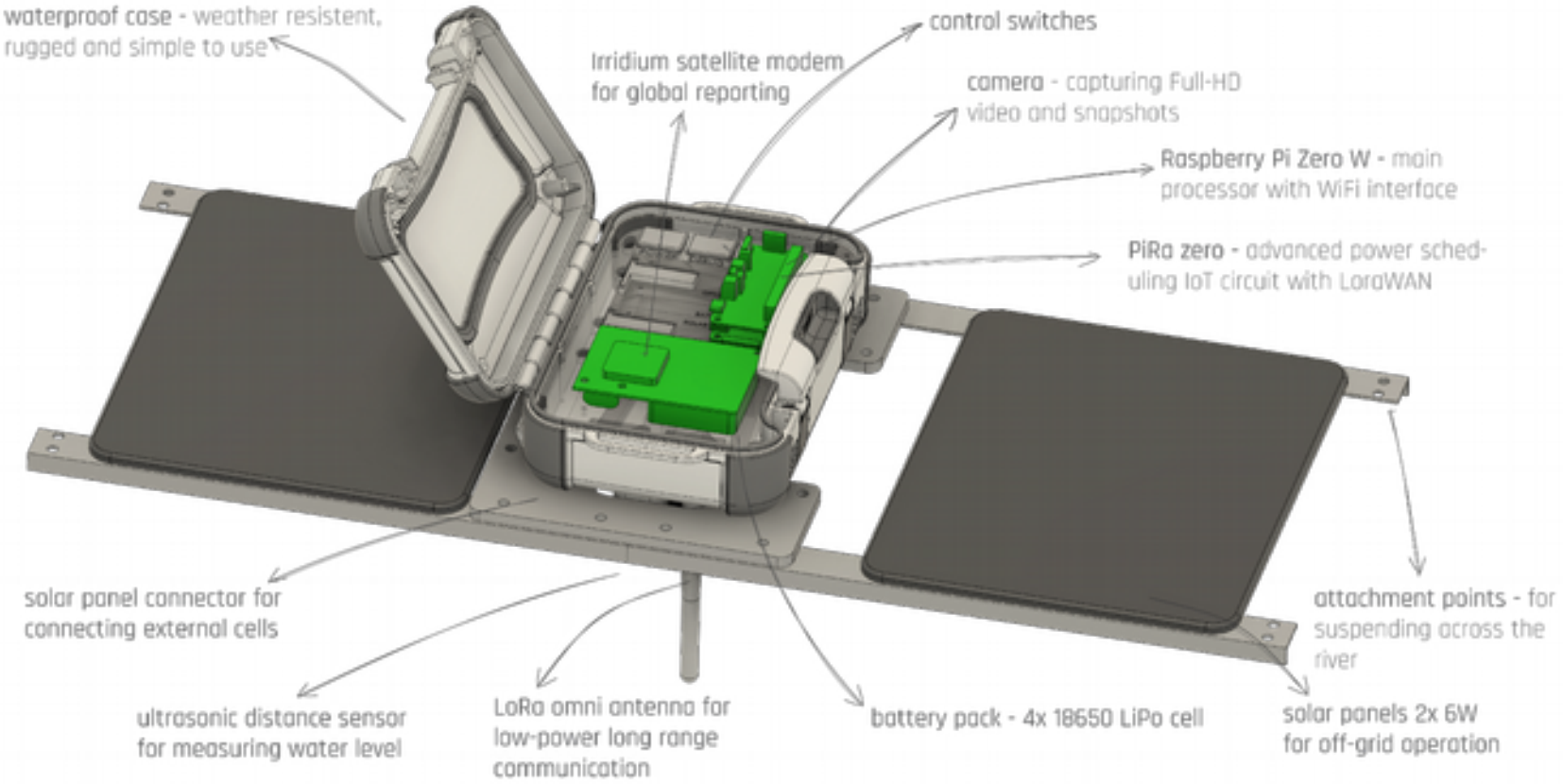
Arribada FMP for Madagascar

Arribada PMP for Antarctica



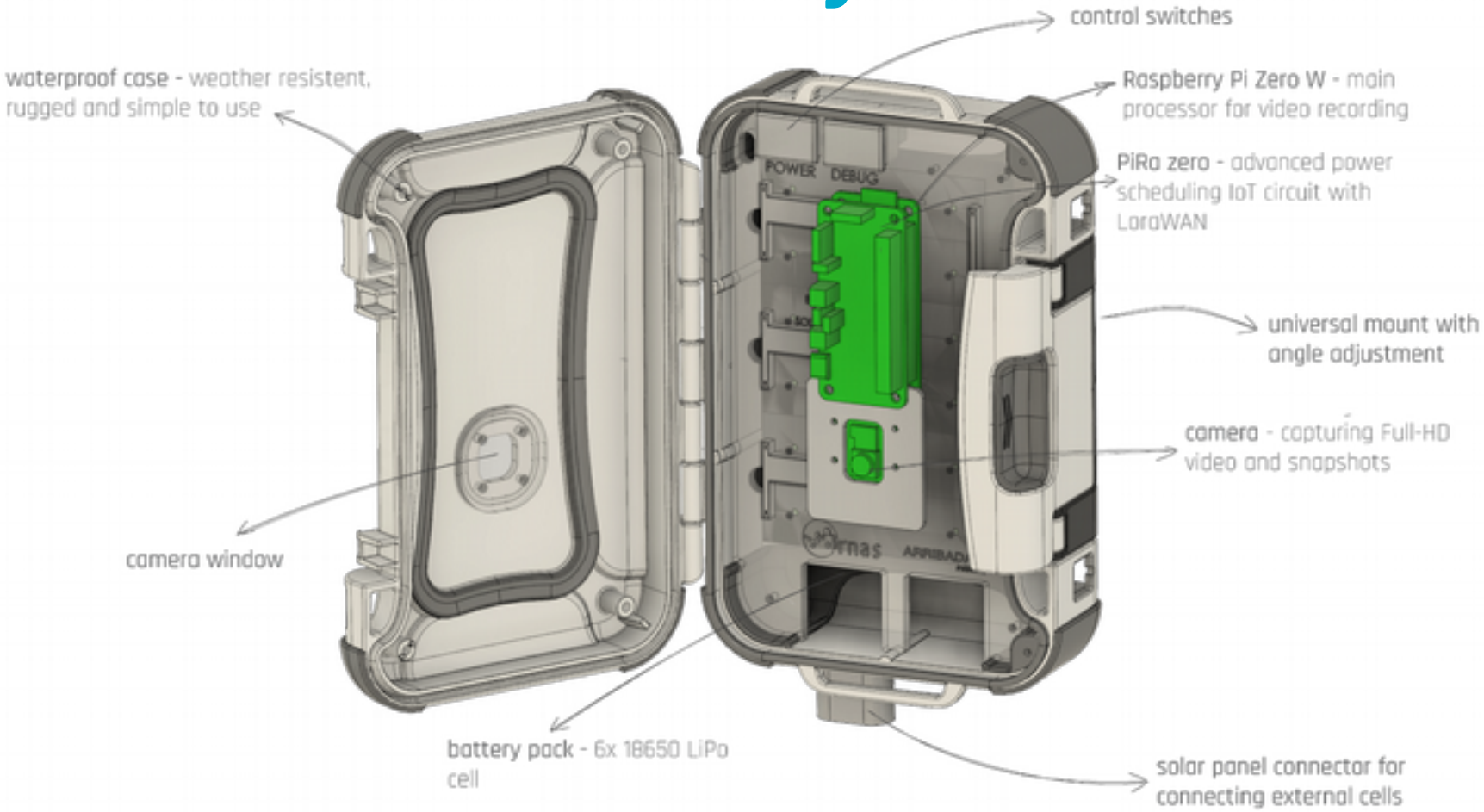


Arribada FMP disassembly



Developed by irnas for ARRIBADA initiative using cutting edge technologies by resin.io Voltaic

Arribada PMP disassembly



Developed by irnas for ARRIBADA initiative using cutting edge technologies by Voltaic

Key challenges

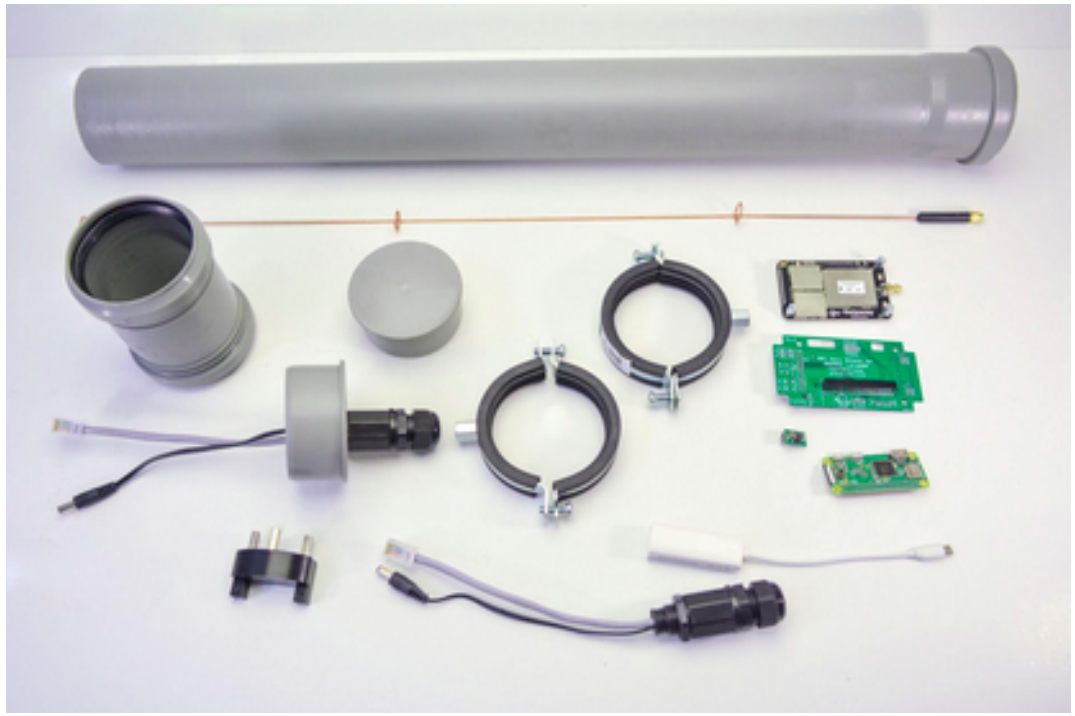
- Simple and low-cost gear for untrained use
  - Zero-config
  - Simple interface, BLE + phone app or WiFi AP with website
- Real-time information on sensor/tracker operation
  - Know that it works, schedule servicing
  - Schedule collection of large datasets
- Network coverage map
  - Difficult in rain forrest and other heavy vegetation
  - Sub-optimal gateway placement
  - Automated way of generating maps

LoRaWAN to the rescue

- Low-cost battery efficient devices
  - SX1276 modules
  - Implemented in sensors of various kinds
- Simple gateways
  - RPi Zero + RAK831
  - WiFi, 3G or other uplink
  - PoE or solar powered
  - Mounted on a building or tree
- Easy to deploy

LoRaWAN IRNAS gateway

- Low-cost effective outdoor unit
  - RPi Zero + RAK831

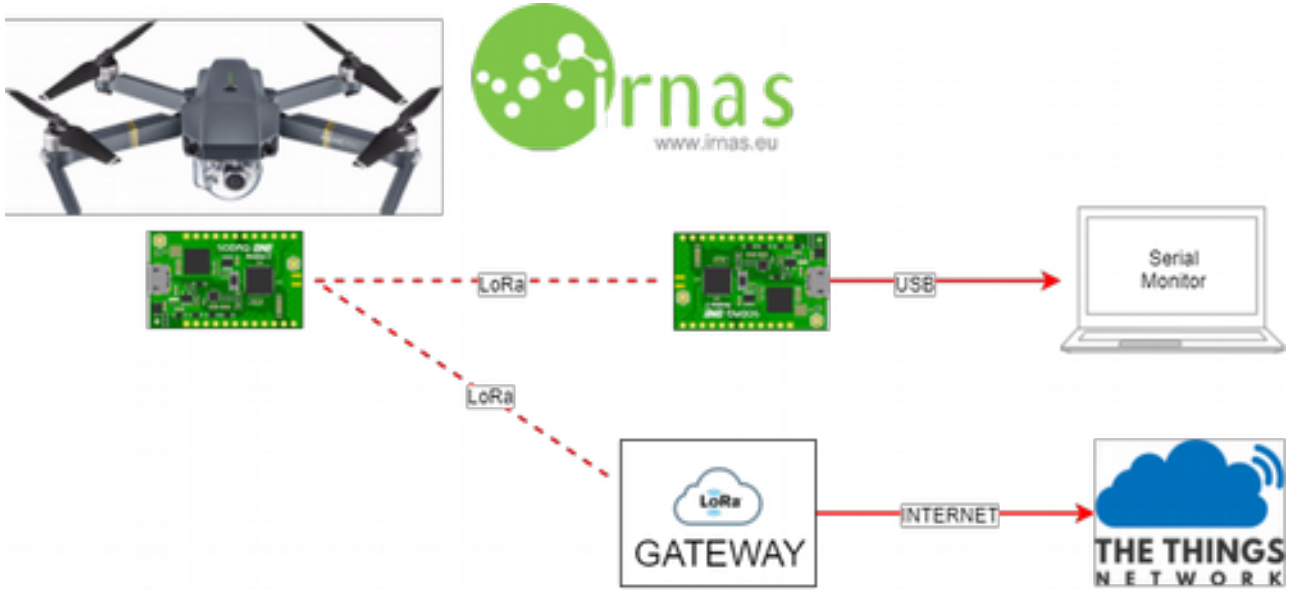


Technical unknowns

- What is the coverage of a gateway?
  - TTNMapper for wardriving
    - Hard to repeat, only at ground level
  - RadioMobile for estimating
    - Inaccurate with heavly land cover (vegetation)
    - Inaccurate with gateways with obstructions
- How do I know a device works at a given location?
  - 20m up a tree
  - Floating in a pond
  - Swimming in the sea
- How do antennas and devices actually beahve?
  - Repeatable testing required

Mapping setup

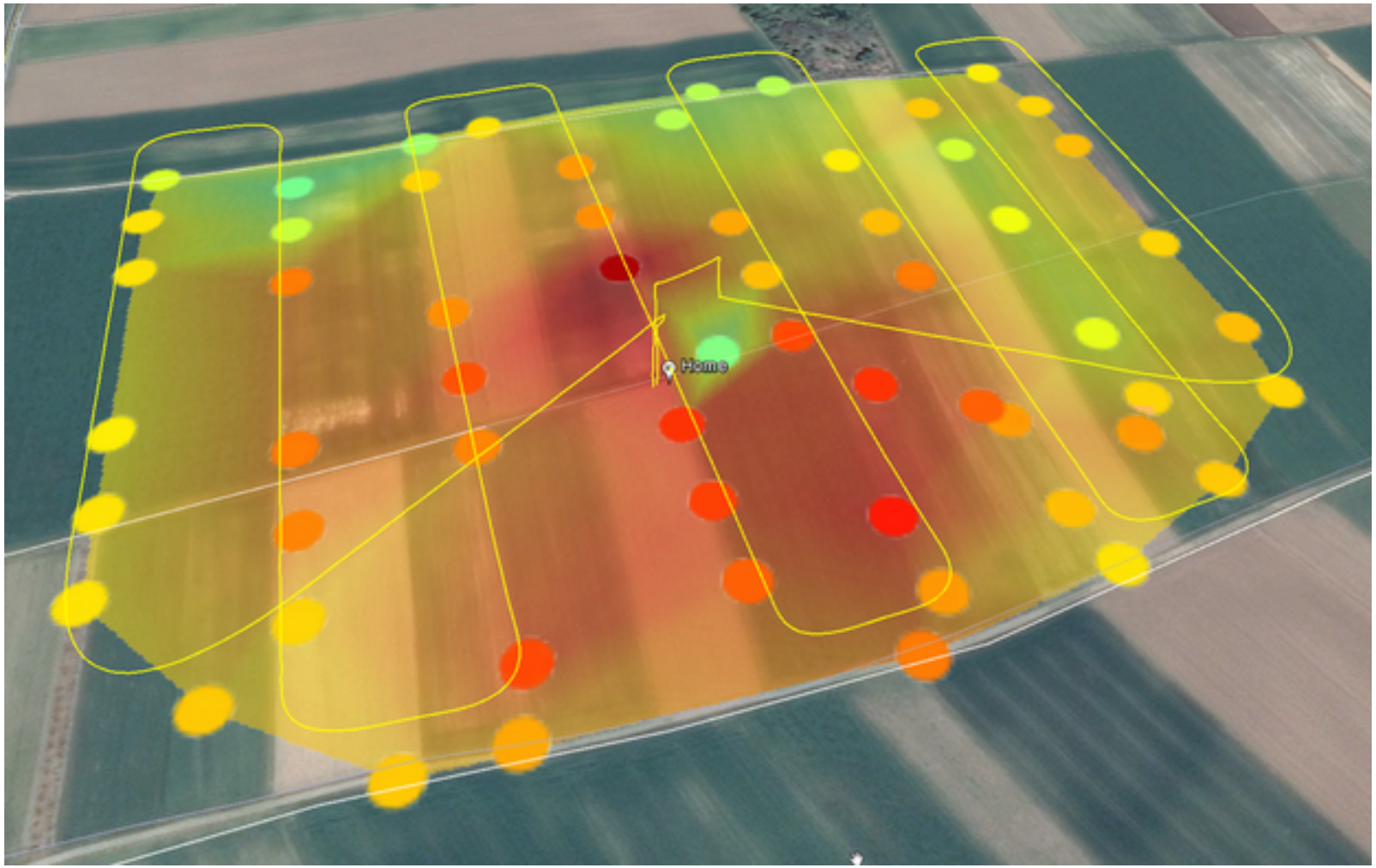
- Online: TTNMapper
  - Operational and useful
- Offline: Device-to-device
  - Under development at IRNAS
- Hardware:
  - SodaqOne with GPS
  - DraginoLoraGPS
- Movement:
  - Drive/bike/walk
  - Drone



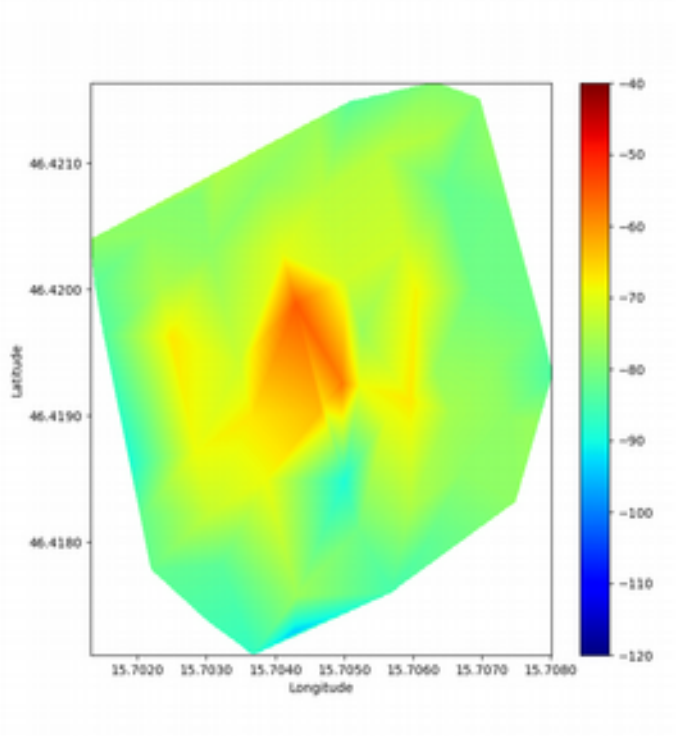
Drone mapping (TTNMapper)

- TTN Gateway
- Drone (DJI Mavic Pro)
- Litchy (mission planning)
  - Fly in a pattern
- TTNMapper
  - Acquire data
  - Process data
- Google Earth display

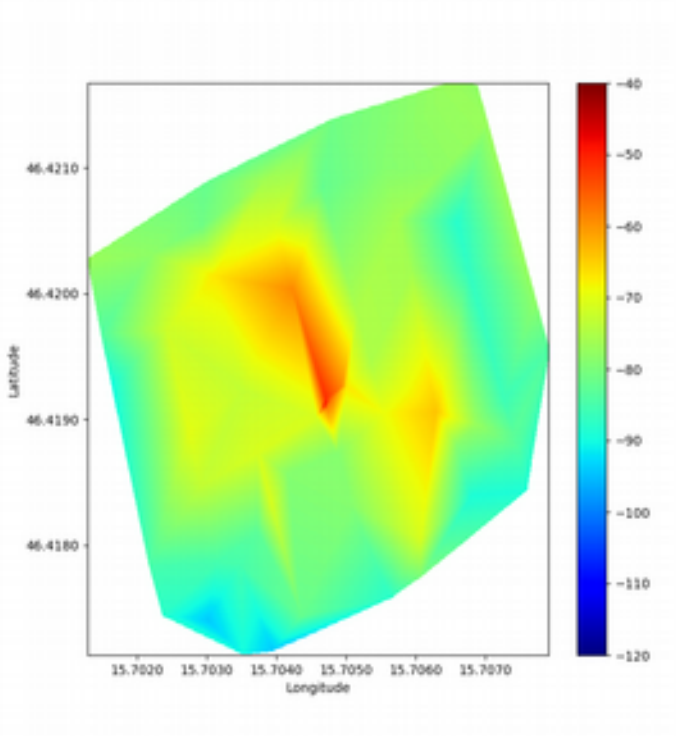
Drone mapping example



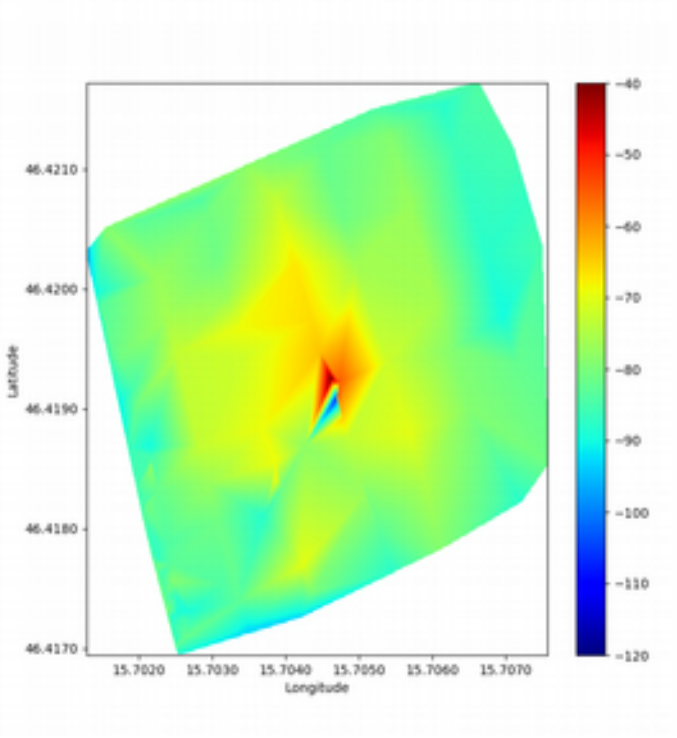
Use-case: Radiation pattern



50m above ground

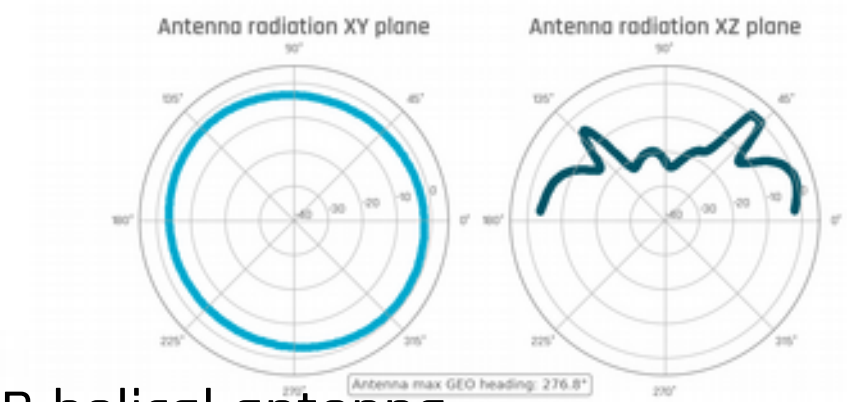


25m above ground

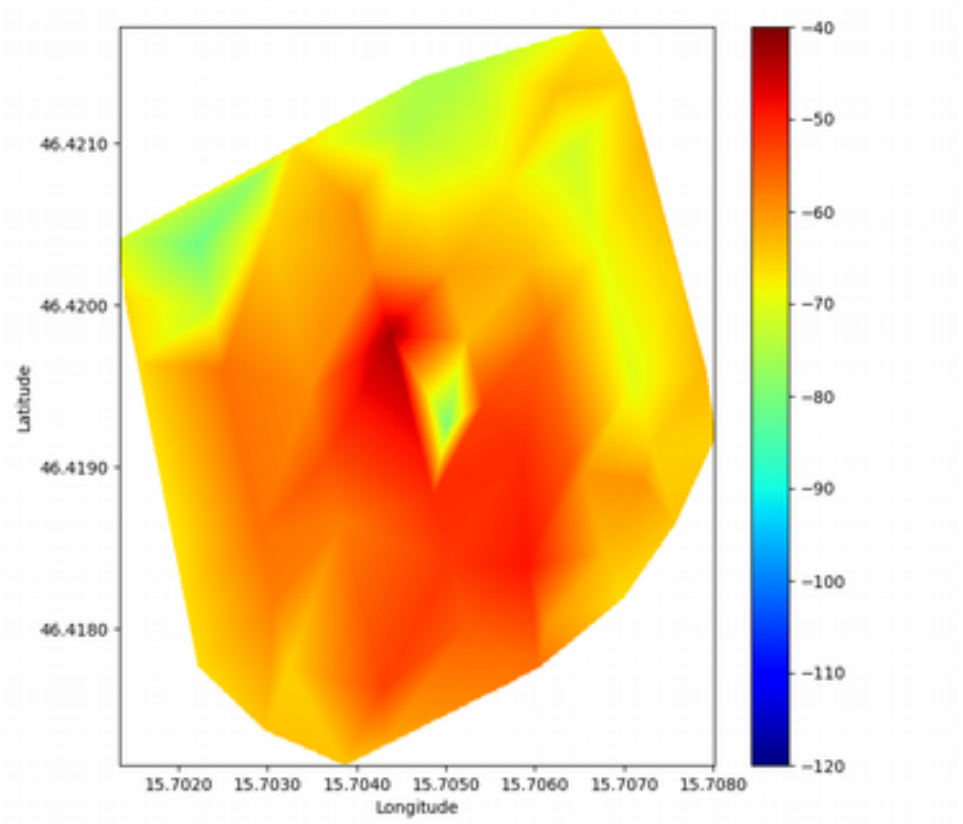


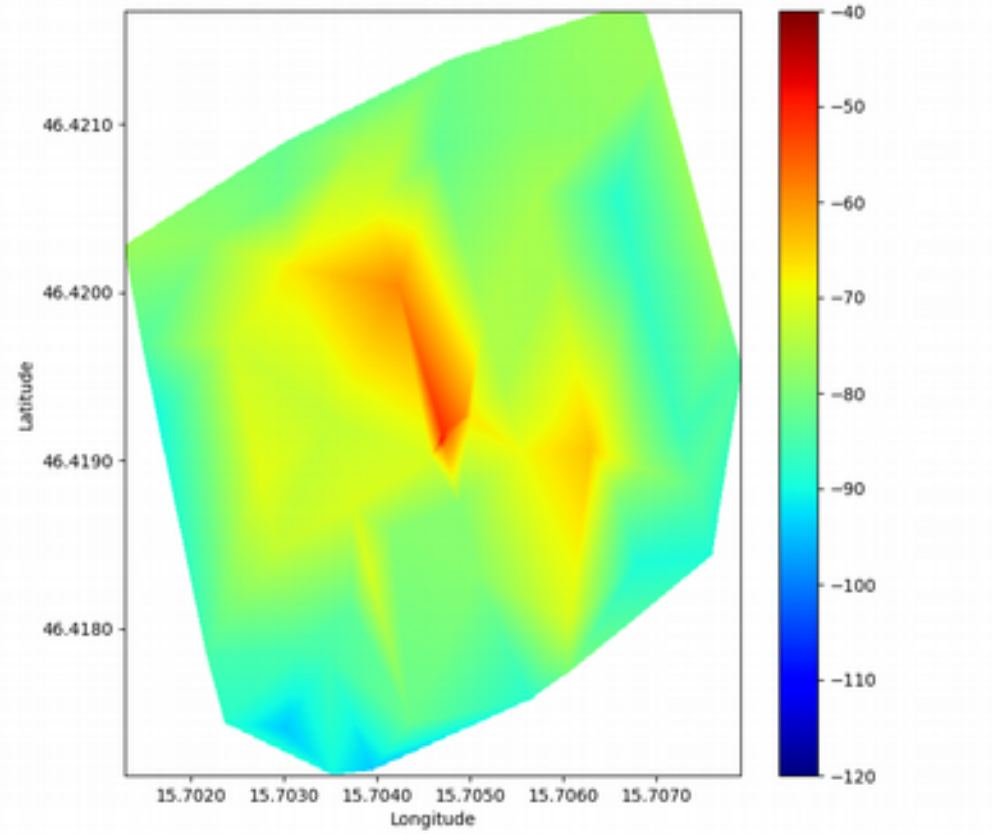
2m above ground

Use-case: Compare antennas

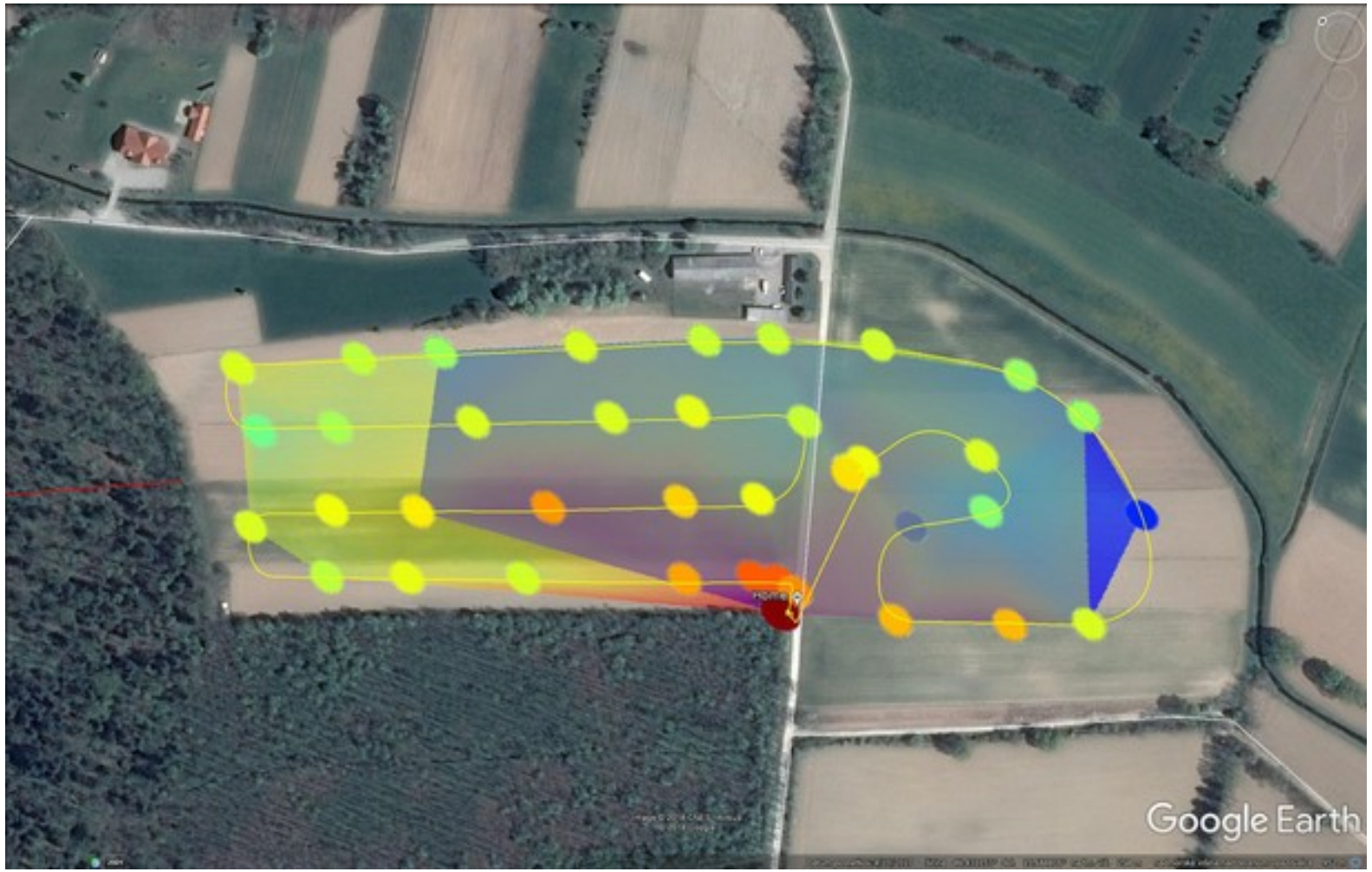


3dB ANT-8WHIP3H-SMA omni vs non-name 0dB helical antenna

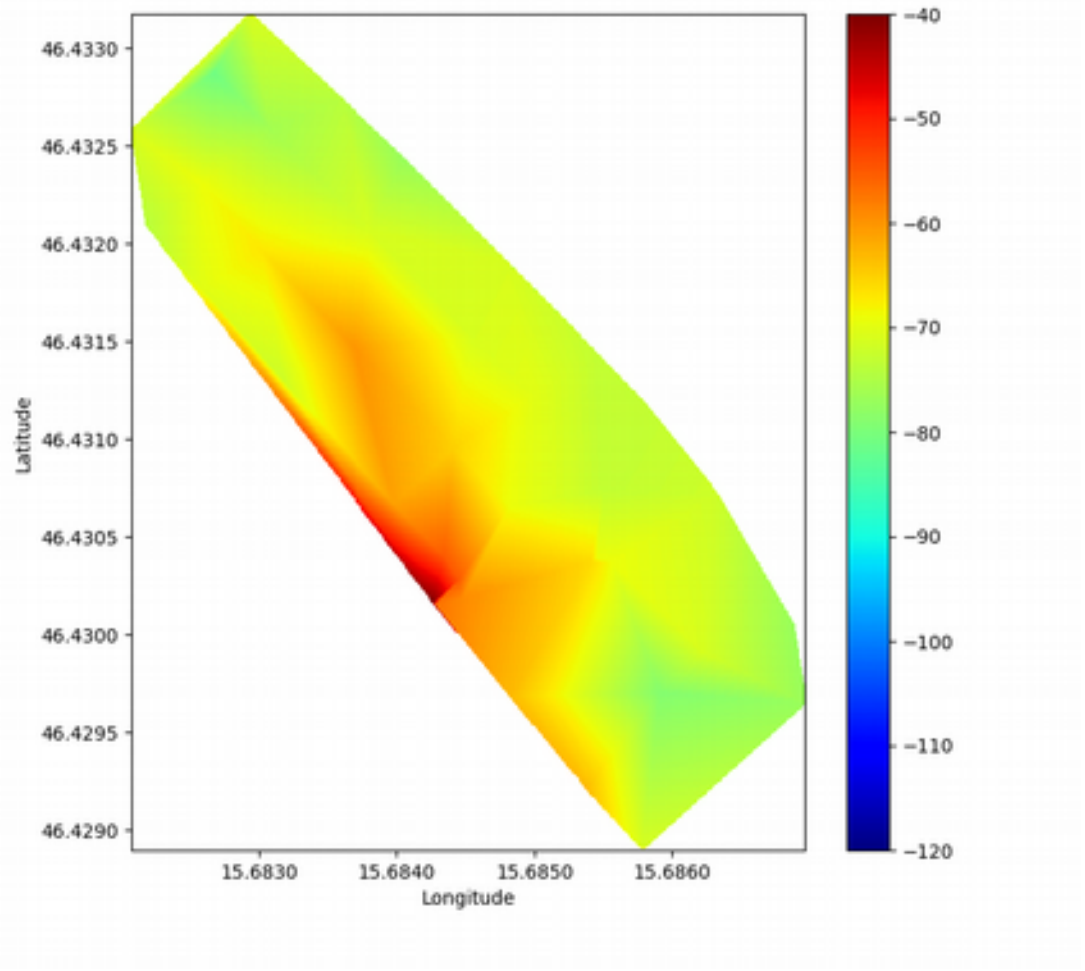




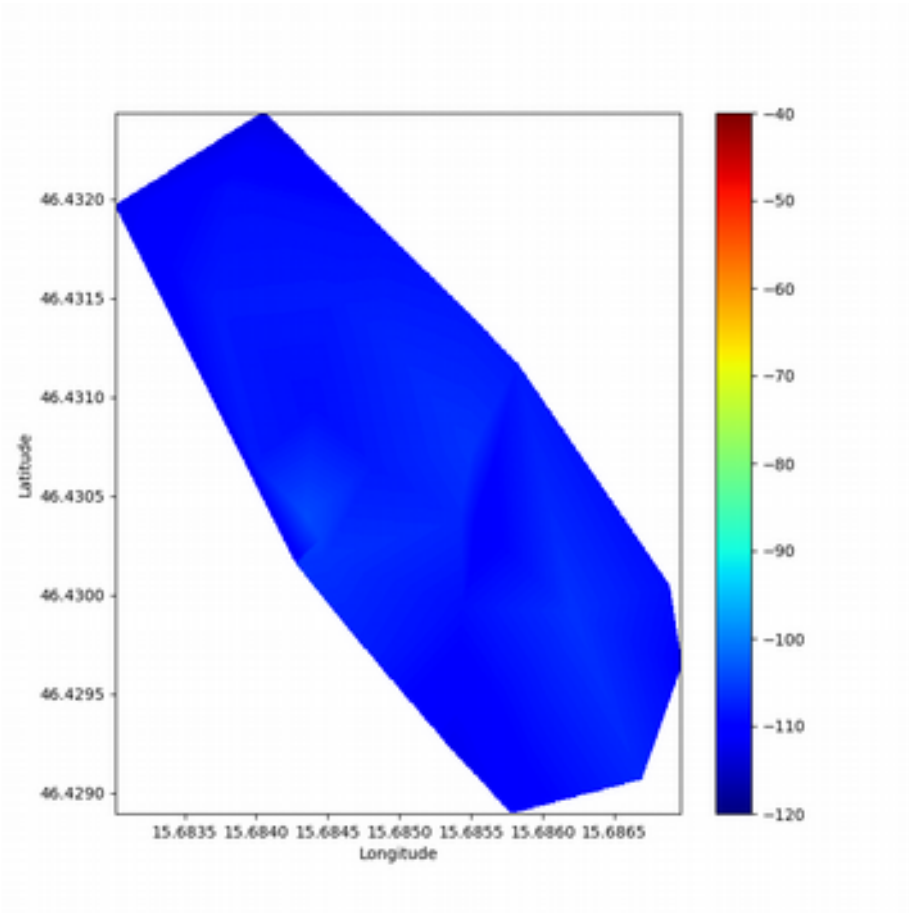
Use-case: Forrest shadowing



Use-case: Compare coverage of gateways

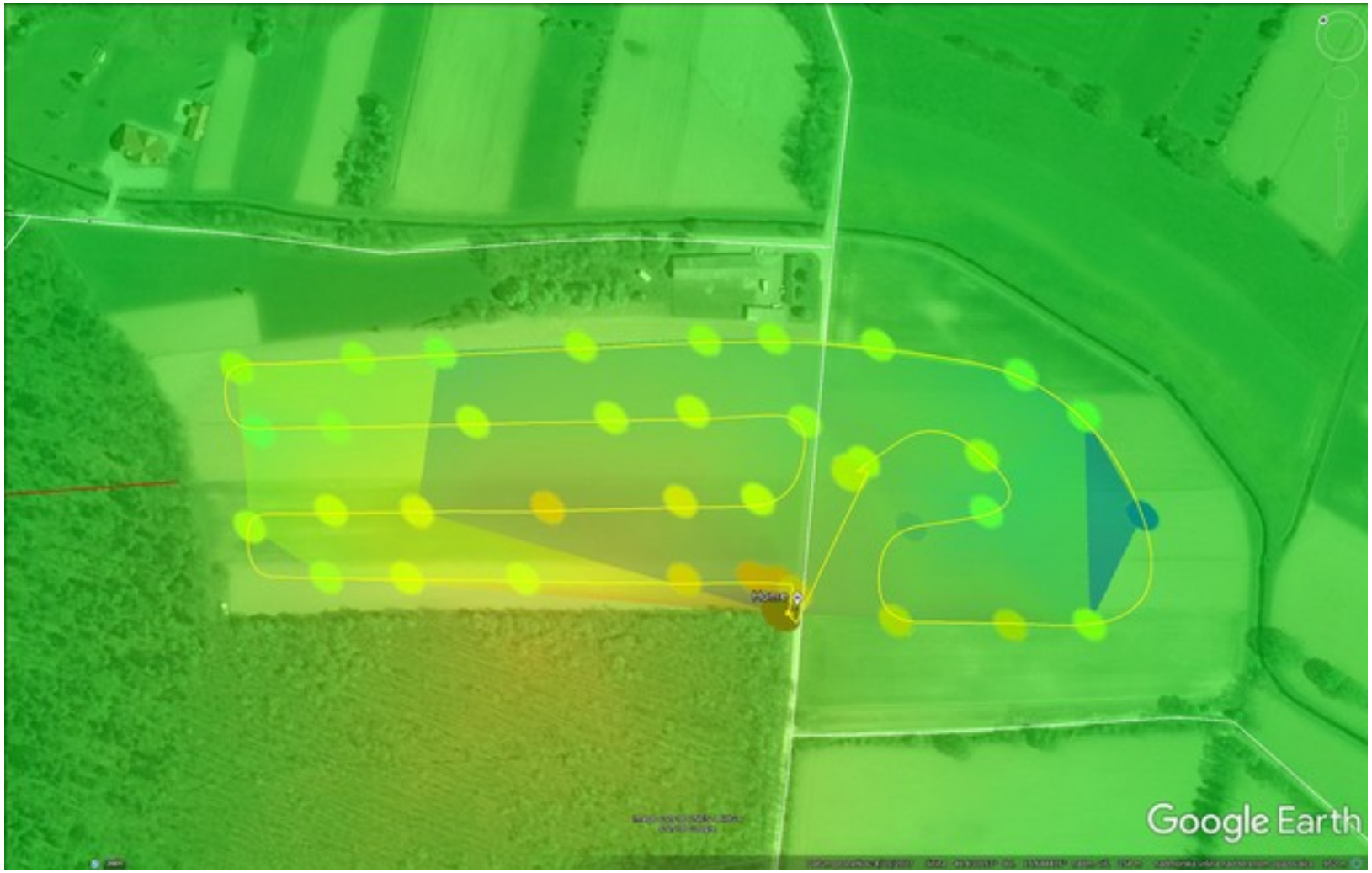


Local GW



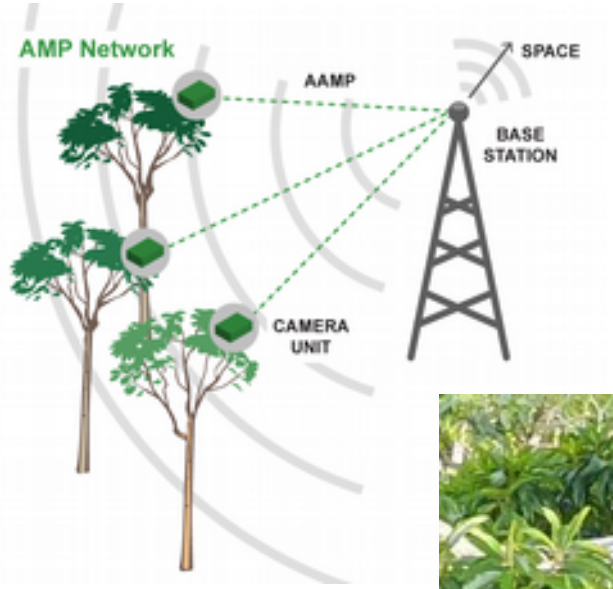
10km from GW

Use-case: Forrest shadowing + RadioMobile



Tropical forrest: Arboreal monitoring

- Connecting cameras in the trees
- Field-of-view of base-station
- Signal strength at tree-height
  - Hike through the forrest
  - Fly the drone to target height
  - Fly close to the cannopy



Principe island: Green Sea turtle monitoring

Principe island: Green Sea turtle monitoring

Experience from on-site work

- Base-station height is limited
  - Heighest tree within 100m of nearest power
  - Pole/tower is unlikely
  - Uplink WiFi/3G if lucky, else satellite
- Health/safety limitation
  - Avoid climbing
  - Minimize dependency on specialized team
- Time-effective deployment
  - Useful function performed offline on all devices
  - Connectivity/managament is enhancement

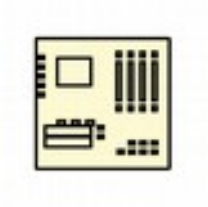
Upcoming projects/sites

- Solar powered TTN Gateway
  - RAK831 + 3G + RPi Zero W
  - 100W solar panel
- PiRa Zero Smart
  - RPi power scheduling
  - BLE interface through Blynk
  - Simple customized devices
- Arribada PitStop tag development
  - Fast-lock GPS + Lora
  - Next generation

Work with us

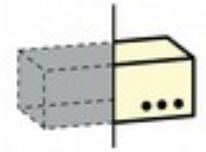
0. Consulting and product conception

1. Experimental testing

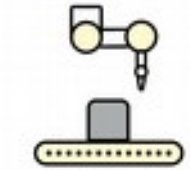


2. Custom electronics design and development

3. Custom mechanical and software design and development



4. Rapid prototyping



5. Manufacturing of products

6. Product testing

Thank you!

Connect

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