RADIUS
No. 101004192

Project overview

Fabio Scarpa
Hitachi Rail

HITACHI
Inspire the Next

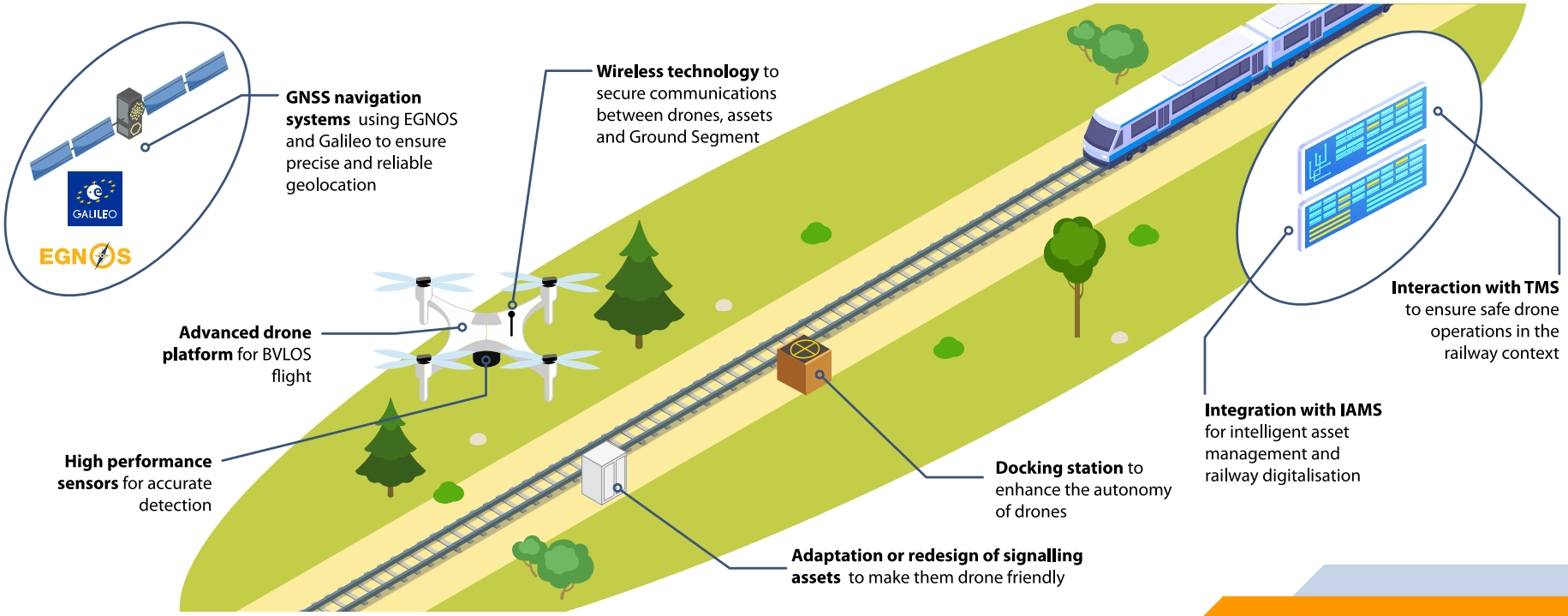
The railway maintenace challenge

There is currently **no optimal** solution to inspect, monitor and maintain railway signalling assets

That is why **RADIUS** proposes a completely **new paradigm**

RADIUS will design, develop, test and demonstrate a **complete monitoring and maintenance system** using unmanned aerial systems (**UAS**)

RADIUS objectives



Project Consortium

PROJECT COORDINATOR

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ARTIFICIAL INTELLIGENCE & DATA ANALYTICS
[ZenaByte]

EUROUSC
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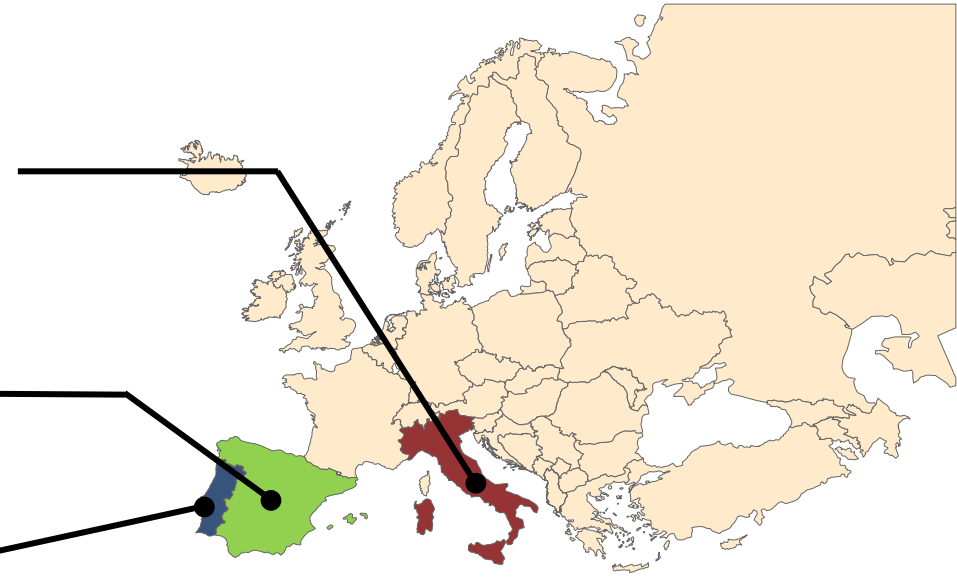
TECHNOLOGIES



Infraestruturas de Portugal

Point of View of an Infrastructure Manager

Luís Mestre
Infraestruturas de Portugal, IP SA

Infraestruturas de Portugal
Ligamos destinos

IP Rail Network

Signalling

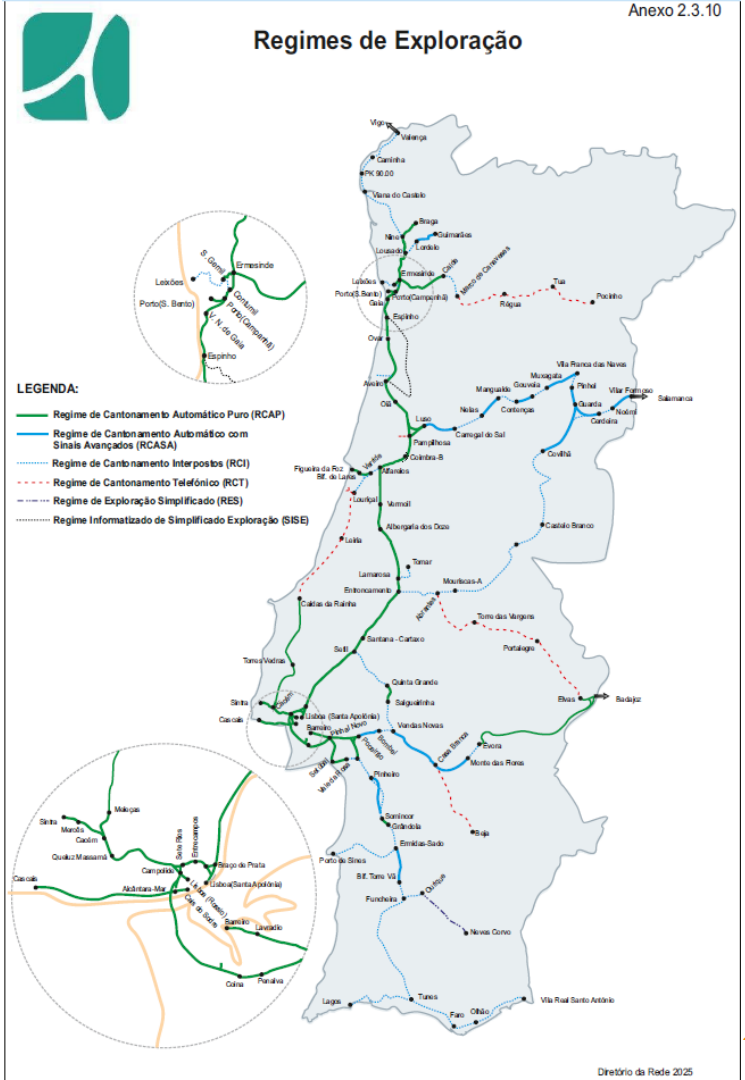
Electronic Interlockings – 2 079 Km
Mechanical Interlockings – 447 Km
TOTAL – 2 526 Km

(source: IP - Network Statement 2025)

Level Crossings

Road LCs – 696
Automatic (410)
Footpath LCs – 129
Automatic (41)
TOTAL – 825

(source: IP-ICET-150 2024-02)



Turnouts

Electric drive – 1981
Manual drive – 820
TOTAL – 2 801

(source: IP-DAM backlog-2023

Maintenance of Signaling Assets (including LCs)

- MPS – Systematic Preventive Maintenance
- MPC – Condition Preventive Maintenance
- MC – Corrective Maintenance

MPS – Systematic Preventive Maintenance

Monthly inspections by foot walking, with a team of at least 3 workers, inspecting every asset on the wayside.

Major constraints:

- Highly restrictive safety measures, depending on traffic.
- Some activities only possible overnight.
- High risk of safety and health hazards.
- Difficult road access on many sections of line.
- Manpower intensive activities.

MC – Corrective Maintenance

Emergency Maintenance Teams

- Availability: 24/7/365
- service level: 60mn

Major constraints:

- Poor knowledge of the faulty asset or it’s failure mode.
- Lack of adequate tools or spares on the maintenance support vehicles.
- Difficult road access on many sections of line.

The Future – Drone Inspection and Maintenance?

What we get:

Less:

- Manpower on the wayside.
- On foot inspections.
- Health hazards.
- Time to repair failures.
- Track possession time.

More:

- Accurate data on assets.
- Faster identification of faults.
- Availability of the track for business.
- Knowledge on assets condition.
- Information for predictive maintenance.

The Future – Drone Inspection and Maintenance?

And Beyond just Signalling Assets…

Obstacles

Track

Trespassing

Catenary

Vegetation growth

Project timeline

Manuel Oñate
EuroUSC España, S.L.

RADIUS WAS PRESENT IN INNOTRANS 2024 IN BERLIN ON SEPTEMBER 2024

Radius Timeline

January 2021
Project start
Kick-off meeting

August 2021
System and architecture specification

April 2022
Initial release of the RADIUS payload components

June 2022
Initial release of the UAS prototype, ready to be tested

September 2022
First version of redesigned signalling assets and docking station

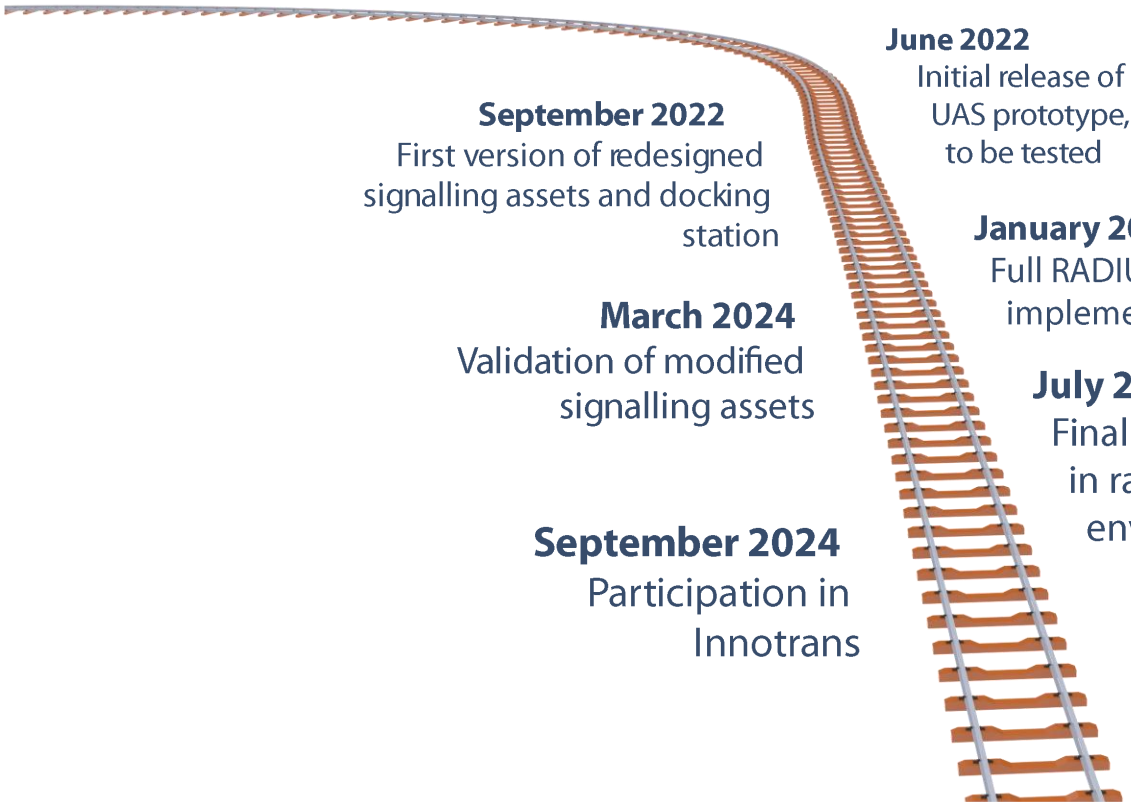
January 2024
Full RADIUS implementation

March 2024
Validation of modified signalling assets

July 2024
Final demonstration in railway relevant environment

September 2024
Participation in Innotrans

October 2024
Project end



Radius Benefits

More frequent inspections

Increasing the frequency of inspections means that preventive measures that increase the life span of signalling assets can be used

Cost reduction

The RADIUS system is easier to use, reducing the initial investment as well as the running costs to maintain railway infrastructures

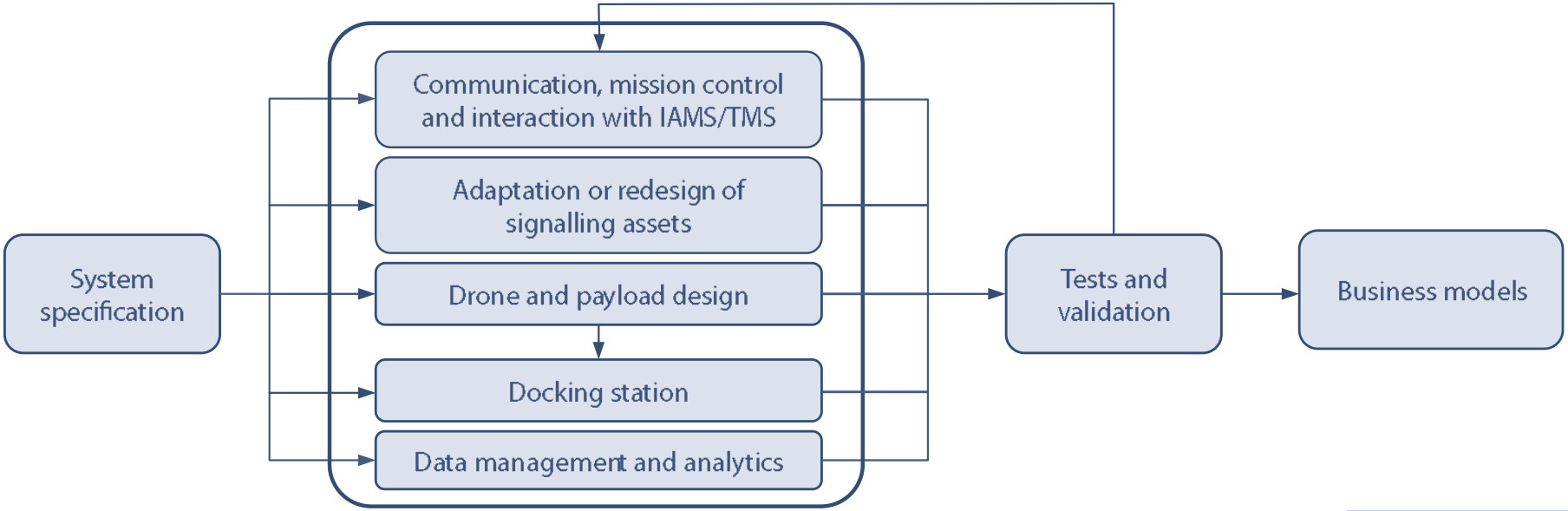
Safety increase

RADIUS will increase the safety of the maintenance operations and also the operational safety of the railways

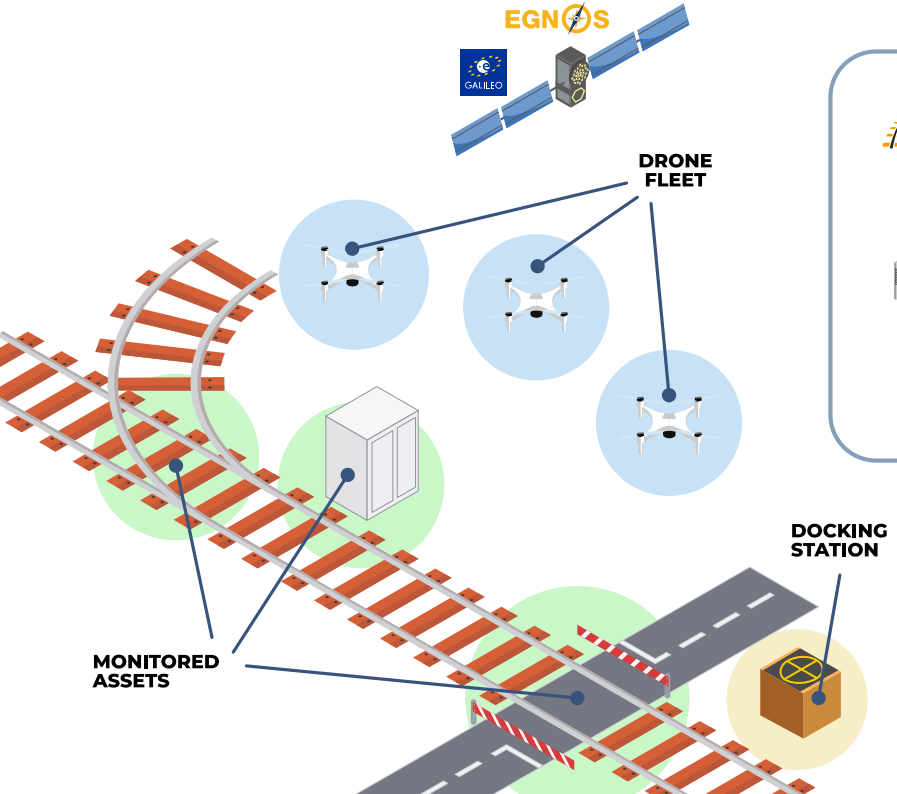
New business models

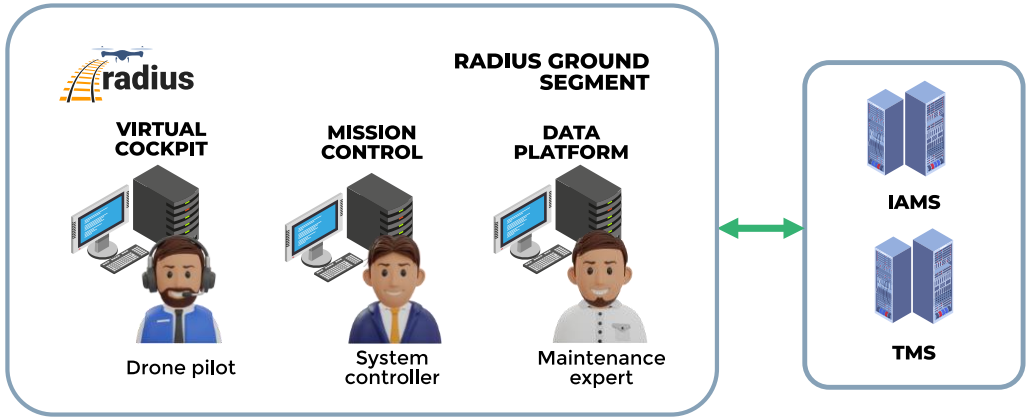
The RADIUS concept can be extended to other activities and markets, creating new service provision business models

Project methodology



Architecture





Data analytics

Carlo Dambra
ZenaByte s.r.l.

ARTIFICIAL INTELLIGENCE & DATA ANALYTICS
[ZenaByte]

The problem

- Visually inspect fundamental railway assets from UAV in an automated way using state-of-the-art Machine Learning approaches
- Cover those monitoring aspects not covered by signalling
- Integrate results with intelligent asset management
- The work was focused particularly on three main assets/use cases:
  - the detection of anomalies in cabinets,
  - the visual check of the correct functioning of light signals, and
  - the identification of missing bolts in switches

Data acquisition

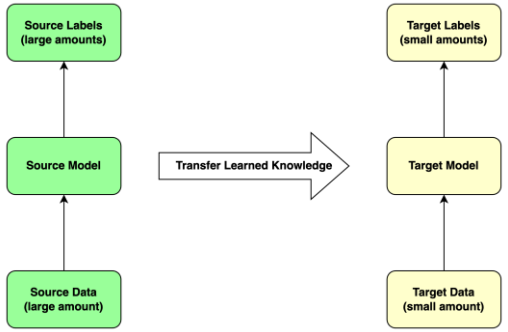
Cabinets

Switches

Light signals

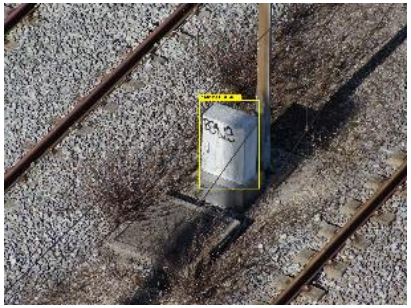
The approach

- Using Convolutional Neural Networks
- Leveraging Transfer Learning, i.e., the idea of exploiting pre-trained models and adapt them on new, but related, tasks
- Exploiting
  - YOLO open-source computer vision model and
  - ResNet18 convolutional neural network



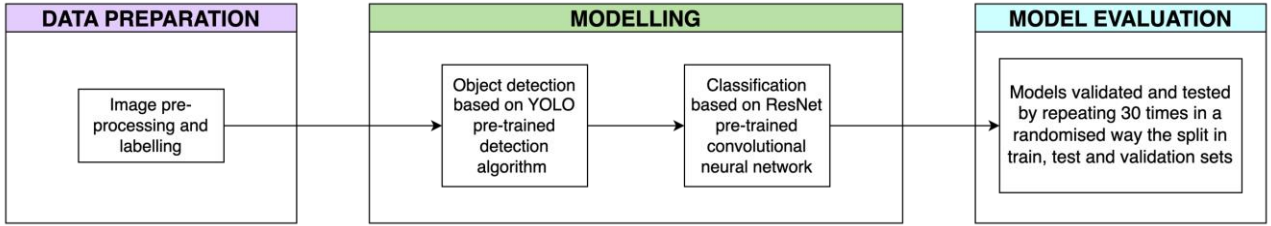
The pipeline: cabinets

Object detection



Classification

Anomalous

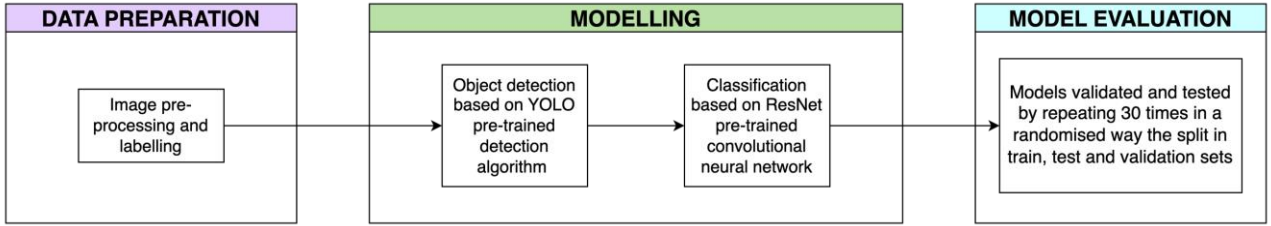


The pipeline: light signals

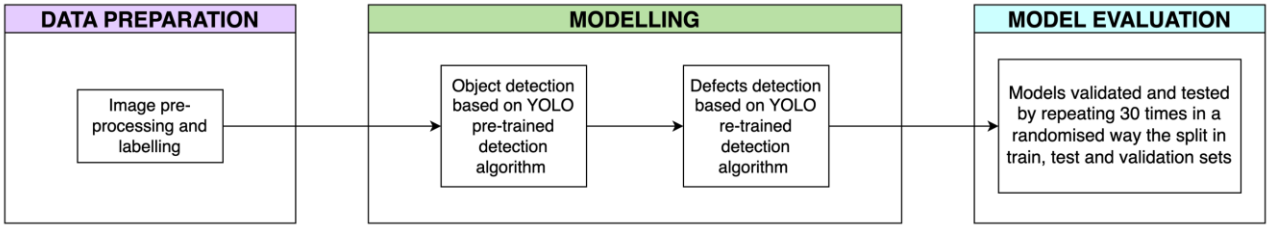
Object detection

Classification

ON



The pipeline: switches



Accuracy of results

	Accuracy	False Positives	False Negatives
Cabinets identification	97% ± 1.2%	1.5% ± 0.7%	1.5% ± 0.7%
Cabinets classification	90% ± 1.6%	6.0% ± 1.4%	4.0% ± 0.8%
Light signals identification	98% ± 1.3%	1.2% ± 0.9%	0.8% ± 1.0%
Light signals classification	90% ± 3.1%	4.5% ± 1.5%	5.5% ± 2.4%
Missing bolt detection in switches	93% ± 2.4%	4.0% ± 1.7%	3.0% ± 1.4%

Issues

- The following issues have been faced:
  - Shadows
  - Objects covering the asset
  - Light-conflicting perspective
  - Assets needing almost 360° inspection

RADIUS and IAM4RAIL (Europe's Rail)

RADIUS results can be easily integrated in the IAM4RAIL Conceptual Data Model (CDM)

Asset	Variable	Format	Notes
Cabinet	Position	Geographical coordinates	With this information it is possible to support asset management by • mapping cabinets • identifying possible anomalies in cabinets
	Status	Binary: ok, anomaly	
	Timestamp	Time	
Light signal	Status	Binary: on/off	With this information it will be possible to compare the collected status with the expected status and identify possible anomalies.
	Timestamp	Time	
Switch	Position	Geographical coordinates	With this information it is possible to identify possible anomalies in tracks or switches and intervene accordingly.
	Status	Binary: ok, anomaly	

Conclusions

- The main lessons learnt during this work are:
  - The results are extremely promising considering the extremely high accuracy achieved for the target assets and the challenging condition posed by the acquisition from drones.
  - The acquisition of images with drones requires attention on the relative position of the drone with respect to the asset under consideration, the lighting of the scene to avoid as much as possible the shadowing effects.
- In general, future research may aim at
  - Enlarging the number of the available defects (e.g., vegetation over the rail, obstacles in the switch action or real defective fasteners) would increase both the completeness and the accuracy of the visual inspection, making it effective for a more exhaustive set of problems.
  - Integrating other use cases and enriching the existing ones with data enabling more custom solutions.
- The results may constitute a very promising starting point for future research in the field.

Drone - friendly Signalling Asset Prototype

Davide Barbato
Hitachi Rail STS

Introduction

This project aims to integrate **Unmanned Aerial Systems** (UAS) technology into **railway** operations to enhance infrastructure surveillance and gather unique data while maintaining the reliability, availability, maintainability, and safety of existing systems.

The test aims to demonstrate the feasibility of an **innovative architecture** that integrates a **drone** with an on-board PC to automate the **communication and data collection process** for a railway asset.

Using UAS technology can offer significant benefits for the railway sector:

- *Automated Asset Recognition*
- *Real-time Data Collection*
- *Predictive Maintenance*

Test case definition

Below are the **steps** of the defined test case:

Inputs	GNSS coordinates on railway asset location, SSID and password of local network
Step 1	The drone with the onboard computer is placed at a distance greater of several meters from the railway asset.
Step 2	The drone takes off and approaches the local diagnostic node.
Step 3	The drone waits at least five minutes in the air at a close distance from the local diagnostic node.
Step 4	The onboard computer in this time frame connects to the local diagnostic node and downloads the data generated by the railway asset.
Step 5	The drone returns to the starting point and lands.
Outputs	Log file containing flight information, data downloaded to the on-board computer.

Standards, norms and regulations

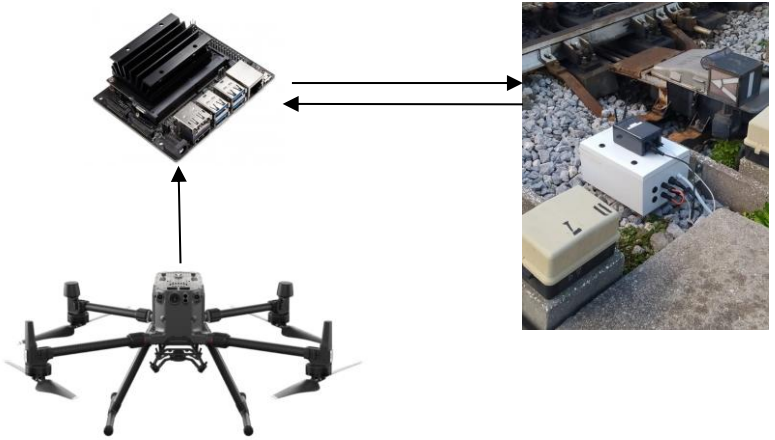
Commission Implementing Regulation EU 2019/947 classifies UAS operation in **3 categories** (open, specific and certified) based on the **level** of the **risk** posed by the operation itself:

- **Open** category: includes low risk operations, for this reason it is not necessary any prior operational authorisation nor an operational declaration by the UAS operator before conducting the operation;
- **Specific** category: includes medium risk operations, in this case an operational authorisation issued by the competent authority is required, after having performed a risk assessment;
- **Certified** category: includes high risk operations, the UAS must be certified, the remote pilot must be licensed and the operator must be approved by the competent authority.

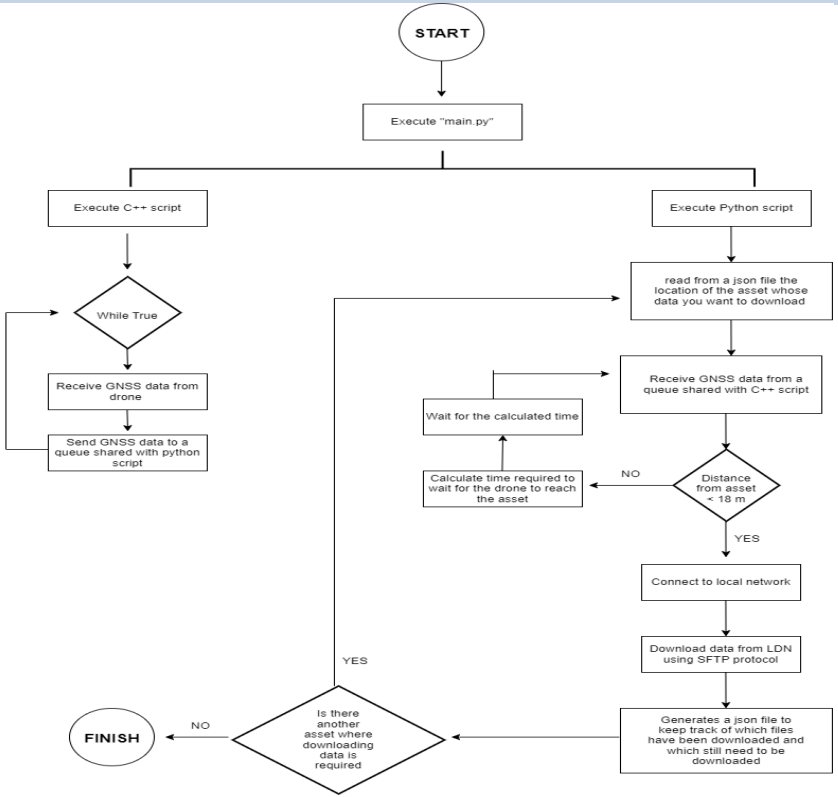
Architectural Overview

Below are the main components used to carry out the test:

- DJI Matrix 300: commonly referred to as the M300, is a commercial drone developed by DJI, intended for professional and industrial applications.
- Nvidia Jetson Nano Developer Kit: serves as the central hub for processing and managing data within the Drone-Friendly Signalling Asset Prototype.
- Local Diagnostic Node (LDN): a system designed to obtain the continual collection and transmission of data from various monitored systems. In the case under examination, a switch point was used.



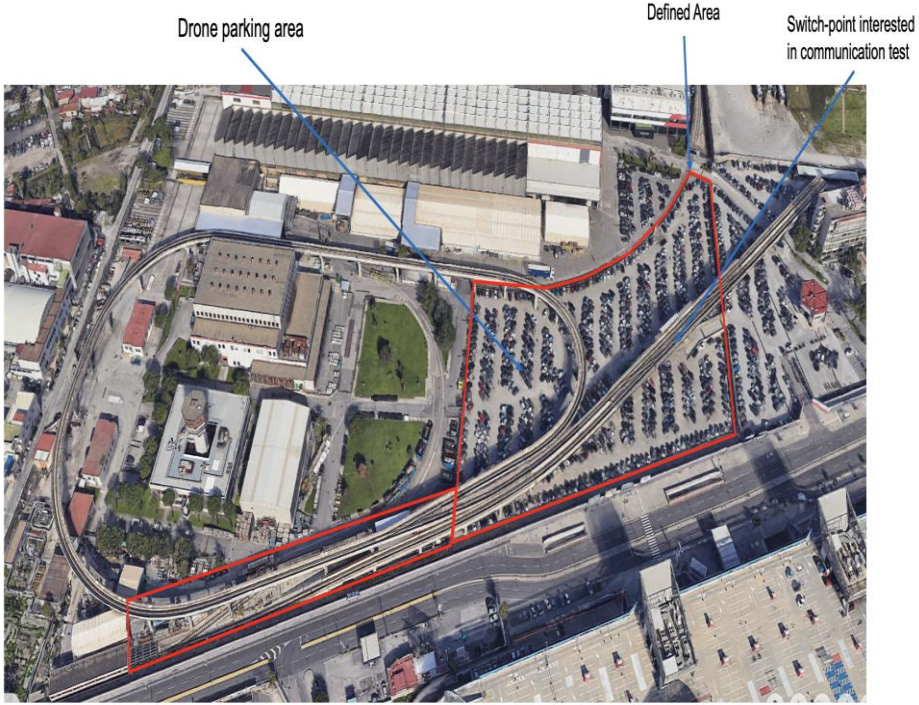
Software Workflow on On Board PC



On the left we can see the software workflow that allows us to communicate and collect data from the railway asset to the on board PC.

Definition of the flight area

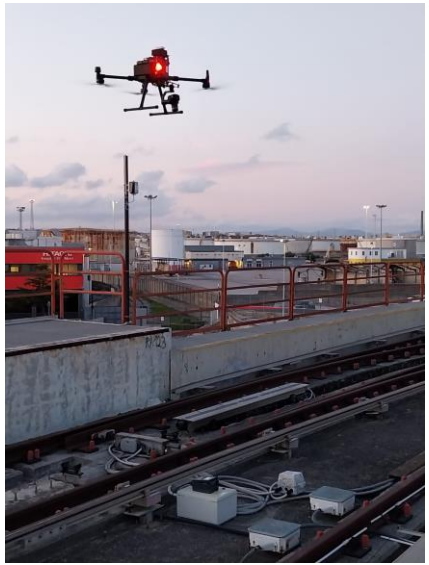
Below is shown on the left the test area delimited for the flight while on the right is shown the drone's starting point with the nano jetson as payload.



Secure communication between drone and asset (1/2)

For each flight, a log file is automatically generated in which the operations performed are described. Each operation is associated with the date and time at which it is carried out.

Below is an image of when the drone approaches the asset and the associated logs.



```
2024-03-23 18:24:56 - root - INFO - C++ subprocess started with PID: 7633
2024-03-23 18:24:56 - root - INFO - Python subprocess started with PID: 7635
2024-03-23 18:25:00 - root - INFO - Received GNSS data: 0Latitude: 40.851654, Longitude: 14.310908, Altitude: -48.330395
2024-03-23 18:25:00 - root - INFO - Coordinates of the asset to be achieved: (40.8514, 14.311054, -42)
2024-03-23 18:25:00 - root - INFO - [MAIN] The drone is at 31.441492188158705 meters from the asset.
2024-03-23 18:25:00 - root - INFO - [MAIN] Waiting 2.0751384844184746 seconds until the next check.
```

```
2024-03-23 18:27:31 - root - INFO - [MAIN] The drone is at 18.966626916307824 meters from the asset.
2024-03-23 18:27:31 - root - INFO - [MAIN] Waiting 1.2517973764763164 seconds until the next check.
2024-03-23 18:27:33 - root - INFO - Received GNSS data: 75Latitude: 40.851532, Longitude: 14.310962, Altitude: -35.626938
2024-03-23 18:27:33 - root - INFO - Coordinates of the asset to be achieved: (40.8514, 14.311054, -42)
2024-03-23 18:27:33 - root - DEBUG - [MAIN] Searching asset network to connect...
2024-03-23 18:28:02 - root - DEBUG - [CHECK] Start...
2024-03-23 18:28:02 - root - DEBUG - [DOWNLOAD] Try to estabilish communication with asset.....
2024-03-23 18:28:03 - root - DEBUG - [DOWNLOAD] Connection estabilished!
2024-03-23 18:28:04 - root - INFO - Downloading file acquisition/2022-12-12/DEA13/2022-12-12_10:51:00.549944
2024-03-23 18:28:05 - root - INFO - Downloaded file acquisition/2022-12-12/DEA13/2022-12-12_10:51:00.549944 with dimensions 330.244 Kb
2024-03-23 18:28:05 - root - INFO - Downloading file acquisition/2022-12-12/DEA13/2022-12-12_11:00:25.665497
2024-03-23 18:28:06 - root - INFO - Downloaded file acquisition/2022-12-12/DEA13/2022-12-12_11:00:25.665497 with dimensions 624.573 Kb
2024-03-23 18:28:06 - root - INFO - Downloading file acquisition/2023-01-24/DEA13/2023-01-24_12:43:04.789893
2024-03-23 18:28:07 - root - INFO - Downloaded file acquisition/2023-01-24/DEA13/2023-01-24_12:43:04.789893 with dimensions 532.487 Kb
2024-03-23 18:28:07 - root - INFO - Downloading file acquisition/2023-01-30/DEA13/2023-01-30_12:03:47.272635
2024-03-23 18:28:07 - root - INFO - Downloaded file acquisition/2023-01-30/DEA13/2023-01-30_12:03:47.272635 with dimensions 180.222 Kb
2024-03-23 18:28:07 - root - INFO - Downloading file acquisition/2023-03-30/DEA13/2023-03-30_15:41:59.848424
2024-03-23 18:28:08 - root - INFO - Downloaded file acquisition/2023-03-30/DEA13/2023-03-30_15:41:59.848424 with dimensions 302.448 Kb
2024-03-23 18:28:08 - root - INFO - Downloading file acquisition/2023-03-30/DEA13/2023-03-30_16:07:31.557976
2024-03-23 18:28:08 - root - INFO - Downloaded file acquisition/2023-03-30/DEA13/2023-03-30_16:07:31.557976 with dimensions 337.878 Kb
2024-03-23 18:28:08 - root - INFO - Downloading file acquisition/2023-03-30/DEA13/2023-03-30_16:52:07.865886
2024-03-23 18:28:08 - root - INFO - Downloaded file acquisition/2023-03-30/DEA13/2023-03-30_16:52:07.865886 with dimensions 370.724 Kb
2024-03-23 18:28:08 - root - INFO - Downloading file acquisition/2023-03-30/DEA13/2023-03-30_17:13:05.152725
2024-03-23 18:28:08 - root - INFO - Downloaded file acquisition/2023-03-30/DEA13/2023-03-30_17:13:05.152725 with dimensions 338.259 Kb
2024-03-23 18:28:08 - root - INFO - Downloading file acquisition/2023-03-30/DEA13/2023-03-30_17:44:21.259726
2024-03-23 18:28:09 - root - INFO - Downloaded file acquisition/2023-03-30/DEA13/2023-03-30_17:44:21.259726 with dimensions 305.16 Kb
2024-03-23 18:28:09 - root - INFO - Downloading file acquisition/2023-03-30/DEA13/2023-03-30_17:49:13.536041
2024-03-23 18:28:09 - root - INFO - Downloaded file acquisition/2023-03-30/DEA13/2023-03-30_17:49:13.536041 with dimensions 340.841 Kb
```

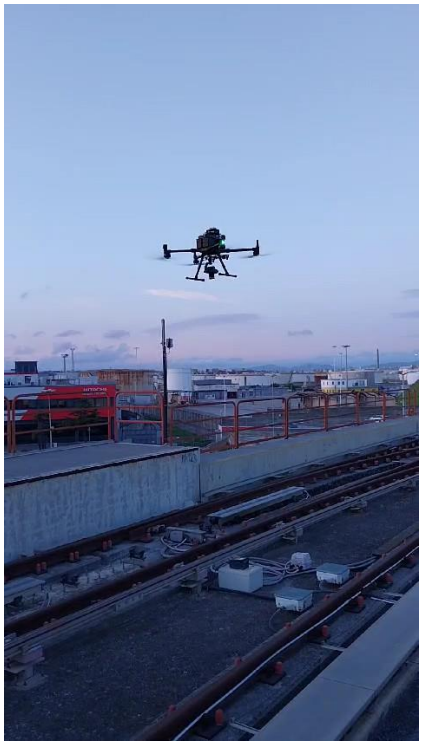
Secure communication between drone and asset (2/2)

At the end of the data download, information is reported on the total amount of data downloaded and the time taken for the download. As a final step, the script keeps track of all downloaded data and prepares to download data from the next asset.

```
2024-03-23 18:28:09 - root - INFO - Downloading file acquisition/2023-03-30/DEA13/2023-03-30_17:49:13.536041
2024-03-23 18:28:09 - root - INFO - Downloaded file acquisition/2023-03-30/DEA13/2023-03-30_17:49:13.536041 with dimensions 340.841 Kb
2024-03-23 18:28:09 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_07:23:42.798321
2024-03-23 18:28:12 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_07:23:42.798321 with dimensions 345.402 Kb
2024-03-23 18:28:12 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_07:44:17.388961
2024-03-23 18:28:13 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_07:44:17.388961 with dimensions 306.829 Kb
2024-03-23 18:28:13 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_08:31:35.027236
2024-03-23 18:28:13 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_08:31:35.027236 with dimensions 341.42 Kb
2024-03-23 18:28:13 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_09:48:25.132567
2024-03-23 18:28:13 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_09:48:25.132567 with dimensions 297.902 Kb
2024-03-23 18:28:13 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_10:32:28.925261
2024-03-23 18:28:14 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_10:32:28.925261 with dimensions 339.427 Kb
2024-03-23 18:28:14 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_10:54:56.977248
2024-03-23 18:28:14 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_10:54:56.977248 with dimensions 299.889 Kb
2024-03-23 18:28:14 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_11:23:55.126845
2024-03-23 18:28:15 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_11:23:55.126845 with dimensions 340.141 Kb
2024-03-23 18:28:15 - root - INFO - Downloading file acquisition/2023-03-31/DEA13/2023-03-31_11:52:30.455223
2024-03-23 18:28:16 - root - INFO - Downloaded file acquisition/2023-03-31/DEA13/2023-03-31_11:52:30.455223 with dimensions 339.114 Kb
2024-03-23 18:28:16 - root - INFO - Downloading file acquisition/2024-01-30/file_grande_1.pdf
2024-03-23 18:28:17 - root - INFO - Downloaded file acquisition/2024-01-30/file_grande_1.pdf with dimensions 4313.204 Kb
2024-03-23 18:28:17 - root - INFO - Downloading file acquisition/2024-01-30/file_grande_2.pdf
2024-03-23 18:28:19 - root - INFO - Downloaded file acquisition/2024-01-30/file_grande_2.pdf with dimensions 4313.204 Kb
2024-03-23 18:28:19 - root - DEBUG - [DOWNLOAD] sending killing process 'checkwifistatus'
2024-03-23 18:28:19 - root - INFO - Total dimension of downloaded files: 14899.368 Kb
2024-03-23 18:28:19 - root - DEBUG - [MAIN] Check Download started
2024-03-23 18:28:19 - root - INFO - Total time for downloading: 15.544472932815552 s
2024-03-23 18:28:19 - root - DEBUG - [MAIN] Kill download entered
2024-03-23 18:28:22 - root - DEBUG - [MAIN] Killed child processes, updating asset coords file to True for the asset: asset1
```

Running the test

- In the video you can see the test carried out in Naples on the test track.
- You can see how the drone is near the local diagnostic node and then prepares to return to the drone parking area



UAS flight authorizations: obstacles and challenges

Sara Molinari
EuroUSC Italia

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Index

- EU Regulatory framework
- Open category: obstacles and challenges for infrastructure monitoring operations
- Specific category: possible types of authorisations
- SORA methodology
- RADIUS Flight tests (Naples and Ourique)
- Potential improvements

EU UAS Regulatory Framework

Regulation (EU) 2018/1139

- solid legal basis for a common regulatory framework in Europe
- definition of rules based on the risk and performance-based approach

Commission Delegated Regulation (EU) 2019/945

- requirements related to the design and manufacturer of UA
- UAS requirements related to safety, privacy, personal data, security and environment

Commission Implementing Regulation (EU) 2019/947

- rules and procedures for the UAS operations
- provisions for personnel, including RP and organizations, involved in UAS operations
- category of UAS operations: Open, Specific, Certified

Commission Implementing Regulation (EU) 2019/947

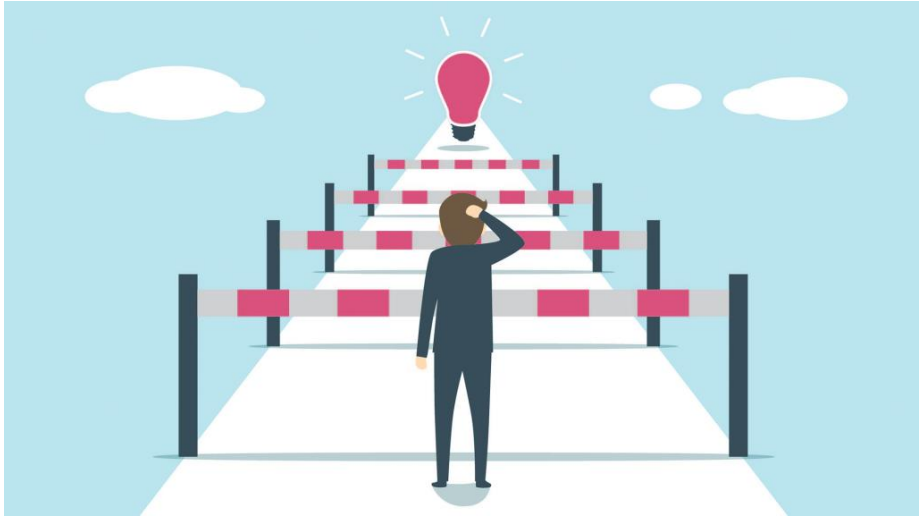
Principle of proportionality: each category is associated to a given risk level and is regulated by a different set of limitations/requirements.

Limitations	OPEN (low risk)	SPECIFIC (medium risk)	CERTIFIED (high risk)
MTOM (kg)	< 25 kg	No limitations	No limitations
Flight conduction	VLOS	VLOS / BVLOS	VLOS / BVLOS
Max. operational height	120m (400ft) AGL	No limitations	No limitations
Fly over people assembly	Not allowed	Allowed	Allowed
Max. characteristic dimension	No limitations	< 3 m when flying over assembly of people	No limitations
Dangerous goods	Not allowed	Allowed if available a crash-proof container	Allowed
Transport of people	Not allowed	Not allowed	Allowed
Operational declaration/authorisation	Not required	Required (STS, PDRA, SORA, LUC)	Required (traditional aviation authorisation)

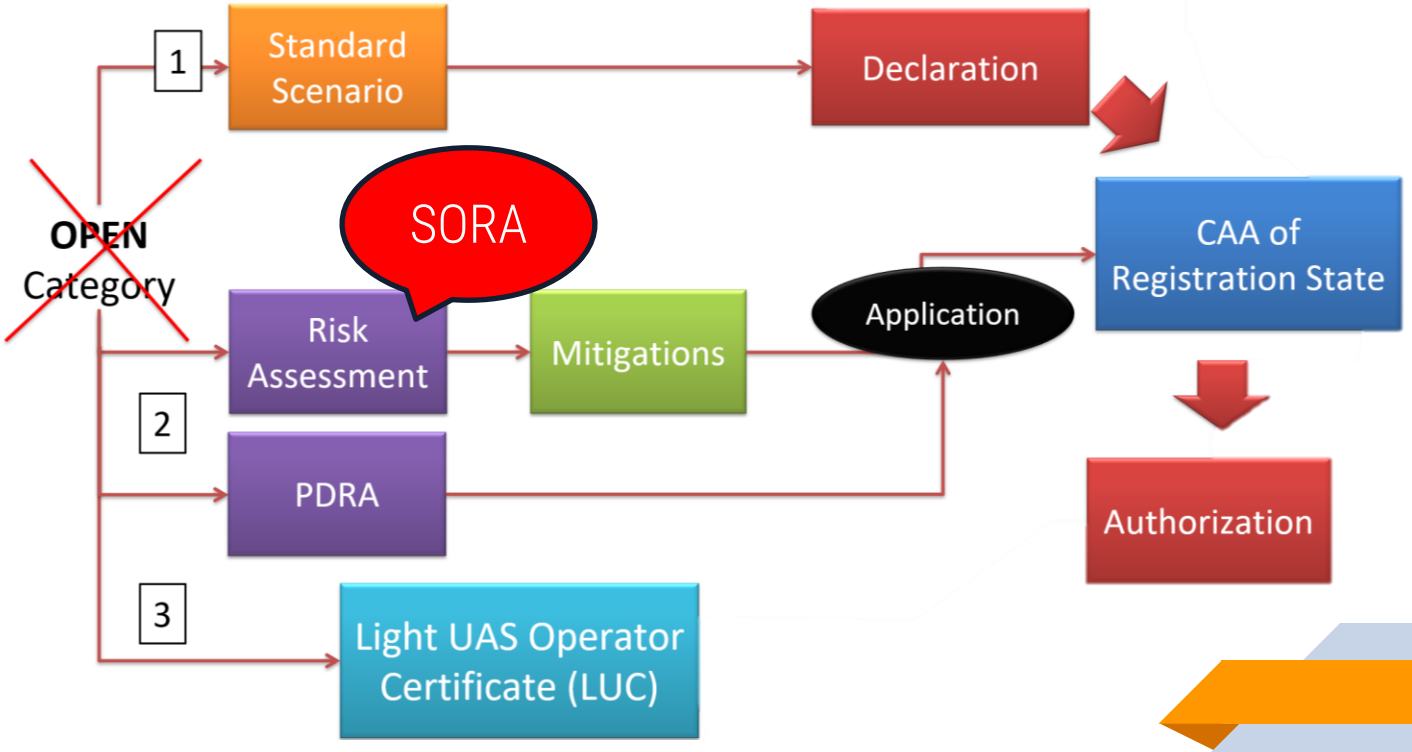
Open category: obstacles and challenges for infrastructure monitoring operations

Limitations:

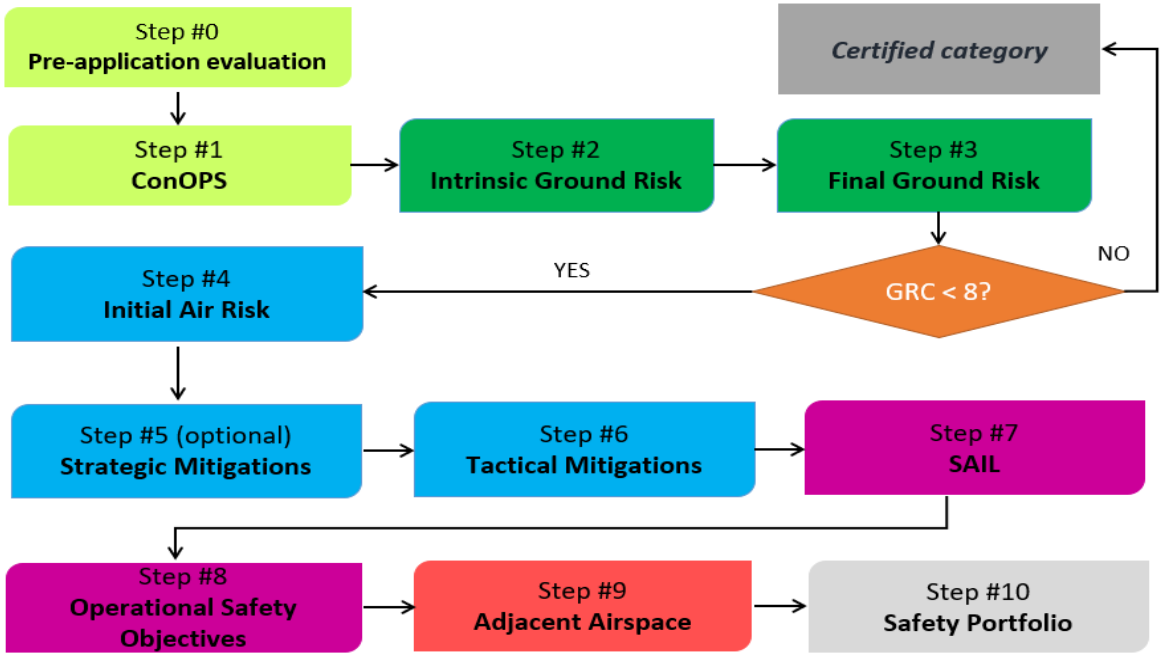
- No BVLOS operations
- No payload transport
- Small UA (i.e., reduced mass) for flying in populated areas → UA with reduced range
- CE mark and class mark



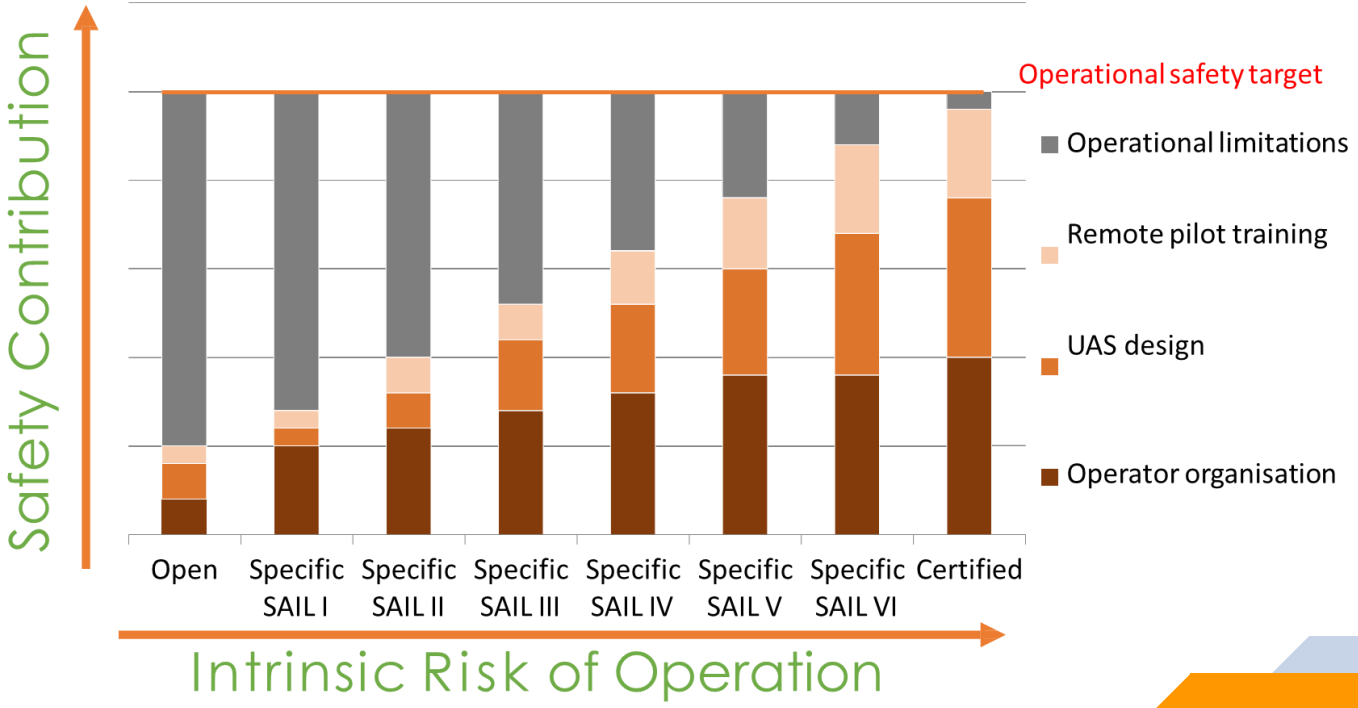
Specific category: possible type of authorisations



SORA structure



SORA concept



RADIUS flight tests: Naples (IT)

Standard Scenarios (IT-STS-01)

- VLOS flight over a controlled ground area
- h_{max} =25 m *(Flight allowed under 25 m)*
- DJI M300 RTK *(MTOM 9 kg)* - DJI MINI 3 PRO *(MTOM 0,249 kg, OPEN)*
- Payload:
  - Nvidia Jetson Nano developer board
  - LTE Dongle Modem
  - DJI Zenmuse P1 Optical Camera or DJI Zenmuse L1 Livox Lidar payload.

RADIUS flight tests: Ourique (PT)

SORA

- Sparsely populated
- H_{max} = 120 m *(OPS <150m (~500ft) AGL in uncontrolled airspace over Rural Area)*
- DJI M300 (MTOM 9 kg)

Flight authorization request was submitted 3 months before the flights. However, IP never obtain the flight authorization.

Flights were conducted in the Open category

What improvements are needed to enhance the systematic use of drones for asset monitoring?

Simplification of the authorization process:

- **Reduced Evaluation Times**: Shorten the authority's evaluation period for authorization approval.
- **Standardized Models and Documents for authorization requests**: Simplifying the approval process and creating standardized rules and documents for BVLOS operations will enable more extensive and efficient operations.
- **Cost reduction**: Reduce the costs associated with authorization fees.

Other potential improvements:

- **Training**: Operators often receive insufficient training on regulatory aspects, typically focusing first on operational needs. It is essential to provide operators with thorough training on regulatory requirements from the start to ensure they understand and adhere to these requirements.
- **Drone Certifications**: The market currently lacks drones that meet necessary reliability standards and certifications (DVR). There is a need for certified drones that fulfill these reliability requirements to enhance safety and compliance in operations.

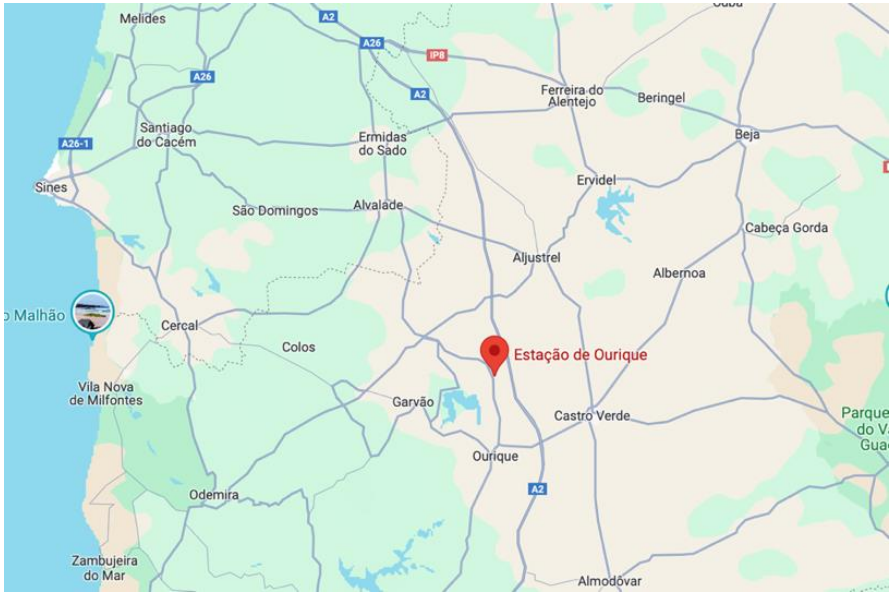
Final Demonstration
Ourique, Portugal

Pedro Ribeiro
EVOLEO Technologies, Lda.

Final Demonstration

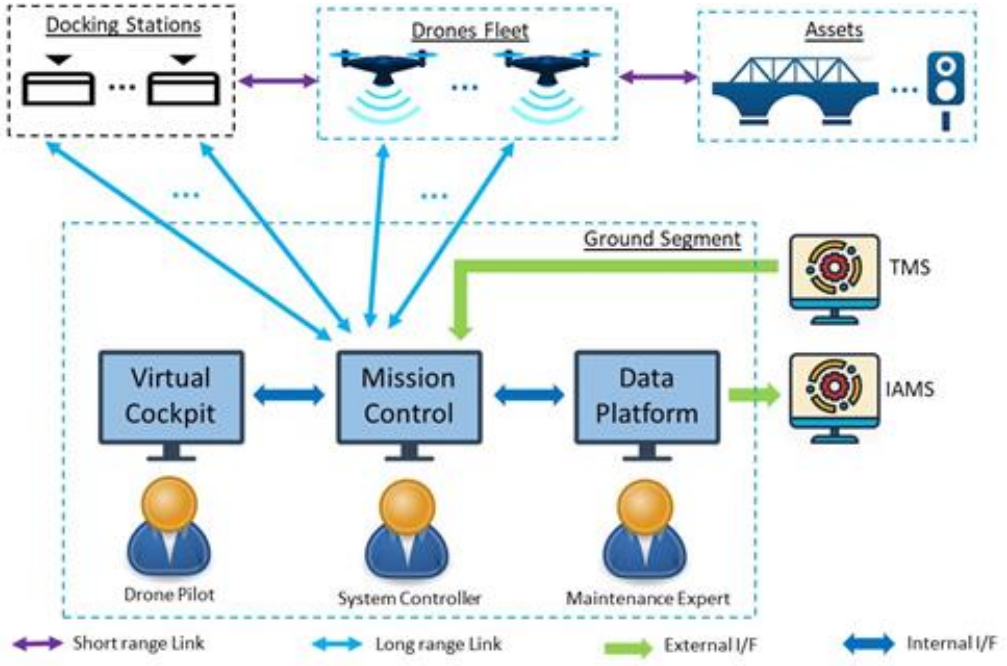
- Location: Ourique, Portugal
- Demonstration of RADIUS components integration
  - Docking Station
  - Drone Gateway
  - Ground Segment
- Demonstration of RADIUS capabilities for assets visual inspection:
  - Cabinets
  - Switches
  - Level Crossings

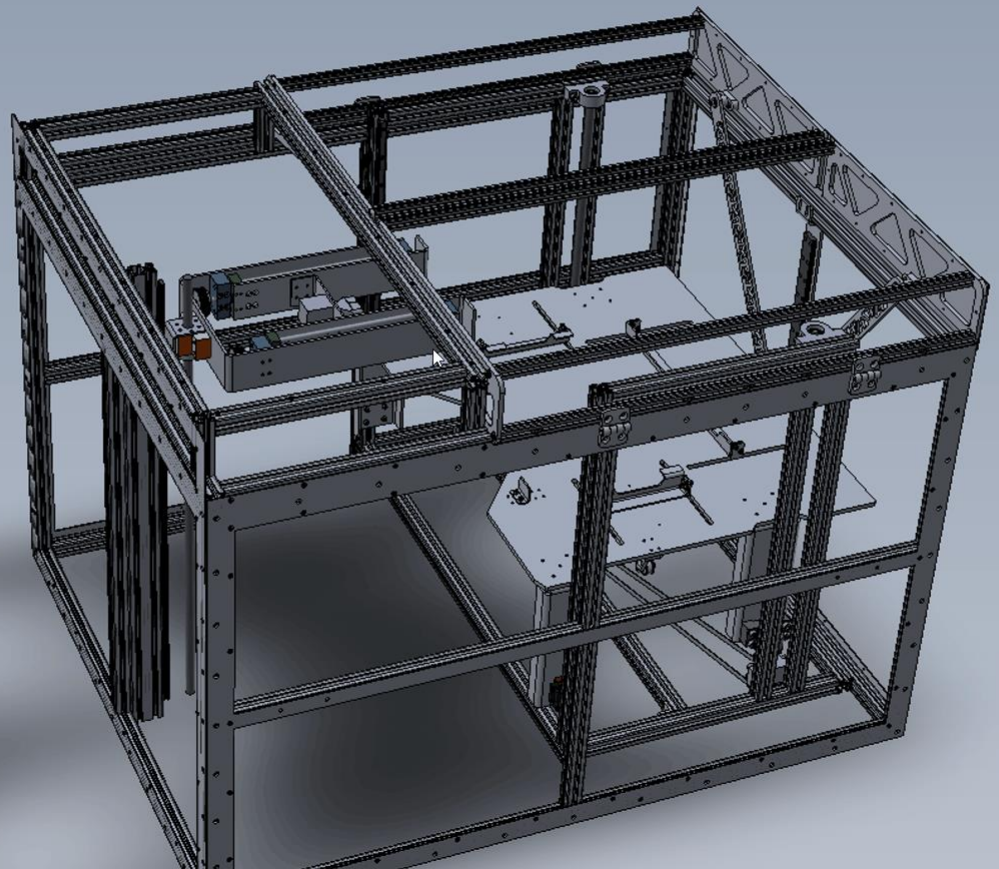
Final Demonstration - Location




R. do Celeiros
R. do Celeiros
R. do Celeiros
Ctmsr-centro Técnico De Molas E Segurança...
R. do Celeiros
Silvicastro,uni,lda
Cafe beira linha
R. Nova
Hostel - A Casa dos Patudos
R. do Celeiros
IC1
IC1
IC1
IC1
Google

RADIUS Architecture Overview

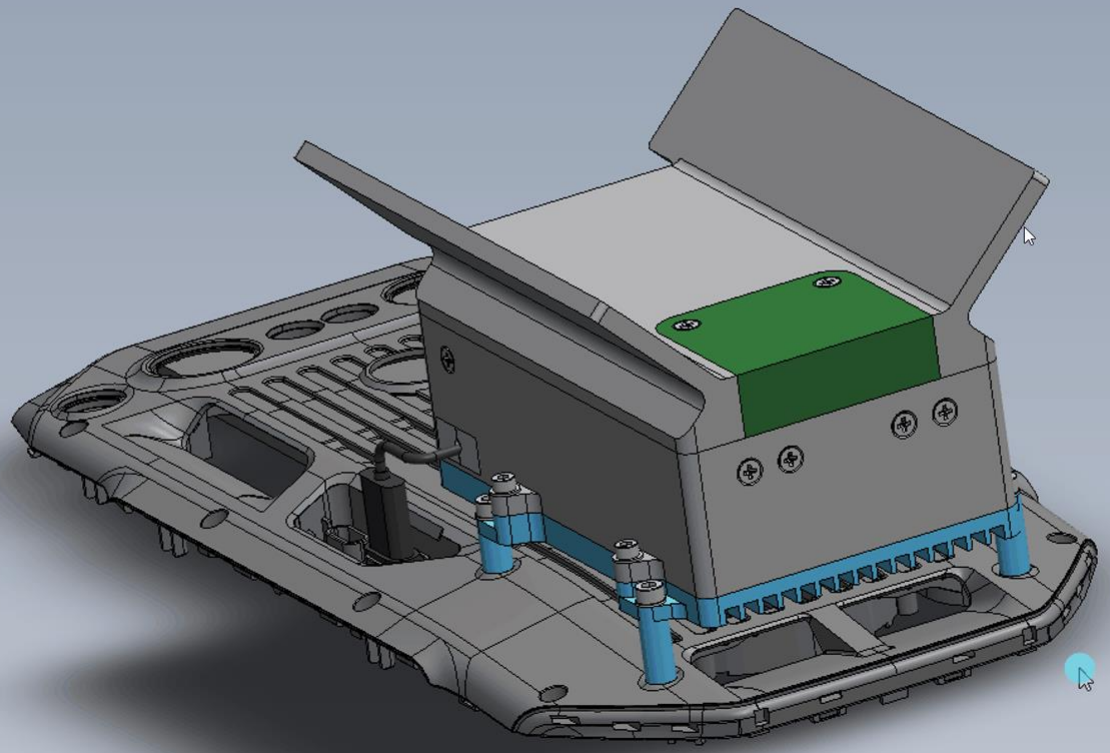




Shell


SHELL
DRONE DOCKING STATION
DA01-0100 SN: 240589
WWW.EVOLEO.TECH
Shell
EVOLEO
TECHNOLOGIES


KEEP CLEAR
Shell

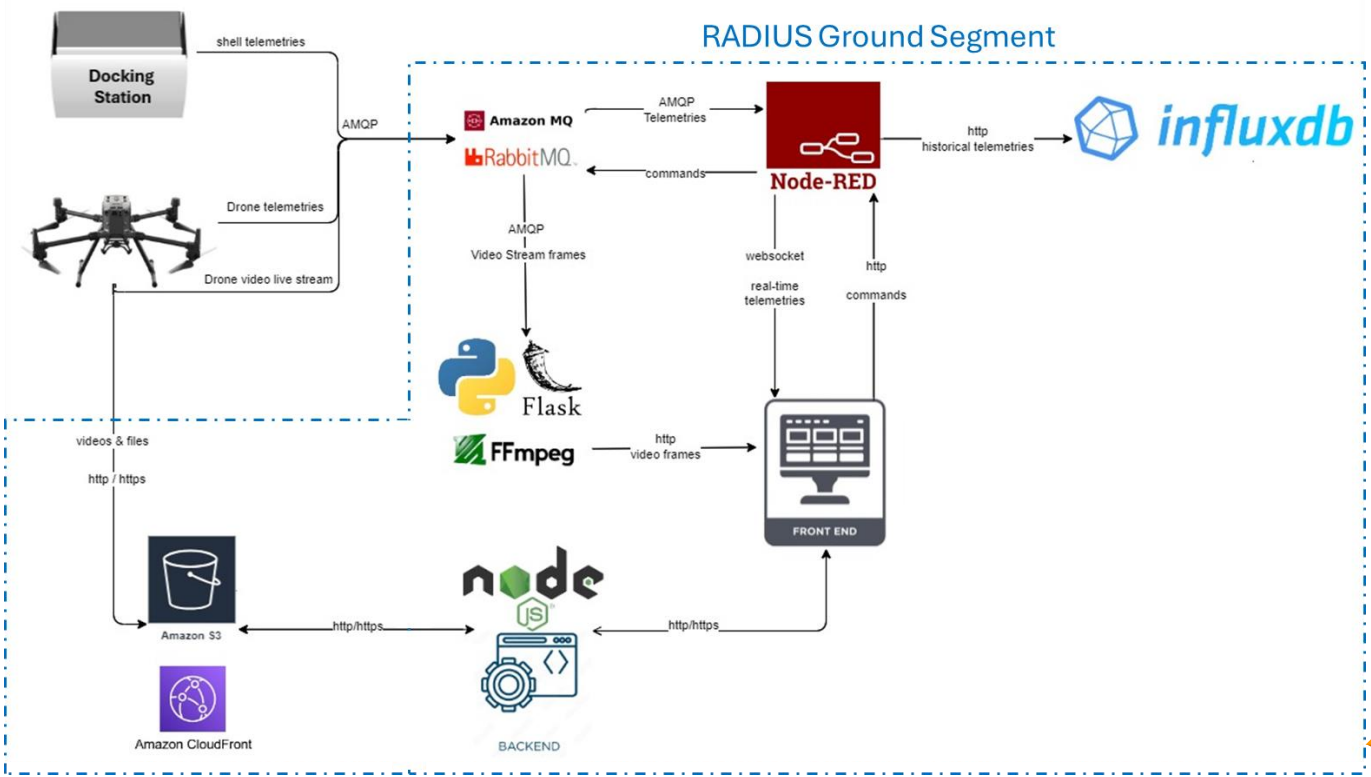


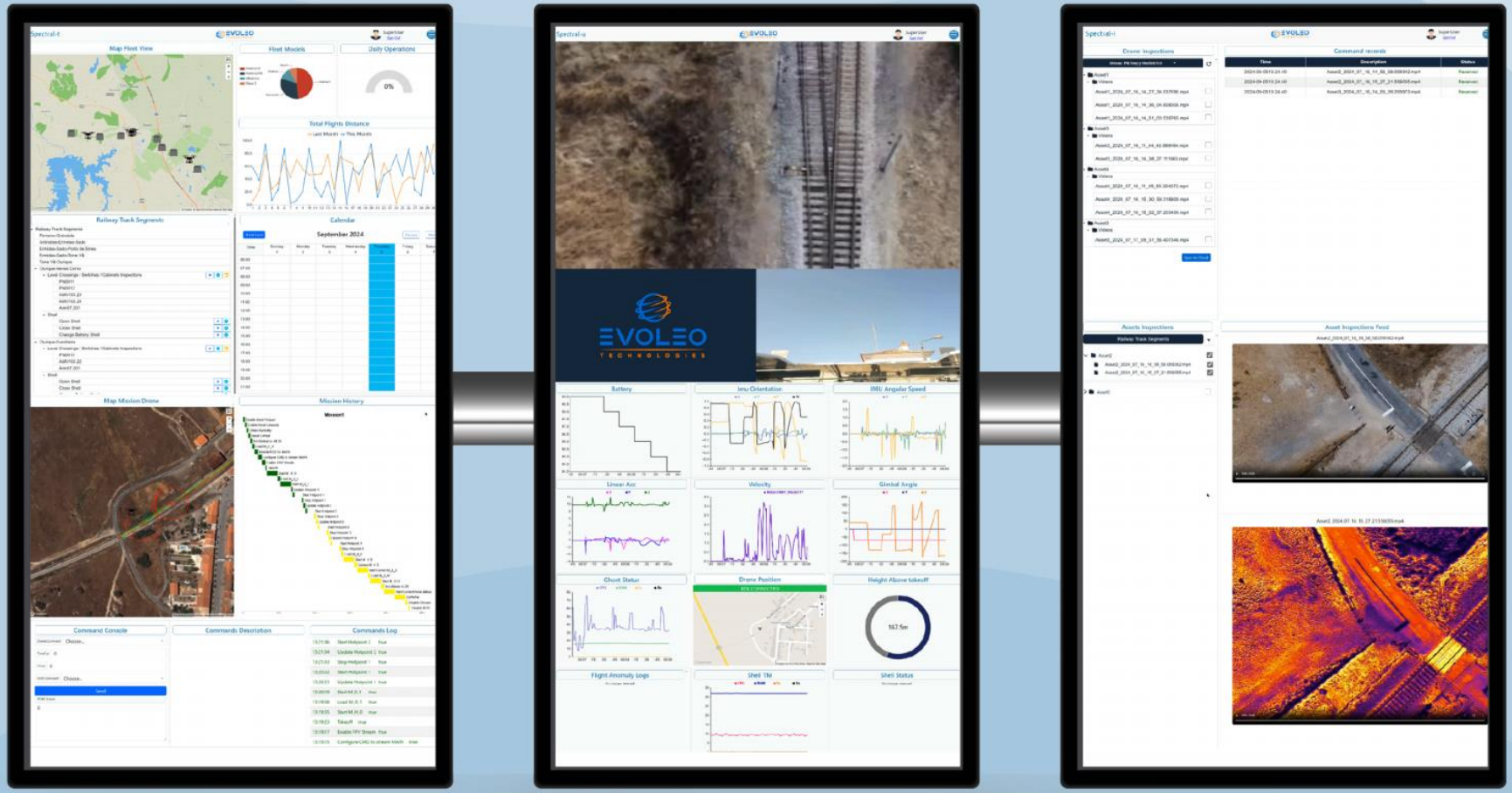
Ghost

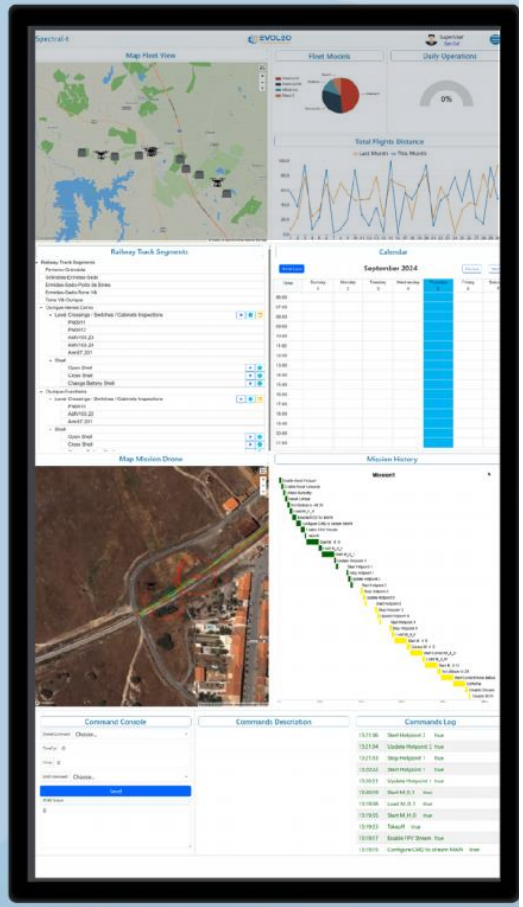

EVOLEO


Ghost

RADIUS Ground Segment Overview




Spectral-t
Map Fleet View
Fleet Models
Daily Operations
Total Flights Distance
Railway Track Segments
Calendar
September 2024
Map Mission Drone
Mission History
Command Console
Commands Description
Commands Log
Spectral-u
Battery
Imu Orientation
IMU Angular Speed
Linear Acc
Velocity
Gimbal Angle
Ghost Status
Drone Position
Height Above takeoff
Flight Anomaly Logs
Shell Tilt
Shell Status
Spectral-i
Drone Inspections
Command records
Assets Inspections
Asset Inspections Feed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EVOLEO
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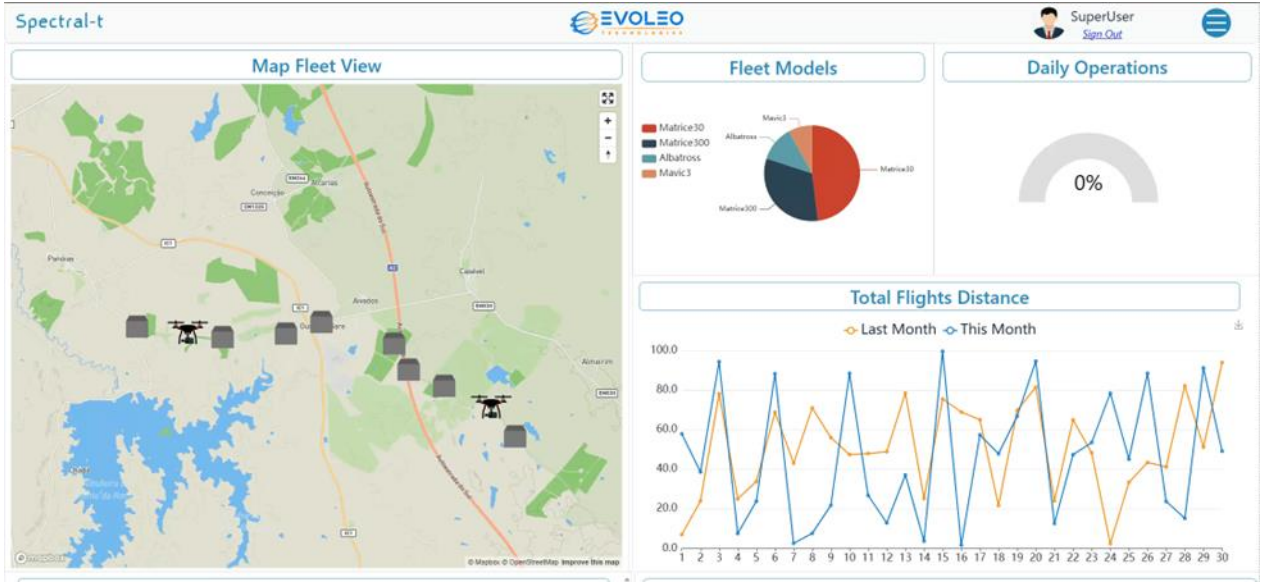
Spectral-t
EVOLEO
SuperUser
Sign Out
Map Fleet View
Fleet Models
Daily Operations
Matrice30
Matrice300
Albatross
Mavic3
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Total Flights Distance
Last Month
This Month
100.0
80.0
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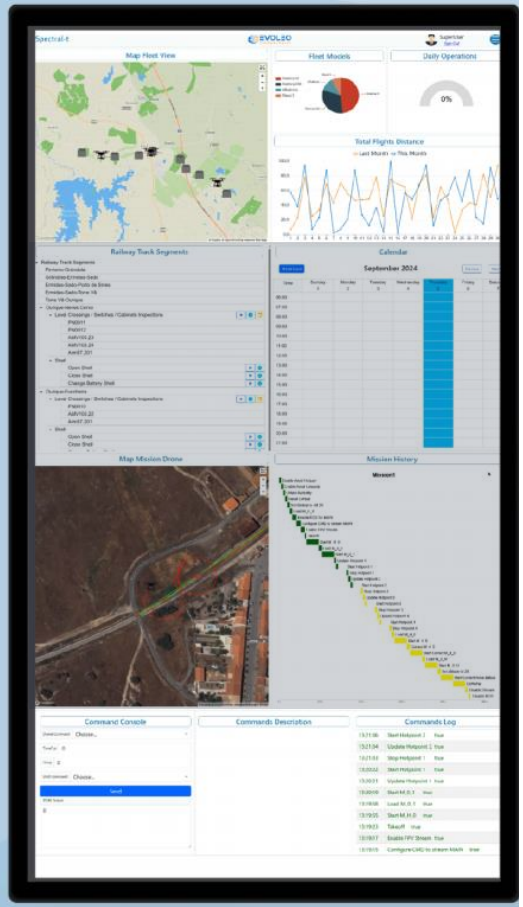
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30



Railway Track Segments

- Railway Track Segments
  - Pinheiro-Grândola
  - Grândola-Ermidas-Sado
  - Ermidas-Sado-Porto de Sines
  - Ermidas-Sado-Torre Vã
  - Torre Vã-Ourique
  - Ourique-Neves Corvo
    - Level Crossings / Switches / Cabinets Inspections
      - PN0011
      - PN0012
      - AMV103.23
      - AMV103.24
      - Arm57.201
    - Shell
      - Open Shell
      - Close Shell
      - Change Battery Shell
  - Ourique-Funcheira
    - Level Crossings / Switches / Cabinets Inspections
      - PN0010
      - AMV103.22
      - Arm57.201
    - Shell
      - Open Shell
      - Close Shell

Calendar

+Add Event

September 2024

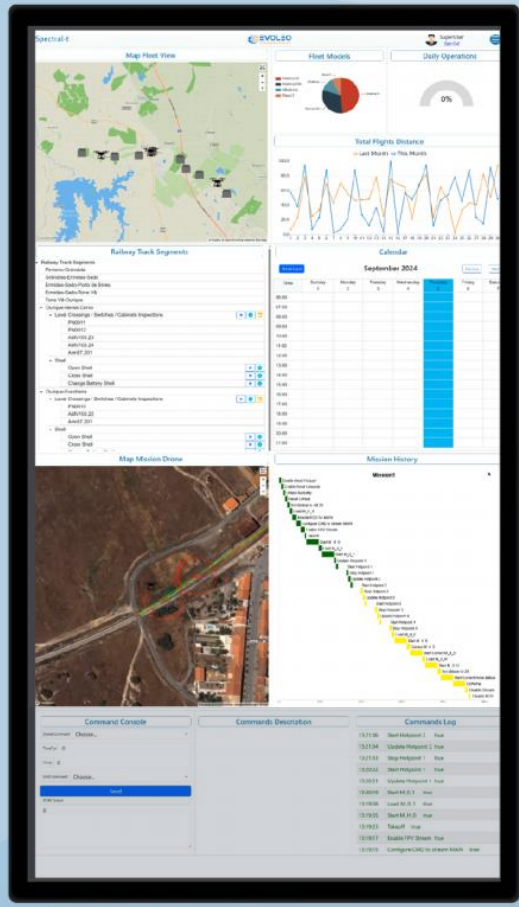
Previous | Next

Time	Sunday 1	Monday 2	Tuesday 3	Wednesday 4	Thursday 5	Friday 6	Saturday 7
06:00							
07:00							
08:00							
09:00							
10:00							
11:00							
12:00							
13:00							
14:00							
15:00							
16:00							
17:00							
18:00							
19:00							
20:00							
21:00							

Map Mission Drone

Mission History

No Data Available



Command Console

Drone Command: Choose...

TimeOut: 0

Delay: 0

Shell Command: Choose...

Send

JSON Output

{}

Commands Description

Commands Log

Spectral-u

EVOLEO

SuperUser
Sign Out

EVOLEO
TECHNOLOGIES

EVOLEO
TECHNOLOGIES

Battery

Imu Orientation

IMU Angular Speed

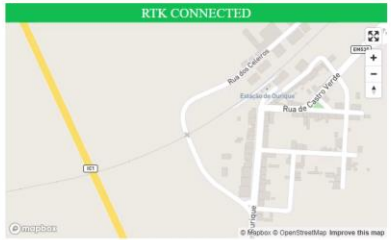
Linear Acc

Velocity

Gimbal Angle

Ghost Status

Drone Position



Height Above takeoff

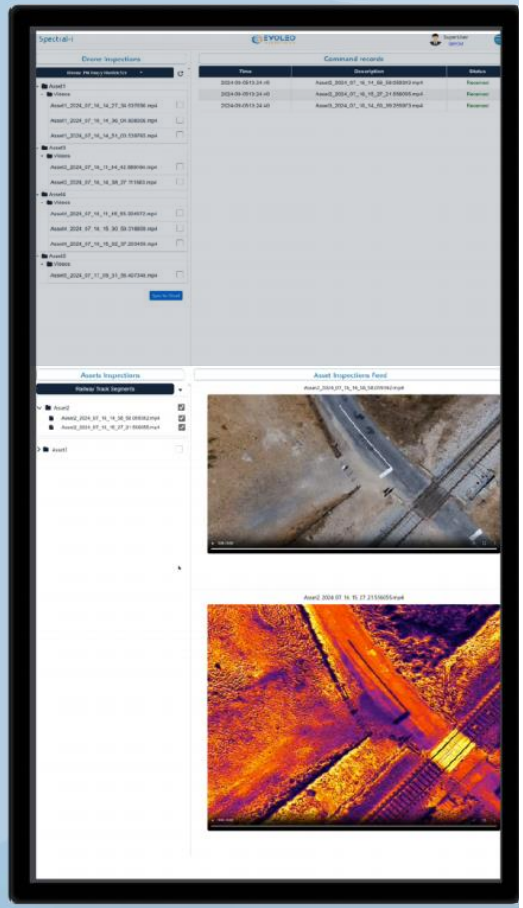
Flight Anomaly Logs

No changes detected

Shell TM

Shell Status

No changes detected



Spectral-i

EVOLEO

SuperUser

Sign Out

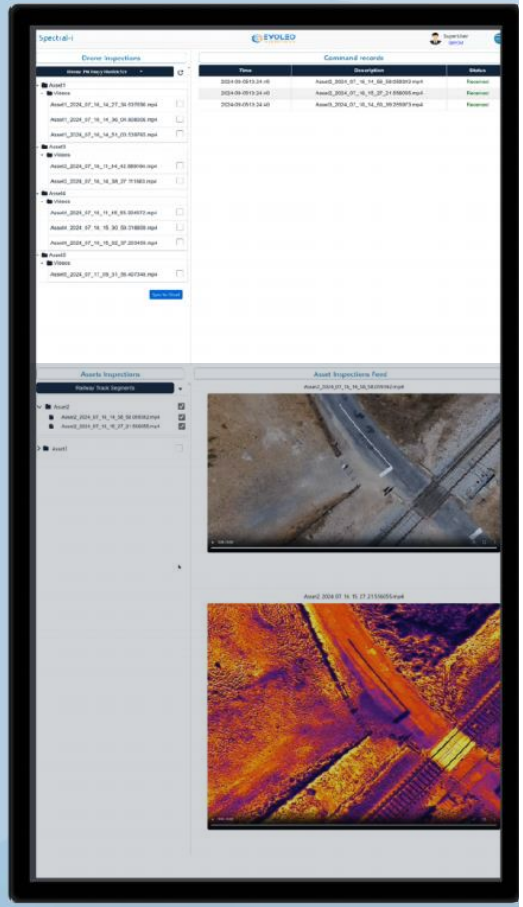
Drone Inspections

Drone PRTmyy10elfzh53r

Sync to Cloud

Command records

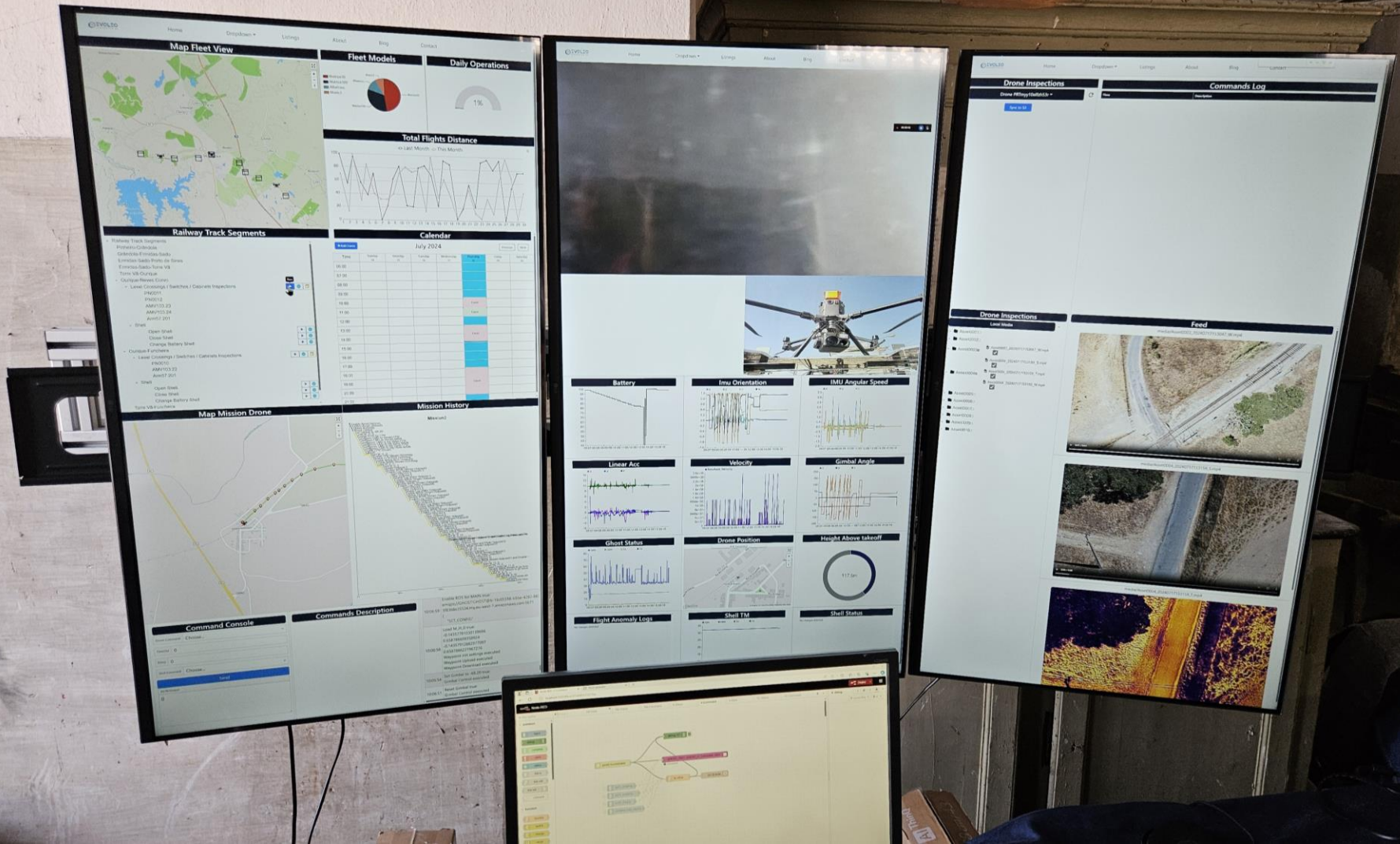
Time	Description	Status



Assets Inspections

Railway Track Segments

Asset Inspections Feed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Feed

Conclusions

- The main lessons learnt during this work are:
  - The usability of the system and potential for future use is very promising.
  - The routine operations and inspections are a good fit for this kind of solution, along with the predefined operations in general.
  - The repeatability of images and video collection is very interesting in terms of AI modelling.
- In general, future research may aim at
  - Longer in-field pilot demos to collect larger datasets, both in terms of assets inspections and operational usage.
  - Integrating other solutions to improve the robustness of the system. (e.g. communications)


SIXT
SIXT

How far are we from operation?

Manuel Oñate
EuroUSC España, S.L.

Key conclusions

Achievements

Viable technology

Feasible operations

Useful information

Future research

Prototype to product

Improved navigation

Asset management platform

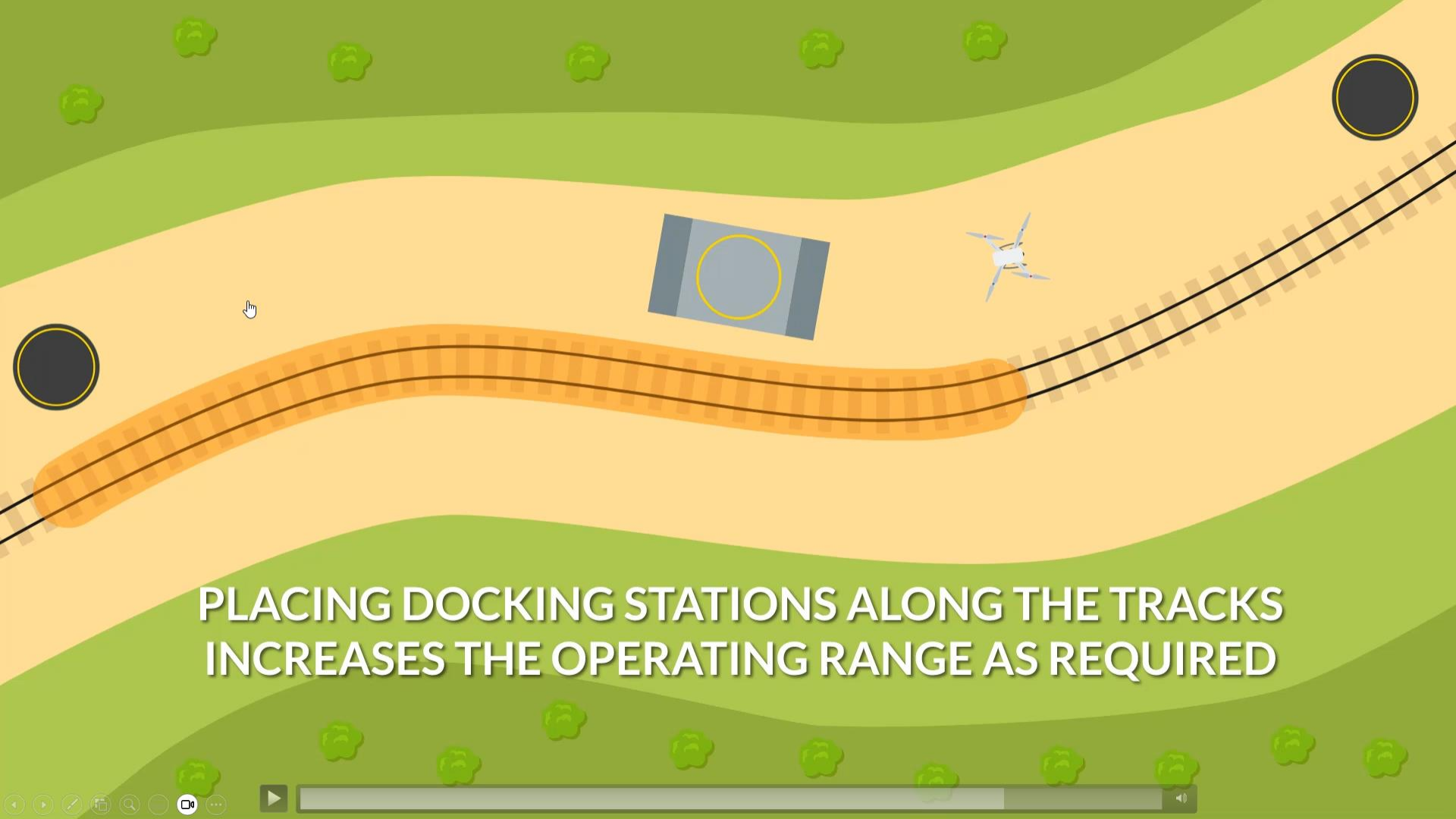
Other applications

Railway domain

Linear infrastructures

RADIUS achievements

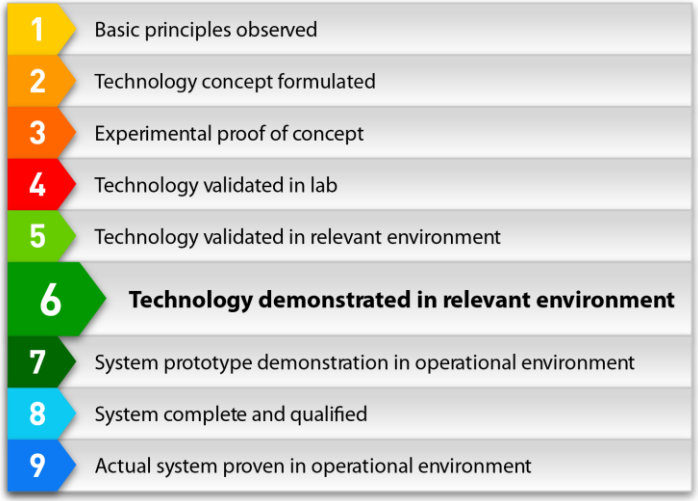
- The RADIUS technology works in the railway environment
- The docking station makes monitoring of long railway tracks workable
- Valuable data acquisition


PLACING DOCKING STATIONS ALONG THE TRACKS
INCREASES THE OPERATING RANGE AS REQUIRED

How far are we from operation?

Radius has demonstrated its ability to improve railway operations, but there are still steps to be taken to make it a commercially viable technology.

From prototype to commercial solution



- Radius has reached TRL6, but more research is required to attain TRL9.
- The project has conducted successfully validation campaigns in relevant environments, but the next step is to convert a prototype into an economically viable commercial solution on the market.

Improved navigation

- Radius currently relies on proprietary RTK positioning systems.
- It would be desirable to remove this dependency. We believe it would be possible to use non-proprietary Open-Source solutions based on EGNOS, OSNMA and Galileo High Accuracy System (HAS).
- Probably, they would have to be complemented with other means, such as artificial vision algorithms using the onboard cameras for precision landing on the docking stations.

Asset management platform

- Reconnaissance flights generate a huge amount of data that needs to be processed and archived efficiently so that it can be exploited to the full.
- Therefore, further steps need to be taken to develop and integrate a specialised and customised asset management system with full integration with existing IAMS.

Other applications in the railway domain

- Radius has demonstrated its viability for monitoring the status of signalling assets, but the technology has the potential to be extended to other categories of assets and other uses cases within the rail sector itself.
- For example, attendants at InnoTrans, repeatedly asked about:
  - Tunnels
  - Track geometry
  - Alert management
  - Vegetation encroachment
  - Clothes

Other applications: inspection of linear infrastructures

- Radius is a project with great potential to be extended to other industries or linear infrastructures, with common characteristics to railways.
- Many of the technologies developed could be extrapolated to other applications, such as the docking station, wireless communications and the image processing algorithms.