INGENIOUS “Smart” Devices in the air and on the ground

WP3 presentation

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INGENIOUS Final Event

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Presentation Contents

1. WP3 Overview – objectives and goals
2. Technologies
3. Benefits for first responders
4. Main findings and achieved results

First responder needs addressed

- rapid **base mapping** of the incidence area (real-time, fully georeferenced)
- actionable **information of indoor environments**
- **indoor positioning** of first responders

WP3 Overview / Technologies

To develop a set of:

- **ancillary devices and platforms**, rapidly and autonomously deployed in the field
- **gather information, enhance awareness, localise FRs and their assets**, and optimise communication between teams and victims.

Scenarios:

- **SAR in damaged block of buildings** after a disaster that affected critical infrastructures
- **Terror attack** in public space with damaged buildings and trapped victims

WP3 Overview / Technologies

- DLR: Modular Airborne Camera System Search and Rescue (MACS-SAR)

- FOI: Multi-purpose Autonomous eXploring drone (MAX)

- SINTEF: Micro Indoor droNe (MIN)

- DLR: Integrated Positioning System (IPS) ;

- ICCS: worksite COMMunications System (COMMS)

- ITC: Ground Control Station (GCS)

MACS-SaR in a nutshell

Large-scale mapping and build a global reference system.

Performance

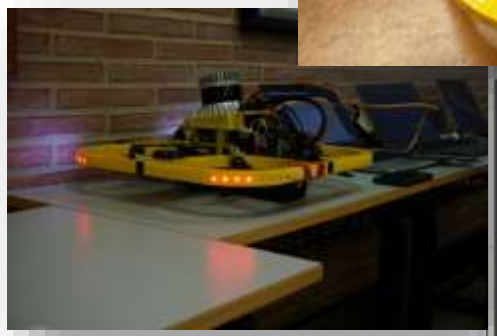
- Average cruise speed of 80 km/h
- Payload capacity of 2 kg
- Flight time of up to 120 minutes

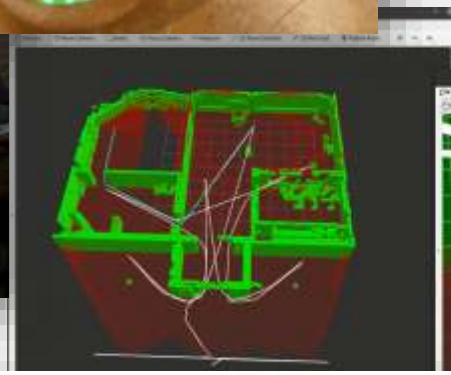
Usability

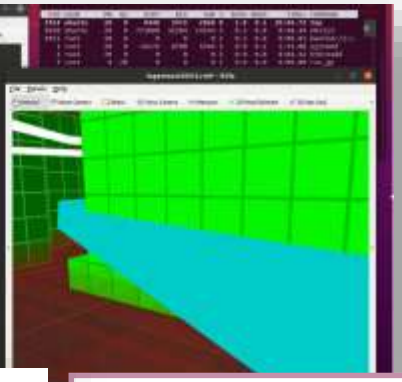
- **Vertical** take off and landing (VTOL)
- Set-Up time less 5 minutes
- Automated start, landing and operation
- Reliable autonomous operation
- Real-time data streaming, georeferenced map building

MAX in a nutshell

- **Real-time autonomous exploration of unknown environments**
- **Custom-built** for maximal flexibility (in terms of functionalities, sensors and communication)
- **Real-time** multi-sensor data – for 3D positioning, mapping and navigation
- **Indoor & outdoor** operation







Real-time 3D path planning

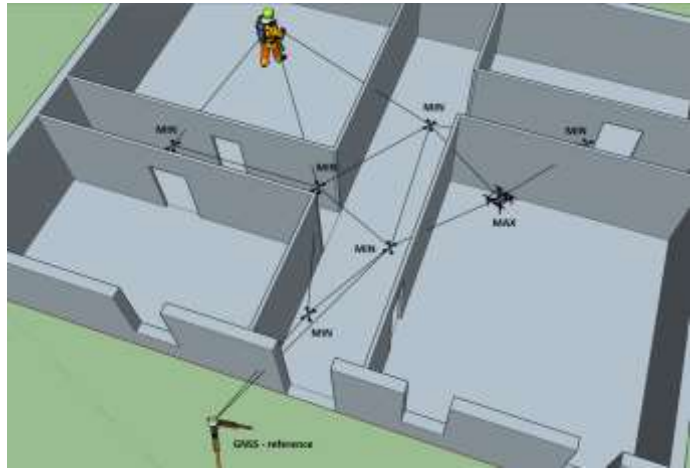
Keep track of explored and yet unexplored areas

MINs in a nutshell

- Deployment points **based on map created by MAX** (FOI)
- **support localization of FRs in indoor** (GNSS denied) environments using ultrawideband (UWB)
- MINs **propagate incrementally** into the scene
- FRs enter after deployment, carrying a **localization tag**

MIN

Tag for FR localization



Concept: MINs providing localization of FR

IPS in a nutshell

- **Outdoor and indoor Localization** of First Responders
- **Continuous transmission of the FRs coordinates** (global UTM coordinates after co-registration with MACS-SAR)
- Transmission of **user-triggered images** with annotated coordinates
- Transmission of a **sparse point cloud** of the travelled space

Comms in a nutshell

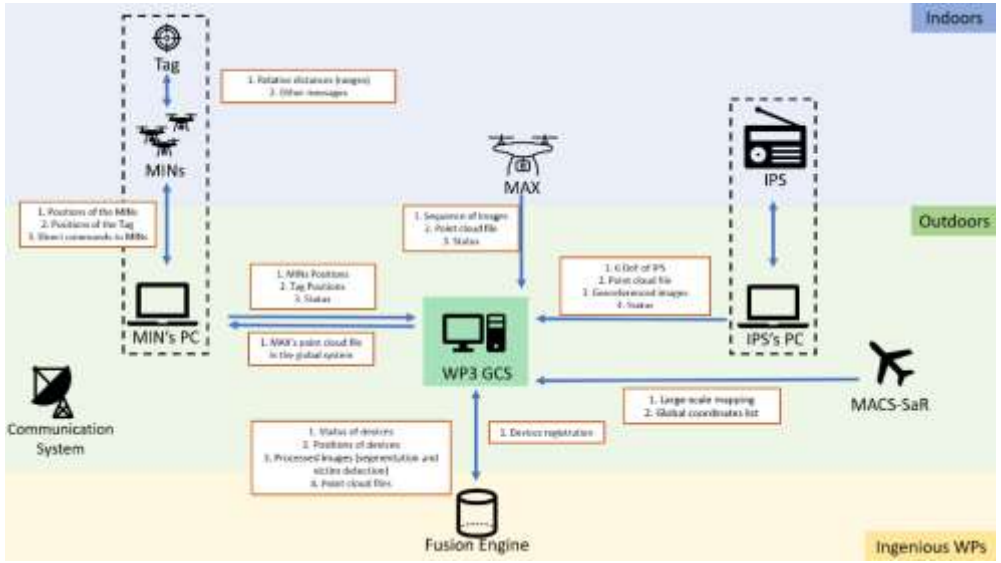
Custom built components to meet ruggedization & ease of deployment goals

- **Portable communication** solution
- Combination of **multiple Radio Access Network** (RAN) technologies to provide resilience
- Careful selection of hardware components and customization to meet user requirements for fast and easy deployment
- **Provision of network monitoring and management** through User Interface

GCS in a nutshell

Scene understanding algorithms using deep learning

- **Semantic segmentation** in low-light environments
- Partially buried **victim detection**



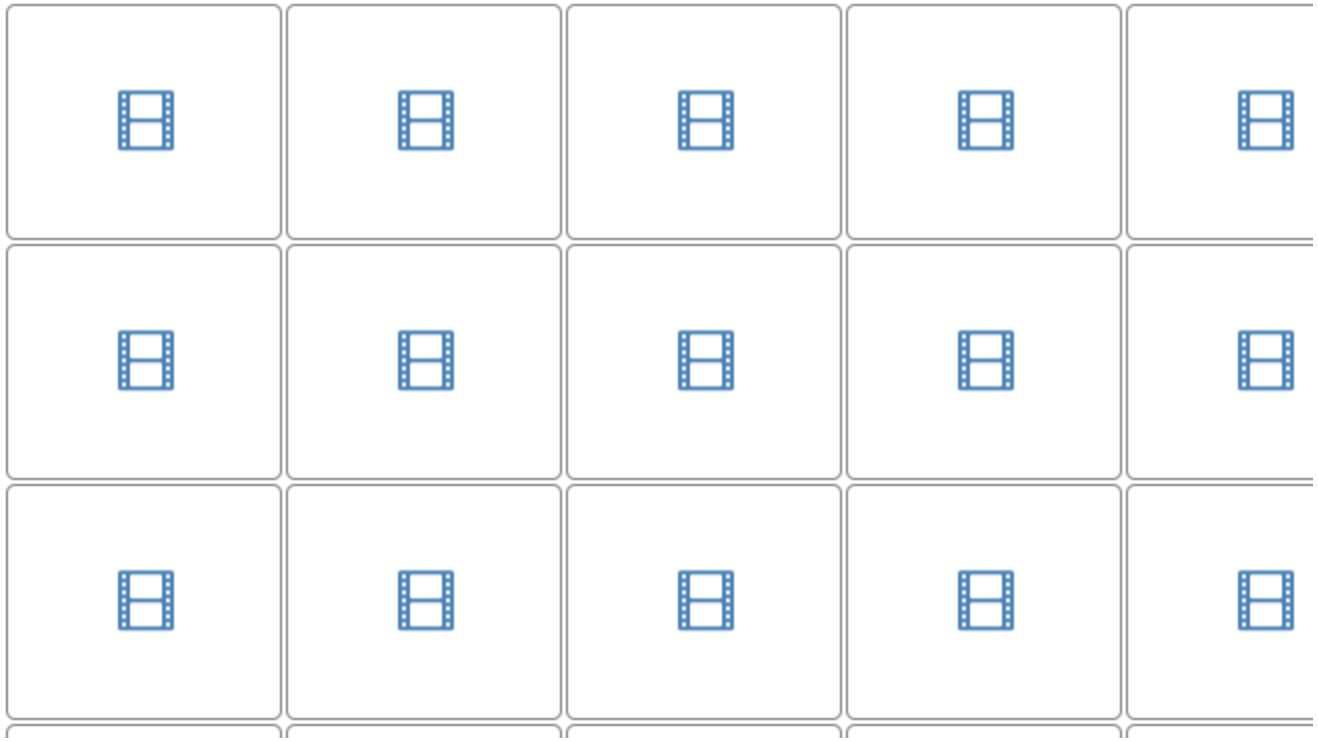
Semantic segmentation. Different colors refer to different semantic classes.

Training with composite victim images

Integration, Testing & Field Validation: MACS-SaR

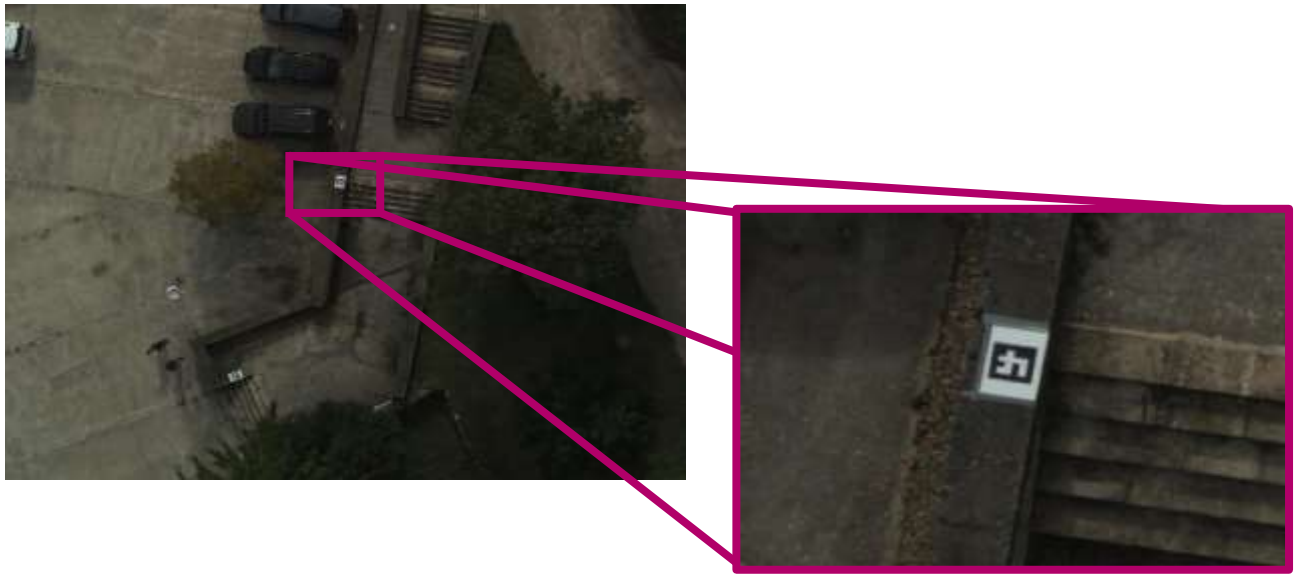
Integration, Testing & Field Validation: MACS-SaR

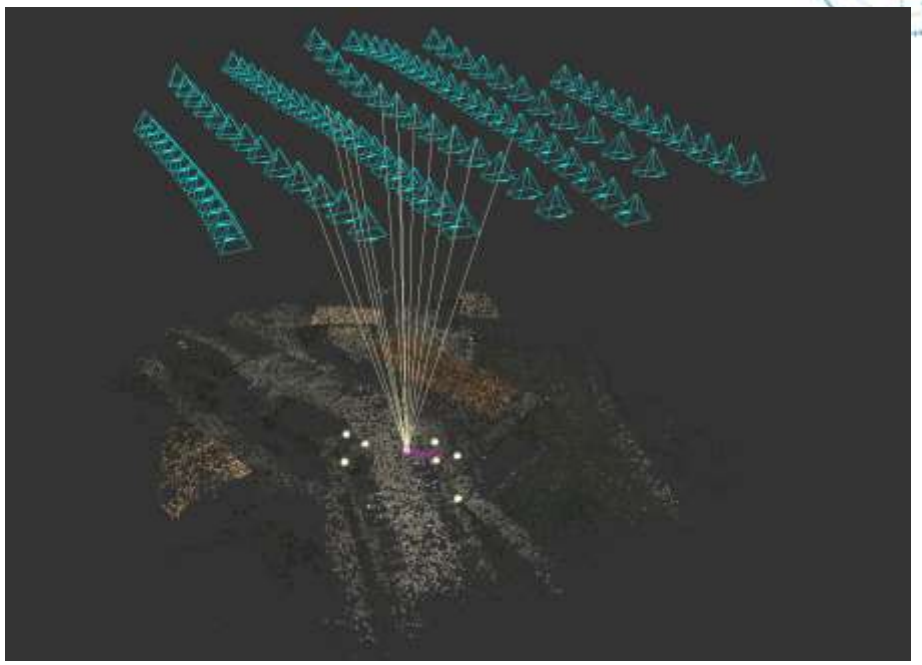
- Realtime data feed (via radio link to ground station)
- Large Scale Operational Picture (GeoTiff)

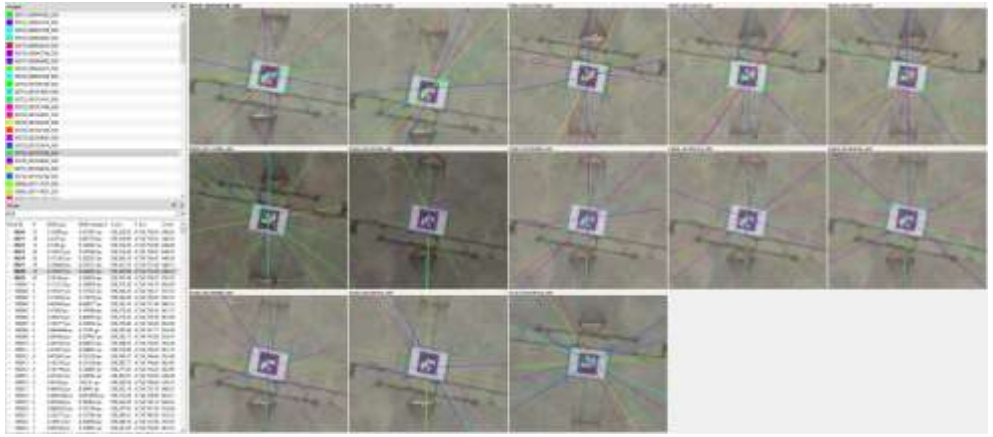


Integration, Testing & Field Validation: MACS-SaR

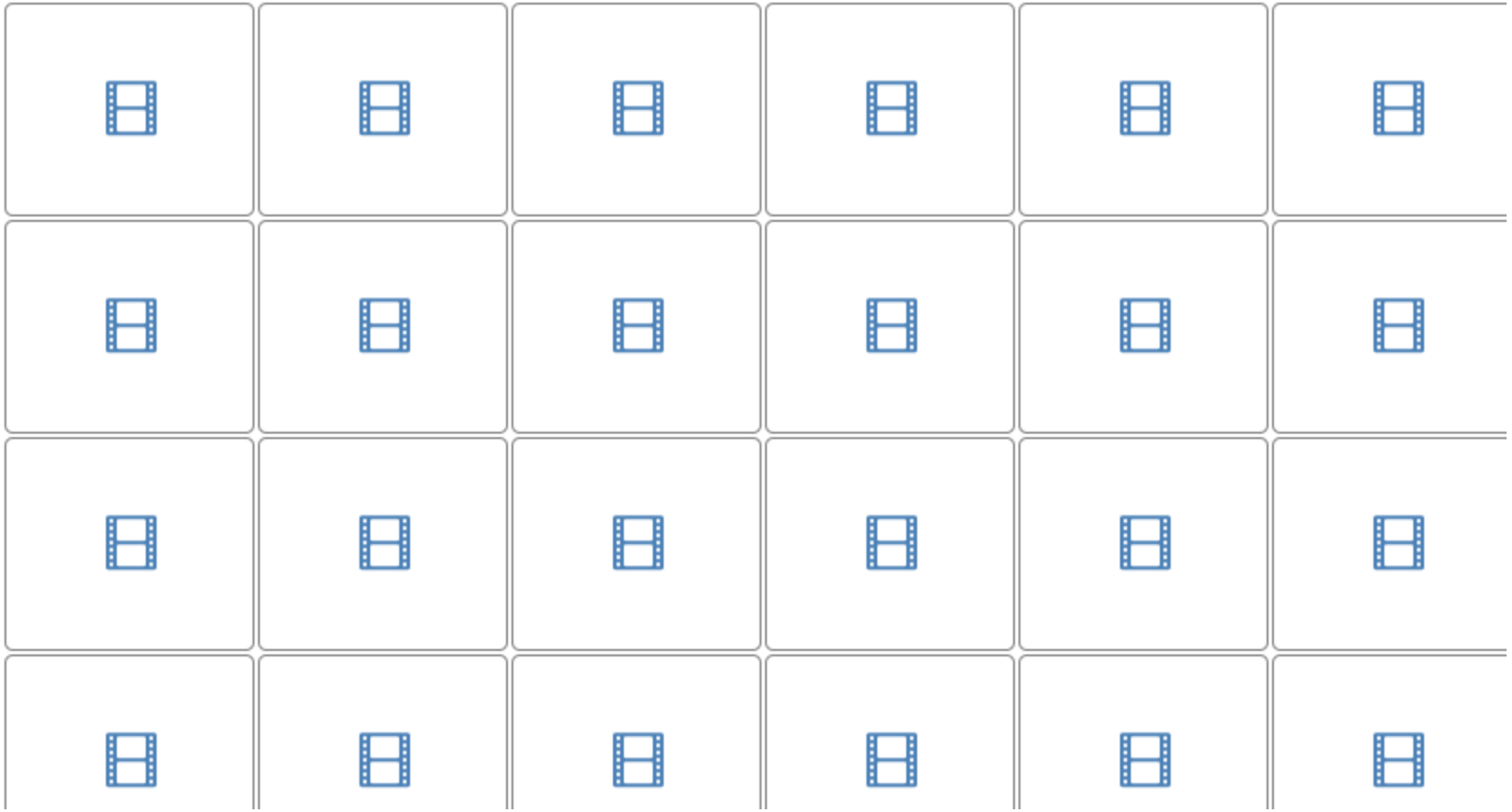
- Delivery of **common reference coordinate system**
  - Utilizing coded markers / tags
  - Basis for other tools to co-register







Integration, Testing & Field Validation: MAX



Integration, Testing & Field Validation: MAX

Output:

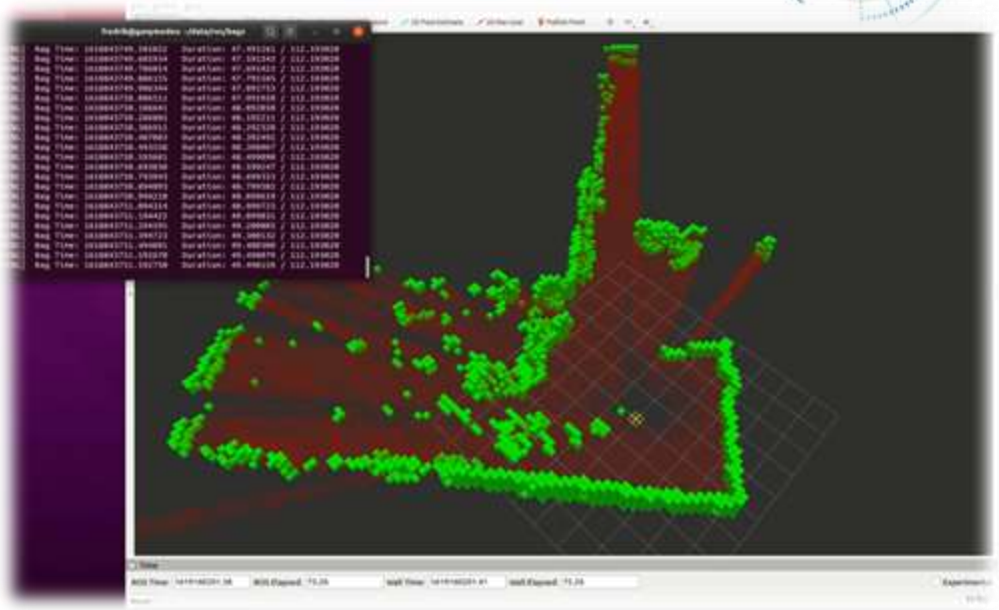
Georeferenced 3D maps

- Scene assessment
- Decide how to approach the building
- Planning of deployment of MIN drones

Sensor data

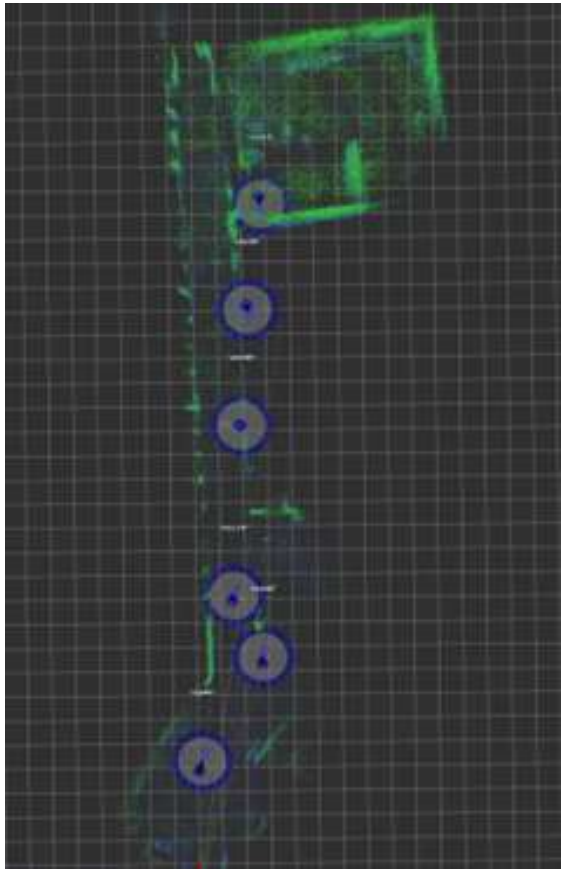
- Visual images
- Thermal images
- Environment sensor readings (temperature, gas, air pressure…)

Indication of yet unexplored space



Integration, Testing & Field Validation: MIN

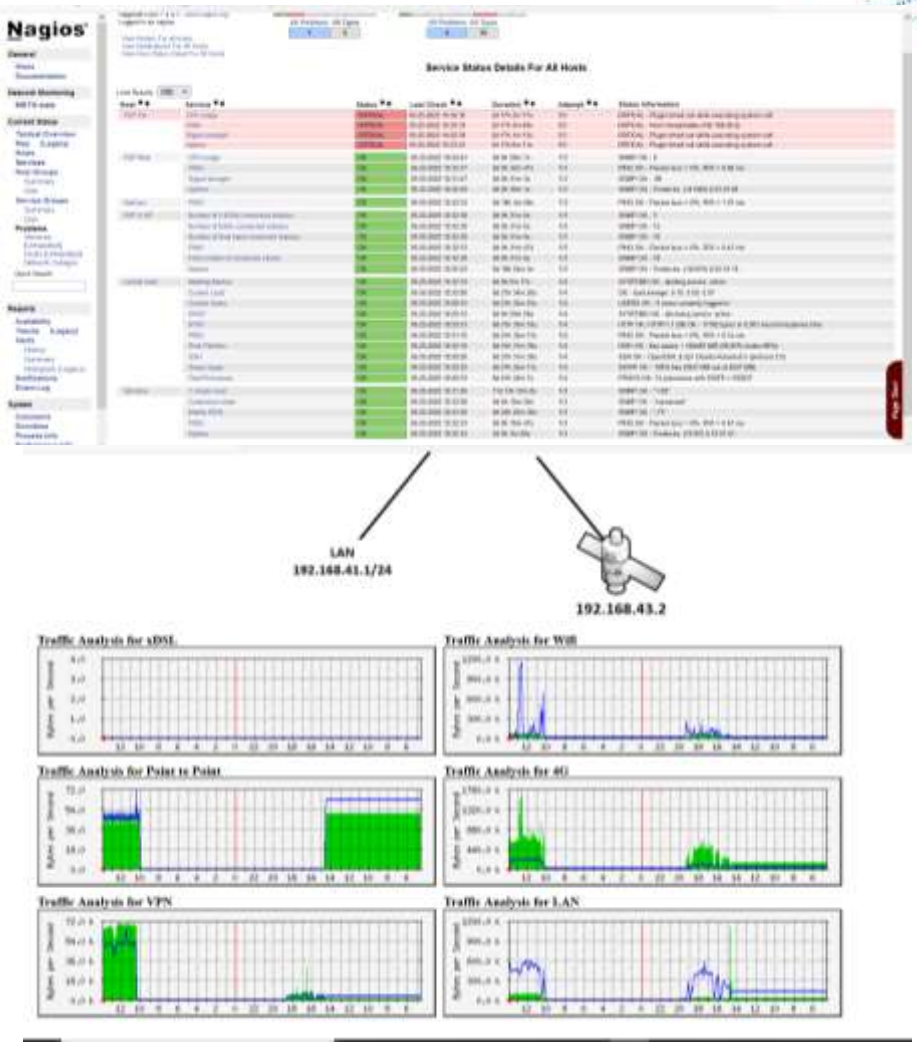
Incremental deployment using a map provided by MAX



Integration, Testing & Field Validation: IPS

- Automatic coordinate registration at georeferenced AprilTags tested successfully
- Online submission of First-Responder‘s position in global coordinates
- Online submission of user-triggered photos
- Generation of point cloud after the walk

Integration, Testing & Field Validation: Comms



Integration, Testing & Field Validation: GCS

data communication and AI algorithms

Main findings of testing activities

The importance of end-users' involvement

- Requirements analysis and adjustment
- Make tools more user-friendly
- Guidance on how to use the tools

Integration tests are important and useful

- Inter-WP and intra-WPs integration
- Data visualization is very useful

WP3 Conclusions

- Tools are fully developed and satisfy end-users' requirements
- Several tests and development iterations made the tools more robust and user-friendly.
- Solutions exist at different TRL levels, from prototyping (MIN), to more robust and reliable solutions (MAX, GCS), to (near)commercial level (IPS, MACS)
- Take-up by the FR community remains challenging

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Thank you for your attention

Any Questions ?

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