

European Commission's Joint Research Center

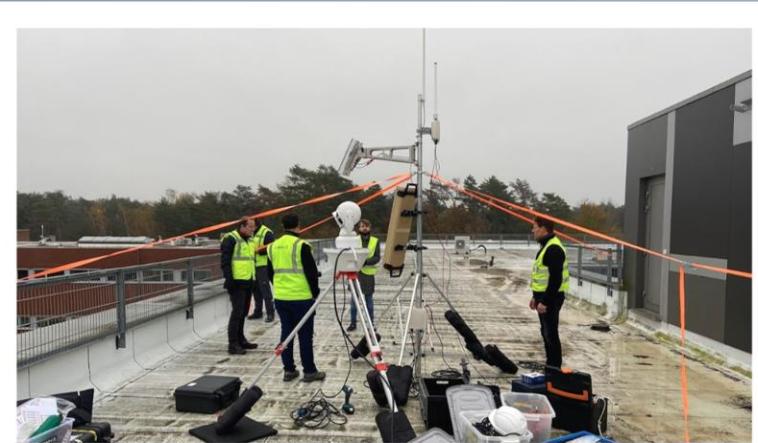
Drone, Counter drone and autonomous systems

HIGH-LEVEL WORKSHOP ON THE CURRENT STATE OF COUNTER UAS

4 November 2024

EUROCONTROL

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Head of Unit Transport and
Border Security, JRC, European
Commission



Head of Unit in the Commission's Joint Research Centre. Policy driven research projects: border security solutions, threat detection technology, drone and counter drone living lab. Until 2016 managing the JRC's corporate ICT department. Before joining the Commission in 2000, project manager in the private sector for various consulting companies including my own. Started as scientific assistant after my MSc in Computer Science. Master of Management (VUB, Free University of Brussels), Project Management (EHSAL management School).

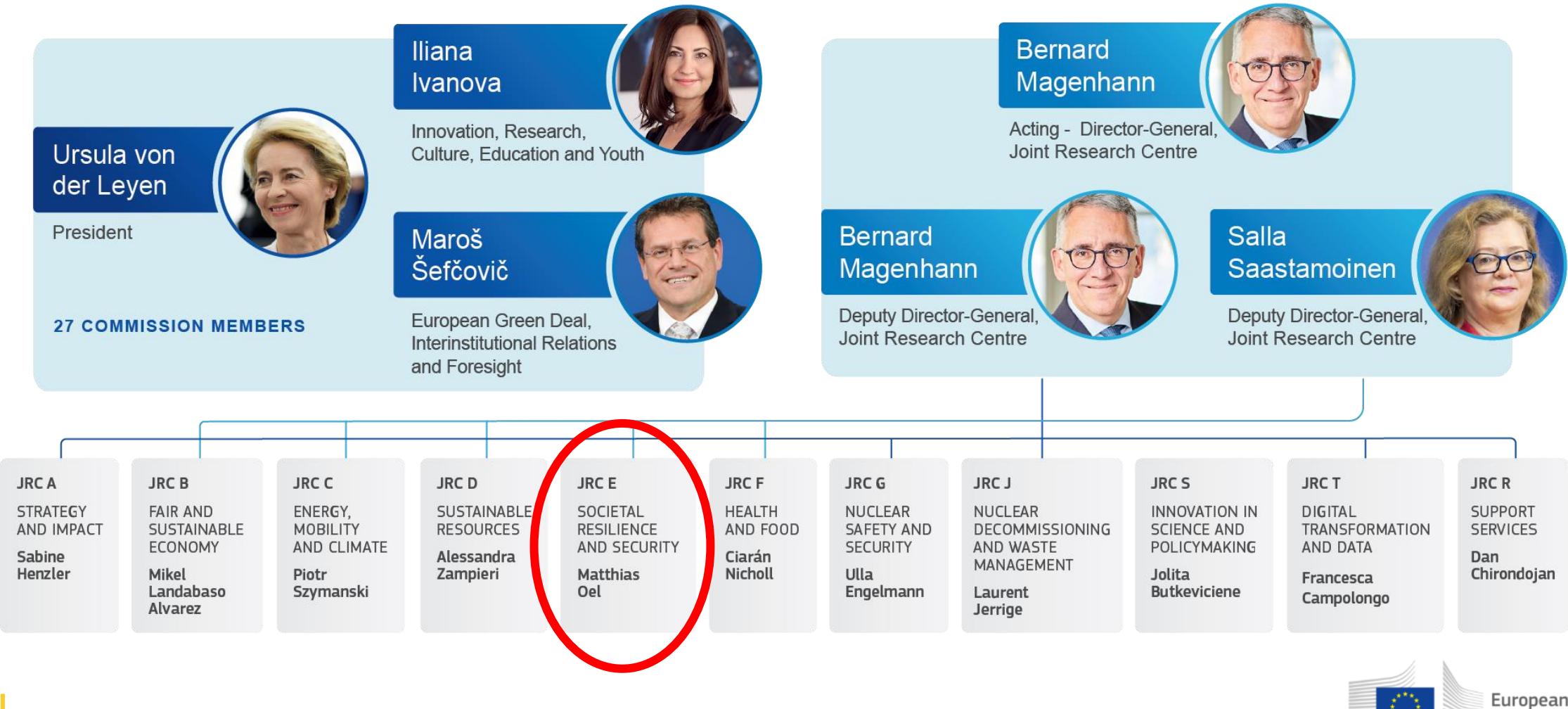
Paul Hansen

Project Manager DRONE project,
Transport and Border Security,
JRC, European Commission



Trained Electronics Engineer and works for the European Commission JRC since 1989. Started making scientific instrumentation for scientists in various projects. Later move into ICT as developer and ICT manager. Managed JRC services for many years before becoming JRC ICT architect for JRC. Change in 2018 to Transport and Border security unit to manage various border related projects before starting the JRC DRONE project. Was involved in the Commission development of Drone Strategy 2.0 and Commissions actions on C-UAS.

The Joint Research Centre within the Commission



Science for policy



ANTICIPATE



INTEGRATE



IMPACT

Our purpose

The Joint Research Centre provides independent, evidence-based knowledge and science, supporting EU policies to positively impact society.

Our role

- **Independent** of private, commercial or national interests
- Works for more than **40 European Commission policy departments**



JRC sites

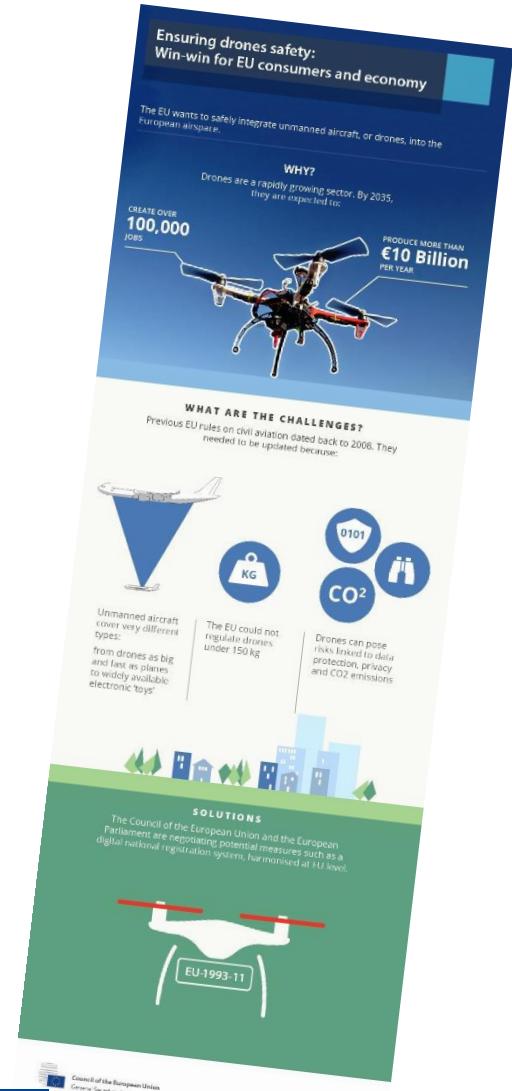
Headquarters in **Brussels**
and research facilities located
in **5 EU Countries**:

- Belgium (Geel)
- Germany (Karlsruhe)
- Italy (Ispra)
- The Netherlands (Petten)
- Spain (Seville)



Unmanned Aircraft System (UAS) Legal base: at the early stage

	Drone rules	Drone airspace rules	U-Space
Scope	Airworthiness, Competence, Operations	Types of airspace and modalities	Access to airspace
Legal basis	EASA basic regulation (Regulation (EU) 2018/1139)	EASA basic regulation	EASA basic regulation
Implementation rules	COMMISSION IMPLEMENTING REGULATION (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft Safety of persons	Rules of airspace 2020-	Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the use of drones in the air space
Principles	Operational centric	Adaptation to local characteristics	Fair access to airspace



Cyber resilience act – new cybersecurity rules for digital products and ancillary services



EUROPEAN
COMMISSION

Brussels, 29.11.2022
SWD(2022) 366 final

COMMISSION STAFF WORKING DOCUMENT

EU Drone Sector state of play

Accompanying the document

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions

'A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe'

{COM(2022) 652 final}

8.2.5 Increasing counter-UAS capabilities and system resilience

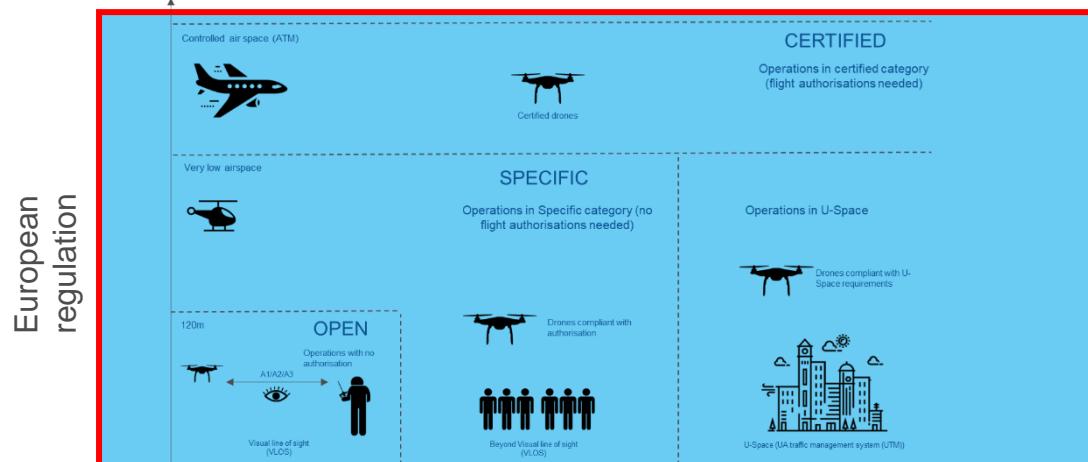
To support Member States the JRC and its drone project will review processes and interactions between stakeholders and the use technologies and how these technologies can be combined into solutions, which can be used to ensure the security of citizens and critical infrastructure.

One part of the drone project is the creation of a living lab with a C-UAS solution implemented that will be open to stakeholders to investigate counter UAS solution aspects and how these can be applied in real. The living lab implementation will be designed so that it can be used as a guide to comply with the legally required **Geel site** protection (Class 1 Nuclear installation).

Drones – EU regulation scope

Regulation 2019/945-947

Civil



Space



Above 60000ft

Air

Defence/Military

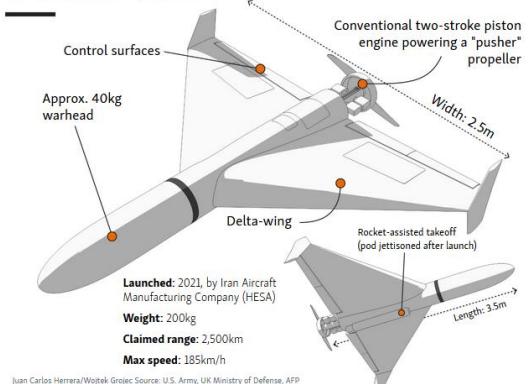


Land



Shahed-136 Drone ("Geran-2")

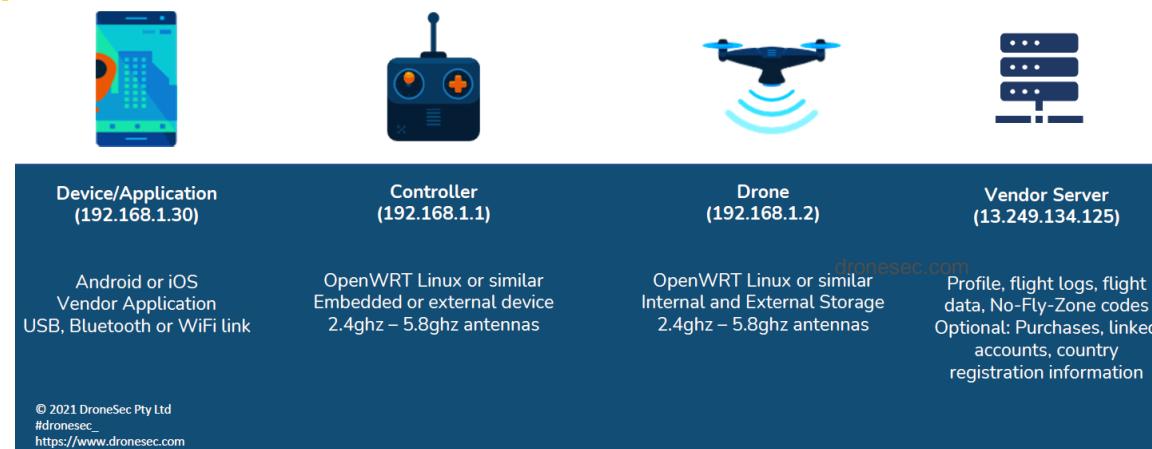
An Iranian-made suicide drone imported by Russia for use in its invasion of Ukraine. Rebranded as "Geran-2" or Geranum-2.



Sea



Fast evolving field



Mobile wireless (flying) computer network, WIFI, 5G/6G, AI, edge computing, computer vision, cloud, smartphone tech, camera, autonomous, swarming, sensors, cybersecurity...

Strategic autonomy / economic security ?

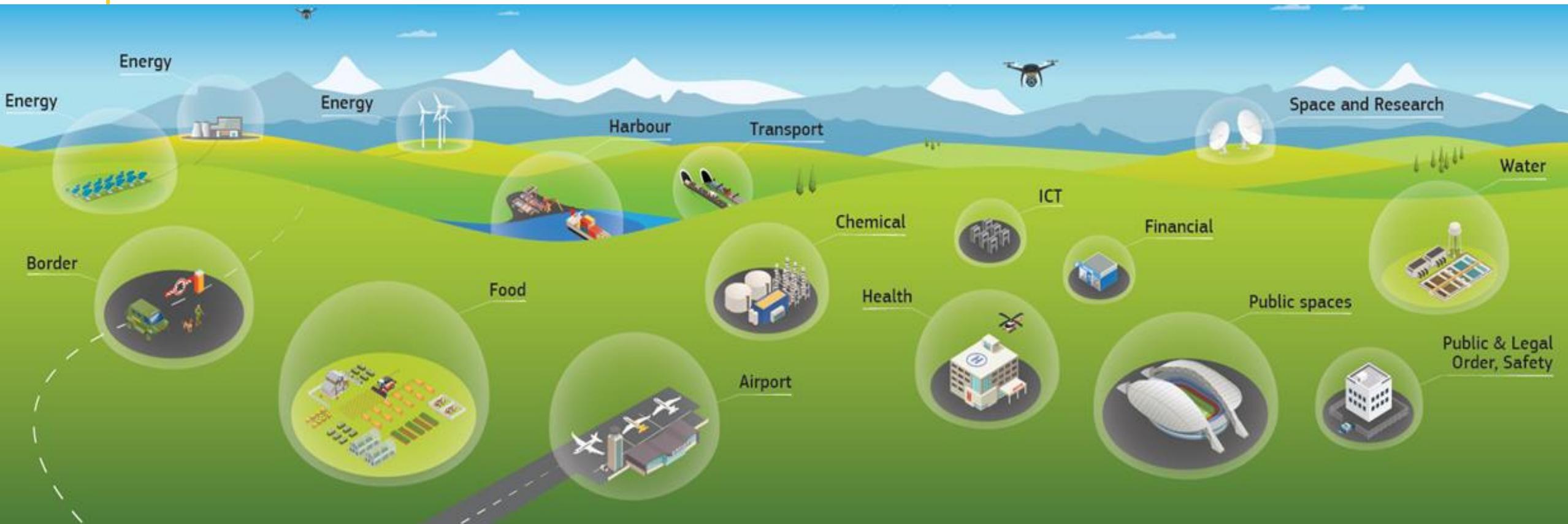


Blurring between civil and defence usage



Green and digital transition

JRC DRONE project



- https://joint-research-centre.ec.europa.eu/scientific-activities-z/drones-counter-drones-and-autonomous-systems_en

Increased misuse and incidents

Gatwick airport: How can a drone cause so much chaos?

By Jane Wakefield
Technology reporter
© 21 December 2018



GETTY IMAGES

As drones become more popular, countries will need to consider regulations to restrict usage

Gatwick Airport re-opened its runway on Friday morning after hundreds of flights were grounded due to a drones being spotted over the airfield on Wednesday and Thursday.

<https://www.bbc.com/news/technology-46632892>

'Kamikaze' drones are the latest threat for Ukraine. Here's what we know



12

<https://edition.cnn.com/2022/10/17/europe/kamikaze-drones-explained-update-intl/index.html>

Ukrainians soldiers converted FPV drone into kamikaze and destroyed Russian occupiers

<https://www.youtube.com/watch?v=pppxwz5tt0E>



Swarms

10,197 drones break world record in Shenzhen Bay light show

Source: <https://interestingengineering.com/culture/china-national-day-drone-show-break-world-record>



Build A DIY Drone Light Show | It's Not As Hard As You Think

By Caleb Bergquist • March 27, 2024

Drone light shows have been gaining in popularity over the last few years. However, the high prices to get started has put a ceiling on adoption. For example, one of the trailblazers of drone light shows was Intel- and they charge \$500 per drone, per show. This means a light show with 200 drones would cost \$100,000, and you don't even own the drone at the end of the show!

This introduces the question, to the ambitious folks, "what if I just built my own drones"? Well, good news! In this blog post, I'm going to show you how you can build your own drones for light shows on your own, DIY style.

Source <https://dojofordrones.com/diy-drone-light-show/>

Autonomous systems

How A Trio Of Engineers Developed A GPS-Denied Drone For Under \$500

Garrett Reim March 06, 2024

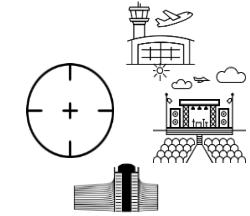
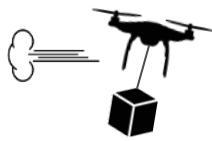


Source: <https://aviationweek.com/aerospace/emerging-technologies/how-trio-engineers-developed-gps-denied-drone-under-500>

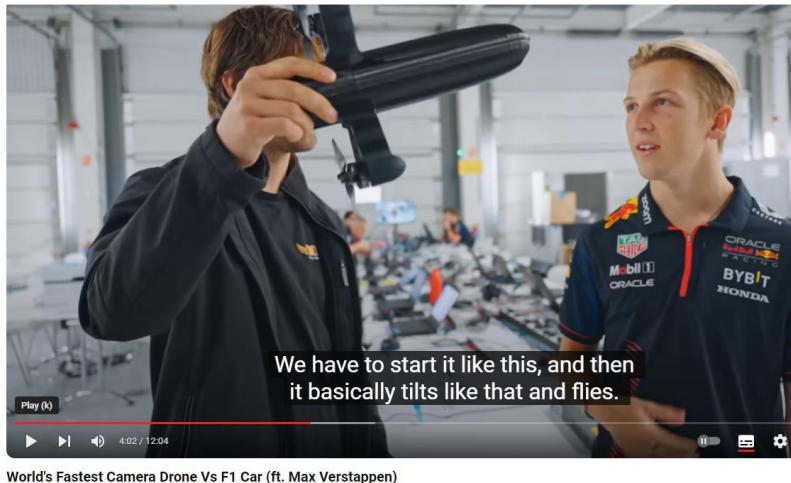
Tu-141 high-speed crashed in Croatia's capital Zagreb, no interception by Romanian, Hungarian or Croatian air force



Counter UAS



- Drone in air is < 20 min!
- At 60 km/h (category 0 max) 2km = 120 sec



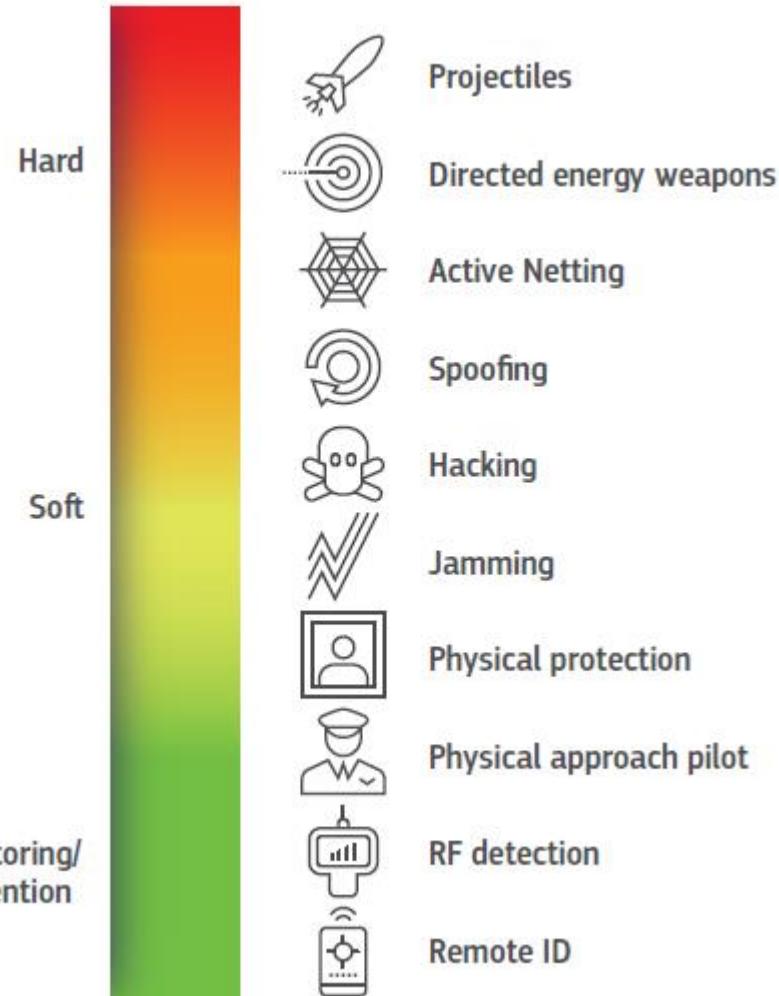
DRONE vs Formula 1 car



Burgemeester Bart De Wever gebruikt anti-droneapparaat tijdens opleiding Skyfall van politiezone Antwerpen

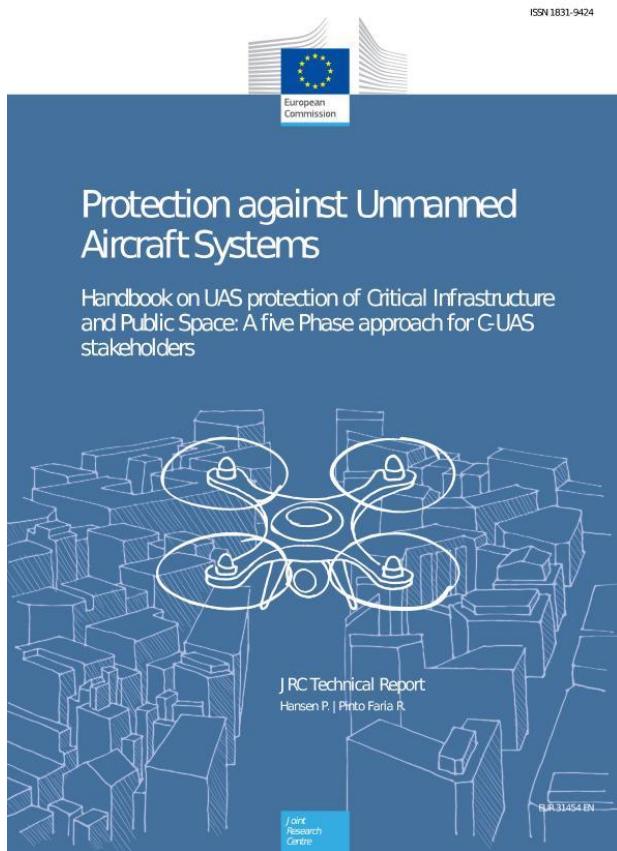
ANTWERPEN Vandaag heeft politiezone Antwerpen de Europese opleiding Skyfall afgerond. Tijdens deze driedaagse leerden politiemensen gebruik maken van anti-drone apparaten en de interceptiemiddelen. Burgemeester Bart De Wever was aanwezig bij het eindmoment en nam deel aan een demonstratie.

Caroline Van de Pol 14 okt. 2021 Laatste update: 14-10-21, 20:13

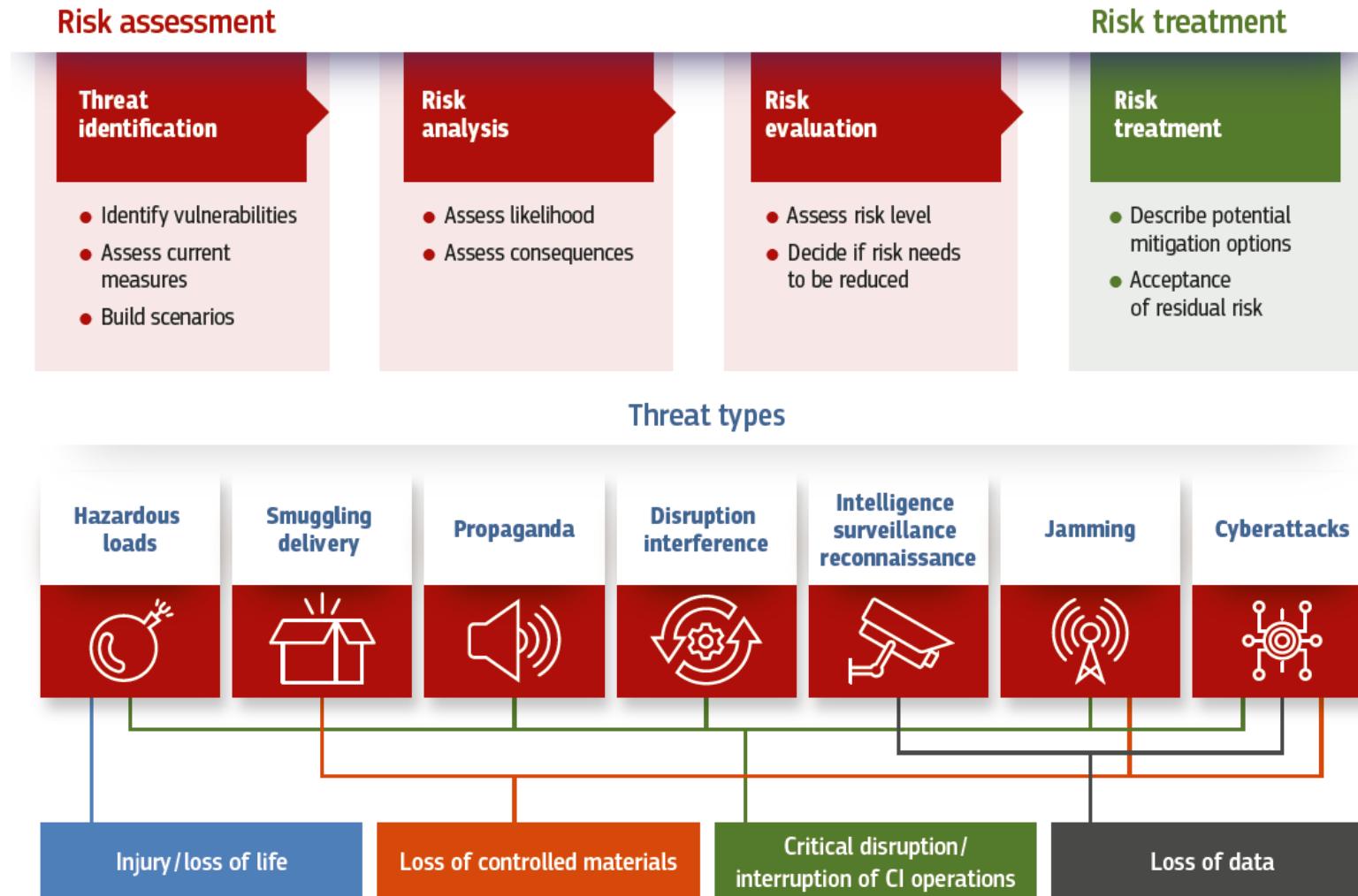


<https://www.hln.be/antwerpen/burgemeester-bart-de-wever-gebruikt-anti-droneapparaat-tijdens-opleiding-skyfall-van-politiezone-antwerpen-a33f37d5/?referrer=https%3A%2F%2Fwww.google.com%2F>

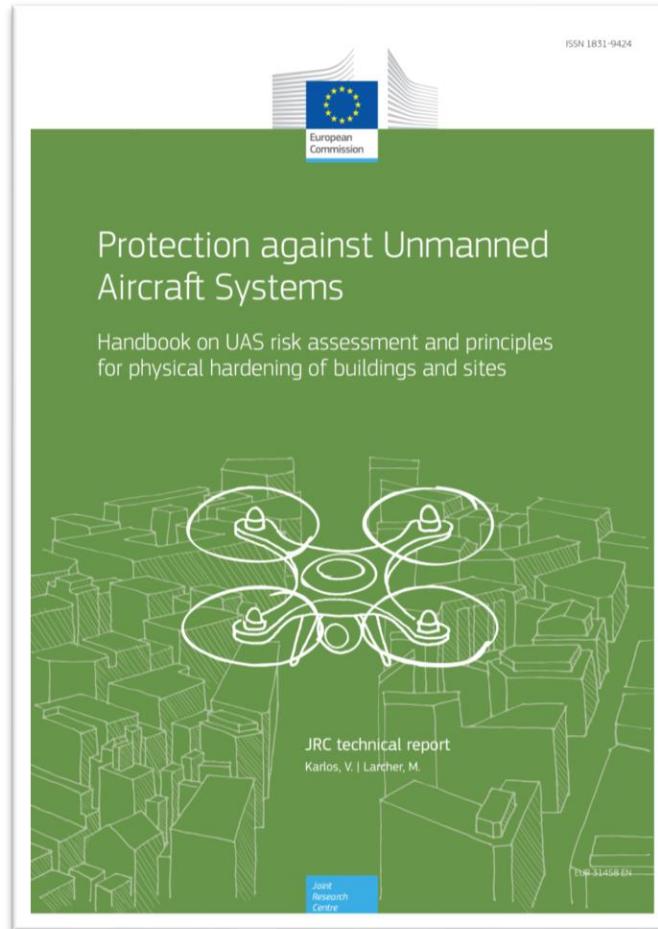
Handbook on UAS protection of Critical Infrastructure and Public Space: A five Phase approach for C-UAS stakeholders



What to protect against whom and where?

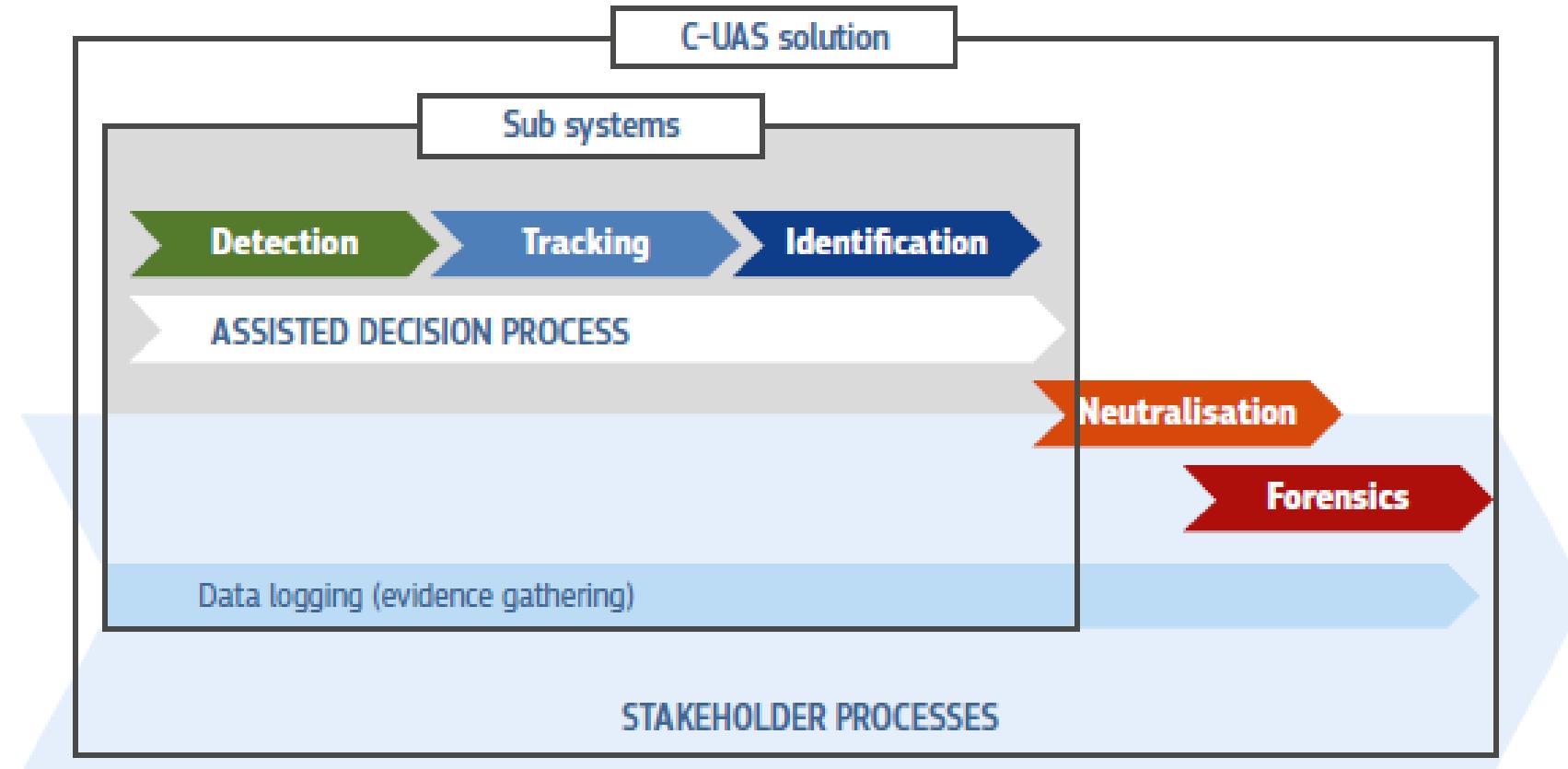


Risk Assessment & Principles for Physical Hardening of Buildings and Sites



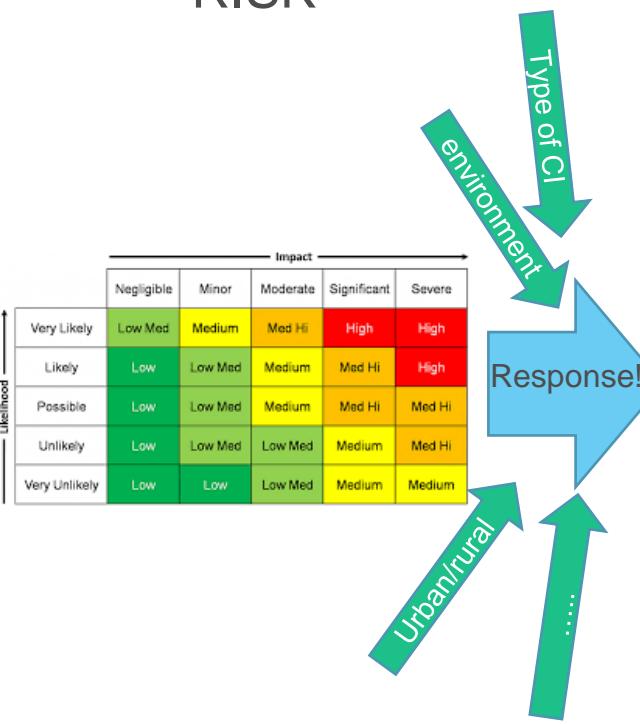
- Risk Assessment
- Physical hardening
 - Blast resistant windows/facades
 - Netting/fences
 - External building skins
 - Attenuation Solutions
 - Concealment and repositioning
 - Awareness Raising, geofencing and identification potential

Think solution instead of system

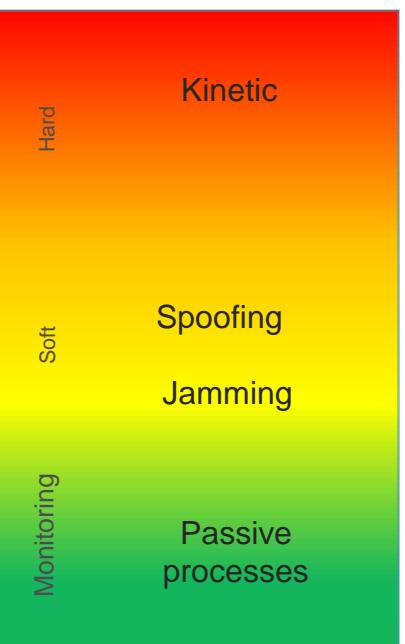


JRC DRONE project C-UAS solution model

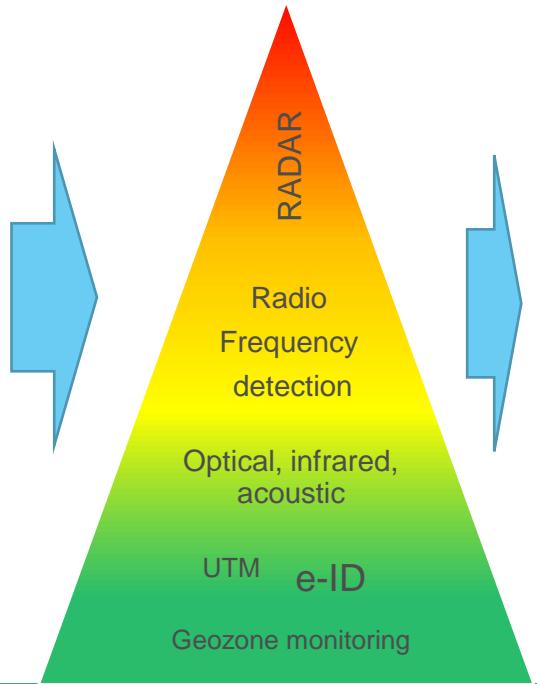
RISK



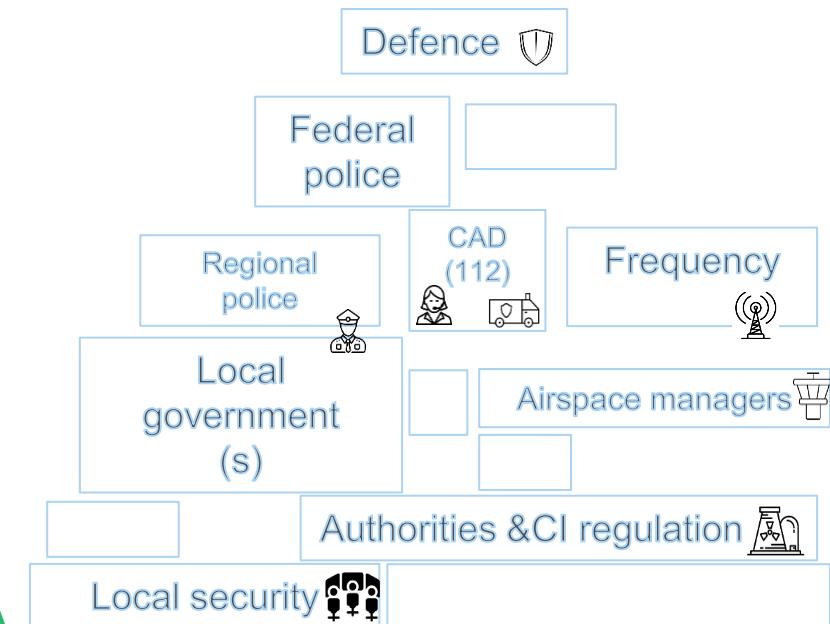
Mitigation



Technology needed



Stakeholders, process and systems integration



Foundation measures (Essential minimum services)

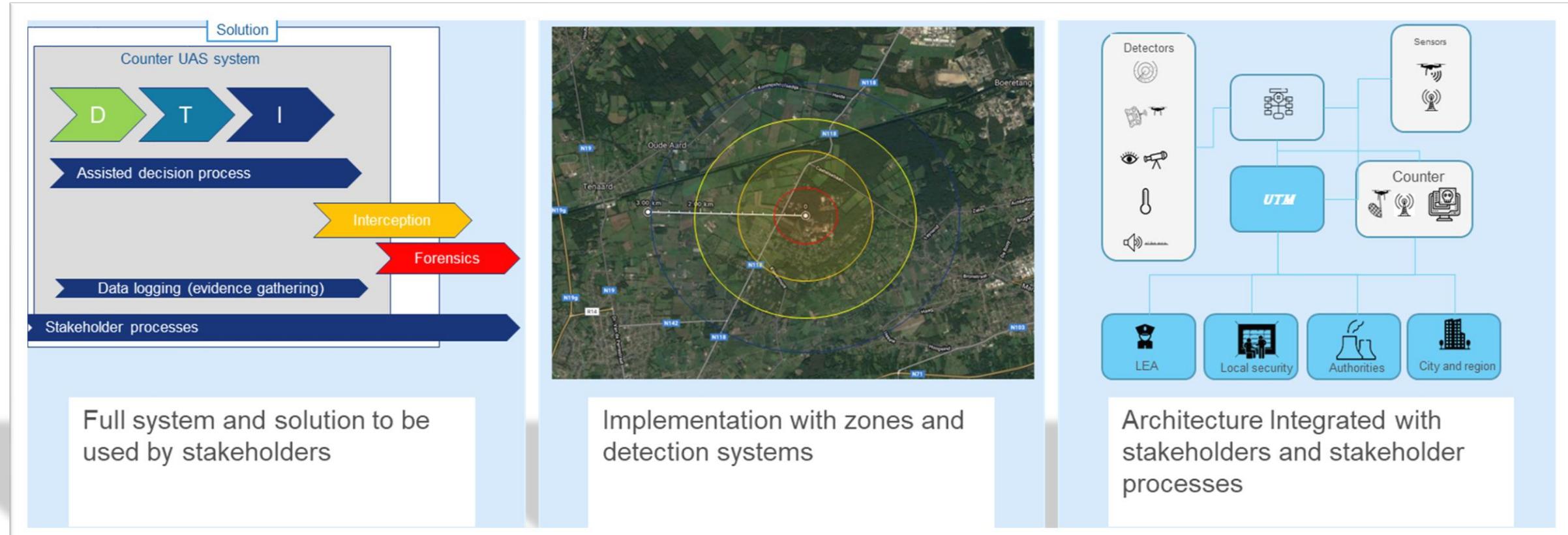
- Event logging
- GeoZone
- Physical protection
- RF monitoring
- Airspace monitoring
- Stakeholder communication
- ICT hardening

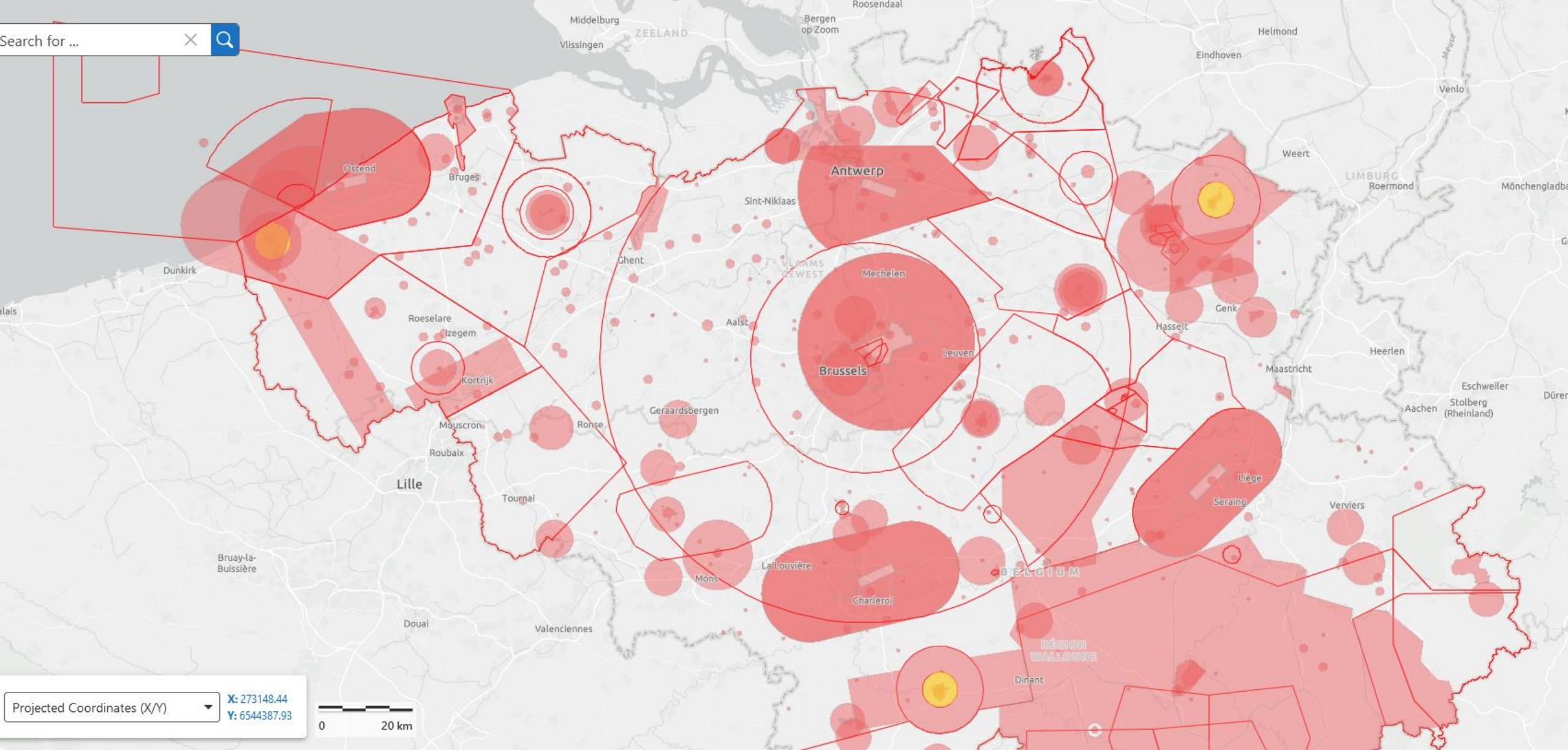
Interoperability is not (only) a technical challenge



Source: European interoperability framework (adapted).

Counter drones - JRC Geel site living lab



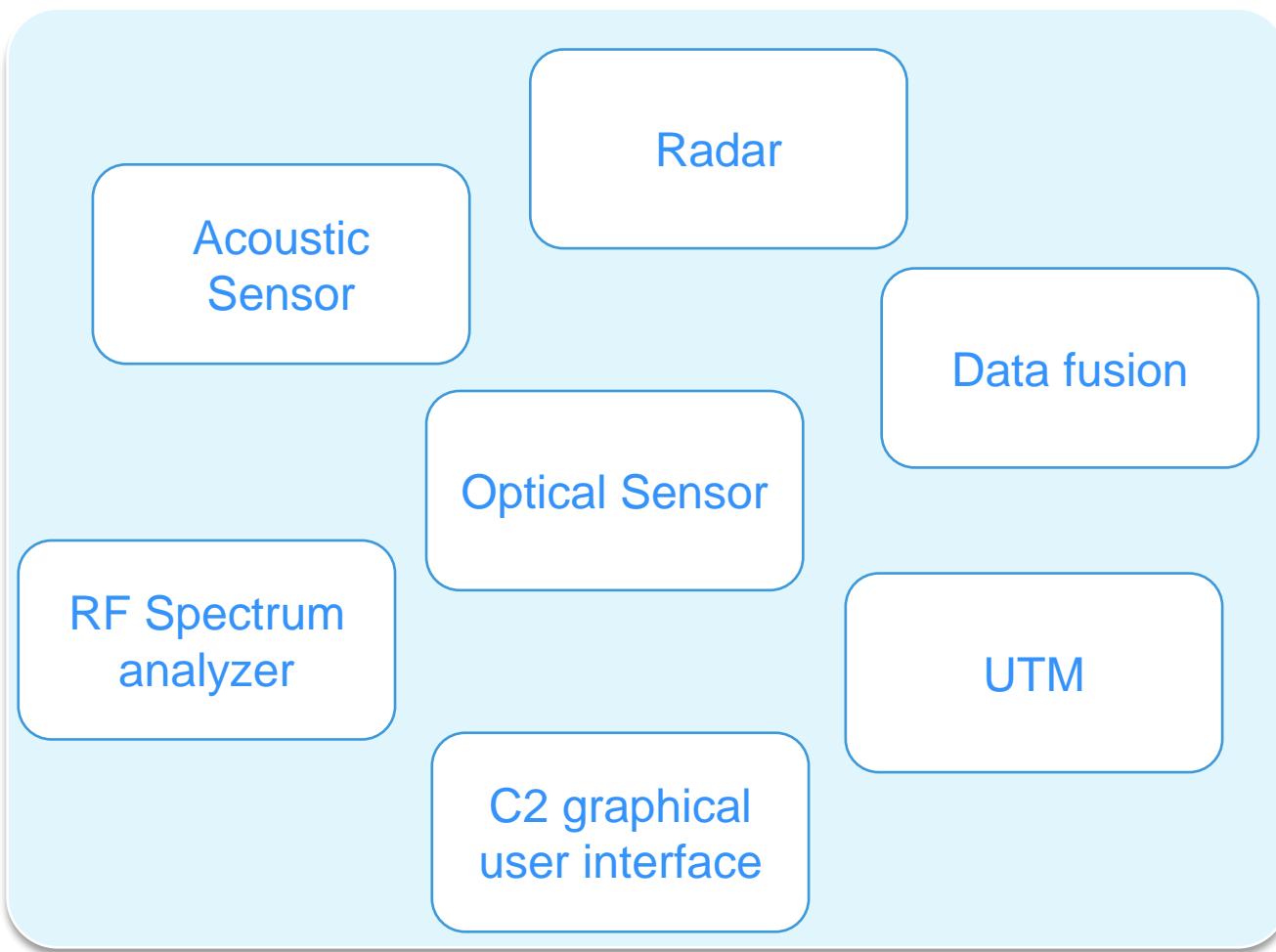


<https://map.droneguide.be/>

JRC no fly zone



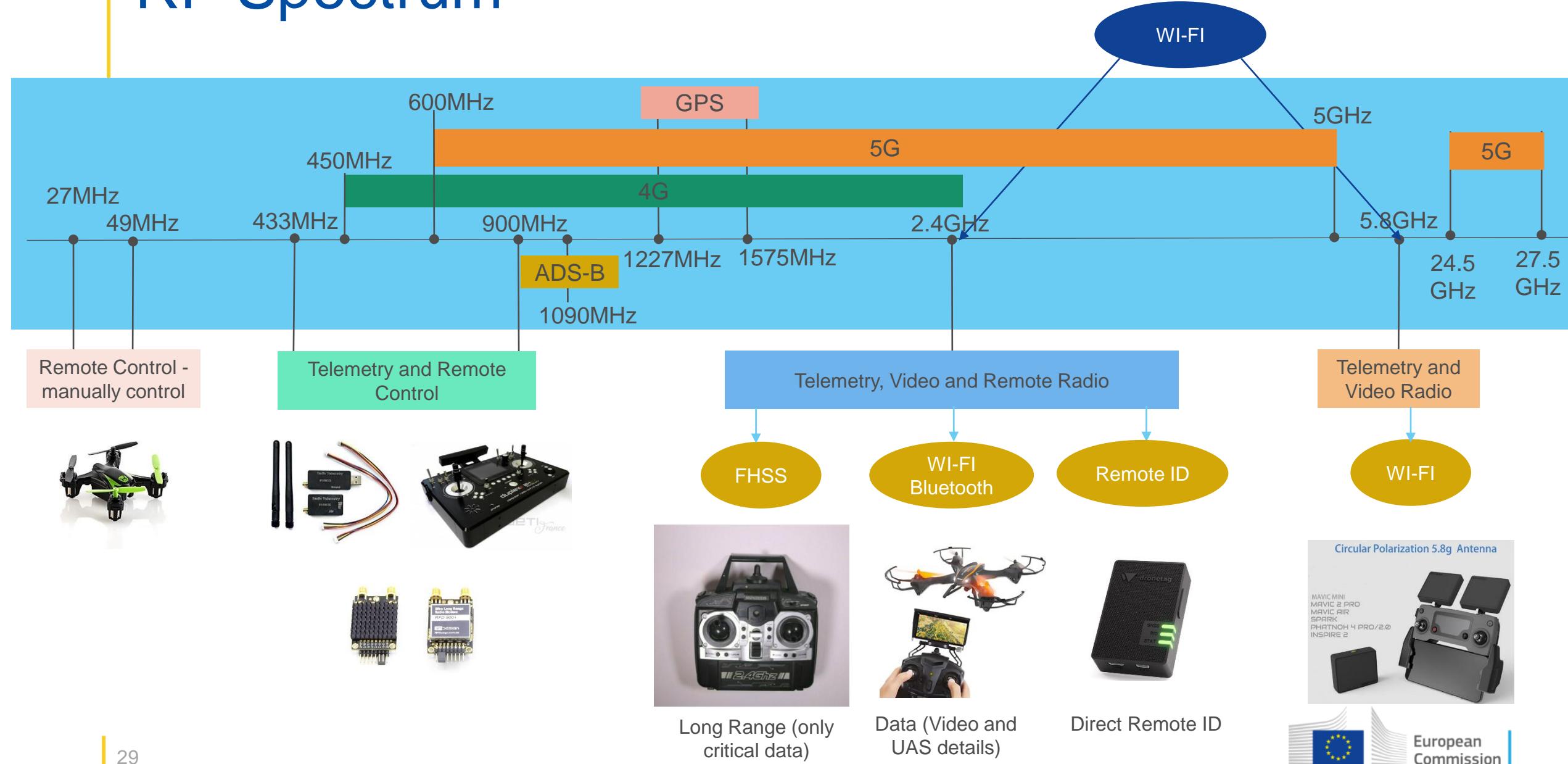
Living lab C-UAS modules



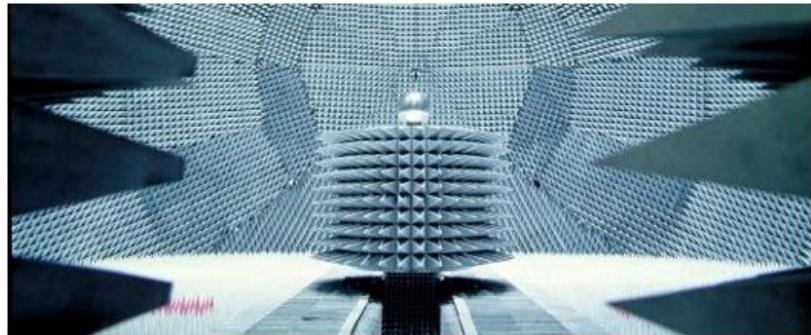
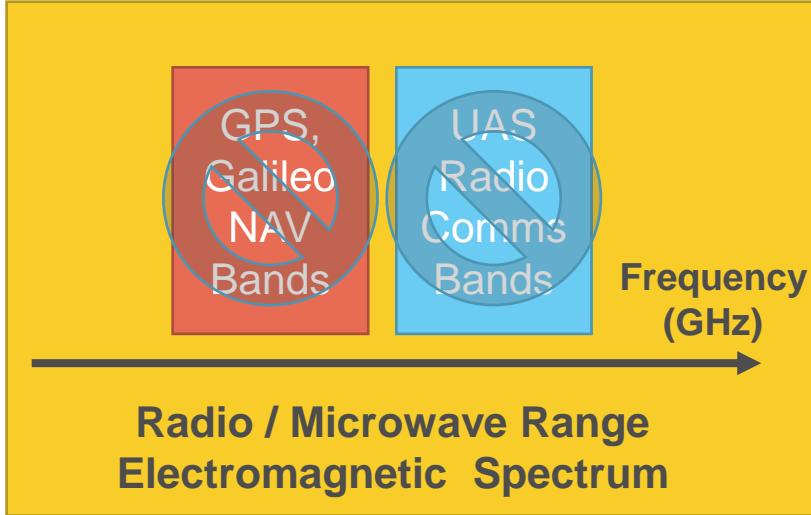
Benefits

- Training of stakeholders (LEA ...)
- Interoperability (C-UAS and local security)
- Simulation vs Real Scenarios
- C-UAS sensing Data (24/7 data for months)
- Live C-UAS Demo
- Tech Report(s) on C-UAS

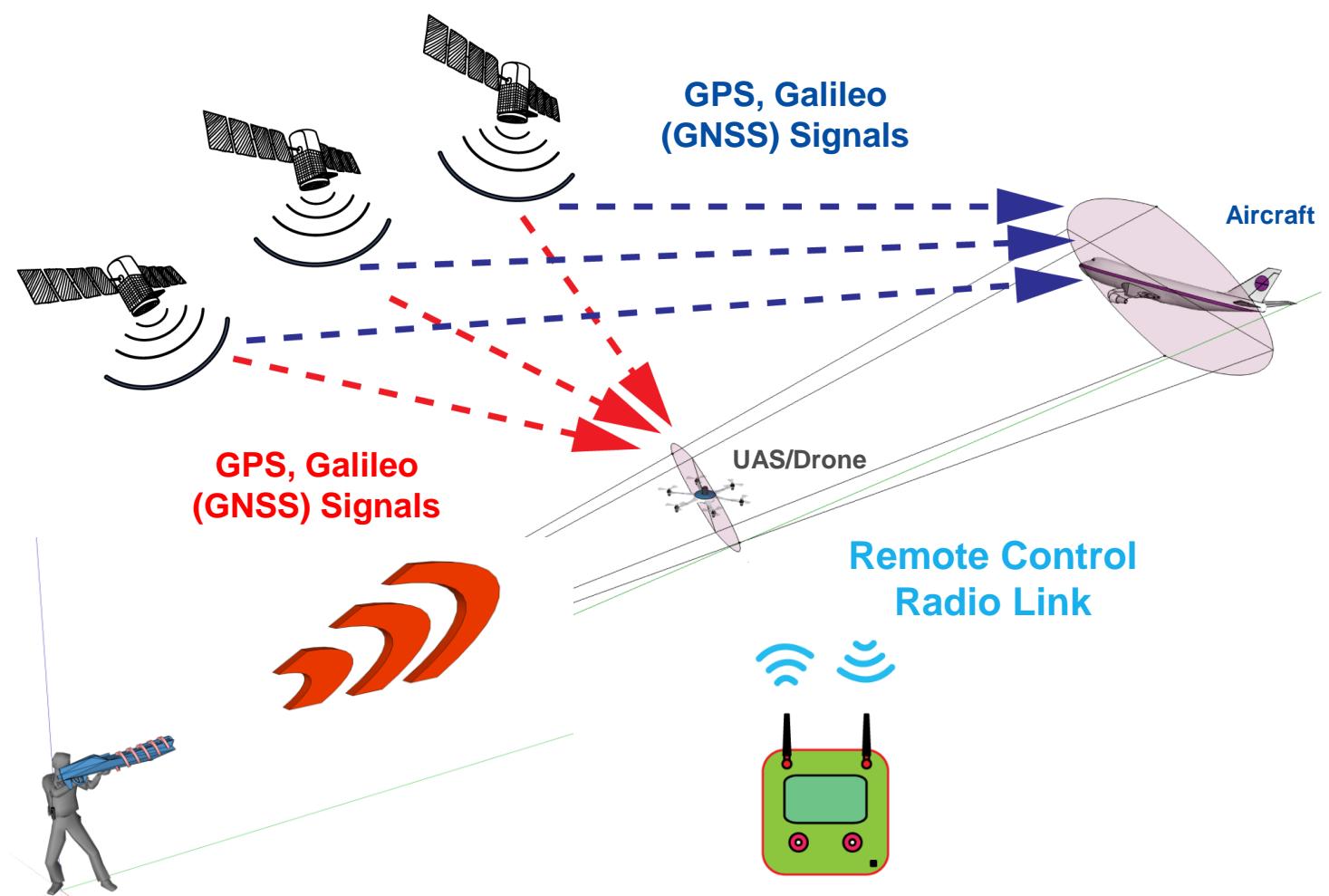
RF Spectrum



C-UAS Jammers: Denying the COMMS / NAV Functions



C-UAS
Jammer



Security Flaws awareness – Counter C-UAS



A security flaw that can render certain types of counter-UAS solutions inoperative



HIGHLIGHTS

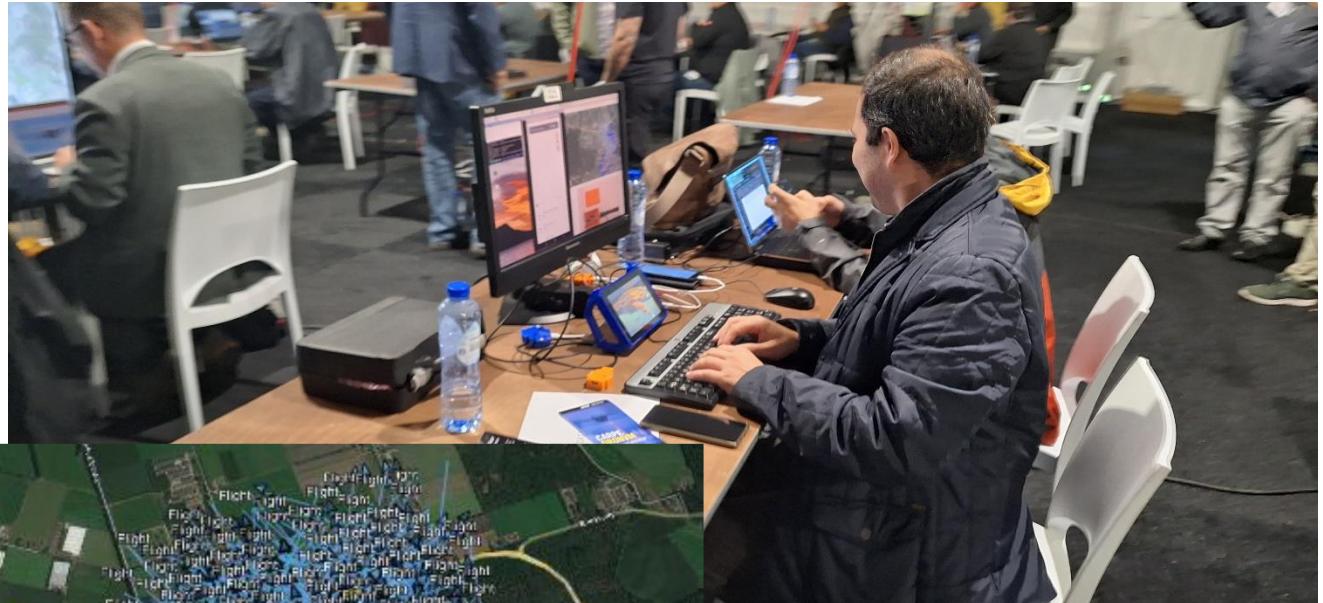
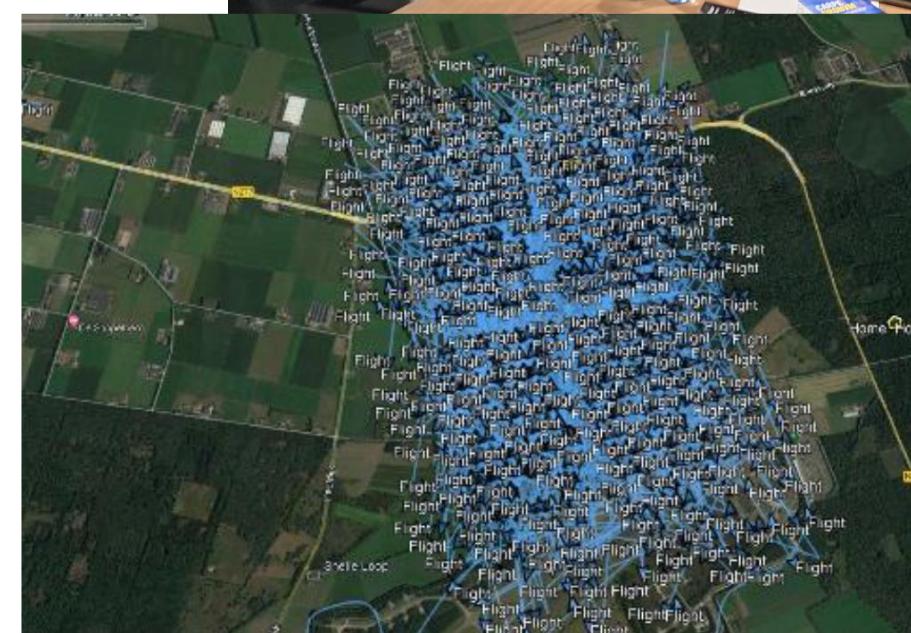
- The use of unmanned aircraft systems (UAS) is becoming widespread in many areas, and U-Space services are maturing in parallel with the implementation of the new UAS regulations.
- Counter unmanned aircraft systems (C-UAS) are technology solutions developed to protect critical infrastructure, public spaces and the security of the citizens from UAS misuse.
- Certain types of C-UAS solutions are vulnerable to spoofing attacks, in which numerous fake drone signals are detected by the C-UAS, thereby overloading the system and rendering it inoperative.

Context

Whilst the commercial applications of **unmanned aircraft systems (UAS)** [1], commonly called "drones" are extensive and exciting, there is also the clear risk of misuse. UAS can support malicious activities involving the physical attack of infrastructure or citizens, surveillance including espionage, cyber operations to breach privacy or support disruption, criminal logistics including theft and disruptive harassment. **To detect and protect against malicious use of UAS**, counter UAS (C-UAS) systems are starting to be deployed. These systems can be used in protecting a public area or critical infrastructure. How effective are these systems? What happens if the C-UAS have certain **vulnerabilities** that can compromise their operation? How can we test their reliability?

Unmanned aircraft systems operational communication

A commercial UAS has communication channels set up between the drone and the drone pilot's controller. This is done using standard Wi-Fi router technology, sending video frames and flight data [2] to the pilot. The pilot receives



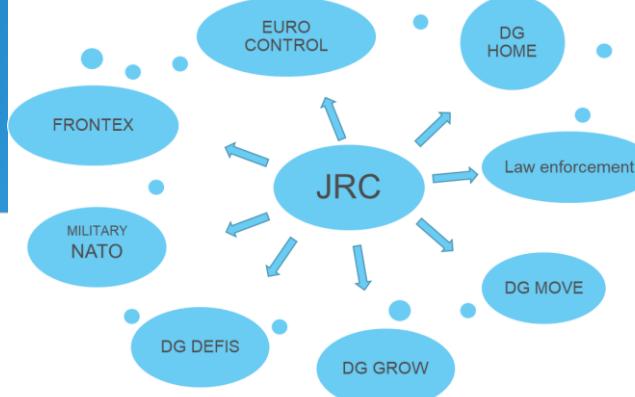
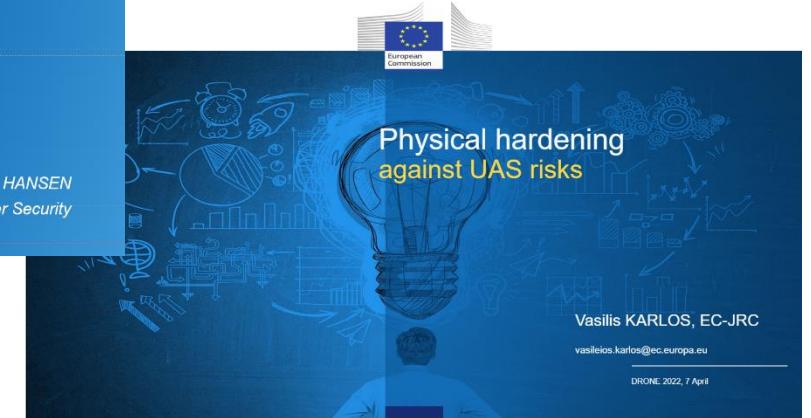
C-UAS mobile RF systems



Conclusions

- Anticipation: very challenging domain.
- Collaboration: multiple fields of expertise, requires cross sector/domain collaboration.
- Potential for civil/defence/space synergies.
- Cross-cutting field with many different sectors and stakeholders: governance and interoperability is required on the technical, semantic, organisational and legal level ... a lot of dots to connect.

JRC competences



Thank you and questions!



https://joint-research-centre.ec.europa.eu/scientific-activities-z/drones-counter-drones-and-autonomous-systems_en

Contact: Paul Hansen, Bartel Meersman
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