

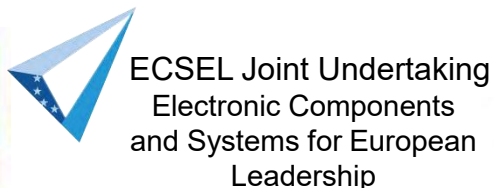
SARxUTMxG

Search and Rescue with Unmanned
Traffic Management and xG 2025-2027

Åke Sivertun - RISE

Alexander Sandström - Remote Aero AB

Vinnova project 2024-01722 2025 - 2027



Purpose of the Project

- * Is to investigate existing infrastructure as support for several different essential services with unmanned vehicles beyond visual range in action research
- * As an example, we use Sea Rescue but want general conclusions
- * We study mobile networks as carriers of cyber-secure Positioning based on GNSS (GPS, Galileo, GLONASS & BeiDao) and Swepos nRTK support service etc. for secure positioning
- * Mobile networks for Navigation and Communication with UXV
- * Unmanned Traffic Management system (UTM) for planning and safe execution of flights

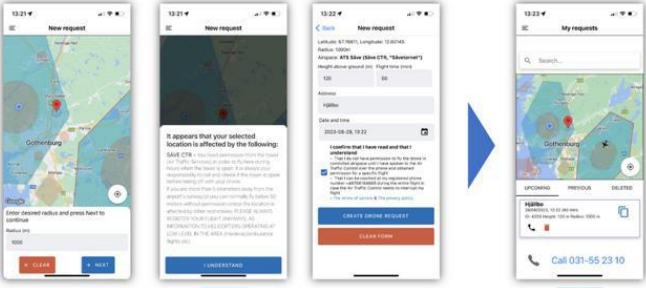


Project journey and collaboration partners

- **RISE Collaborative Unmanned Systems** – project manager – **Åke Sivertun**
- **Remote Aero AB** – builds telemetry and radio systems – **Alexander Sandström**
- **Swedish Maritime Rescue Society (SSRS)** – problem owner and test operator – **Fredrik Falkman**
- **Naviation** developing DroneRequest for airspace traffic monitoring – **Mattias Wellander**
- **Tele2** provides us with mobile IoT adapted for UXV – **Linda Ekener Mägi**
- **Tre3** provides us with 5G SA for, among other things, analysis of connection slicing – **Göran Berglund**
- **Teracom** with 450 MHz and 2.3 GHz connection in governmental networks – **Pontus Berg**
- **Ericsson Electronic Device (EDA)** for signal and QoS measurement – **Per Jarnehammar**

Dronerequest Mobile App



The Dronerequest mobile app allows drone pilots to **notify others** of their flight. It **guides drone pilots** by indicating the locations of controlled airspace and restricted areas, and provides information on **other air traffic** in the area.




Controlled Airspace
For flight within controlled airspace, the process is further streamlined when the airport tower is equipped with the Dronerequest tower interface.

U-space
Features for digital flight authorization (including automatic authorization in dynamic geozones) will be available for areas within U-space.


External sharing
When you submit data on a drone flight in Dronerequest, the relevant information is shared with select third-party platforms and apps. This **enhances flight safety** by providing means for crews of manned aircraft (such as VFR pilots, **ambulance** or **search-and-rescue** helicopters) to see your drone in advance. This is particularly helpful for low-level operations where air traffic is not typically expected.



Location warnings
If the Dronerequest app is running and you have submitted a request for drone flight inside controlled airspace, you will receive **warnings** if you move **outside of that area**. A safety feature if you are actually flying outside of the area, and if you have packed up and left site it serves as a reminder to properly close your flight with air traffic control.




Conflict warnings
If you submit an area for drone flight and our platform detects **overlapping drone activity**, Dronerequest users will receive a conflict warning. Users of other products (similar to Dronerequest) might receive such warnings as well (these products may for instance subscribe to our conflicts API & database).



When operated outside of U-space the Dronerequest platform provides traffic information for UAS operators, air traffic control units, and manned air traffic, allowing **each to make their own safety decisions**.

The app will tell pilots what airspaces or restrictions affect their requested area. The app will tell **how to obtain clearance** if inside a controlled airspace.



What needs should be solved? (What and for whom)

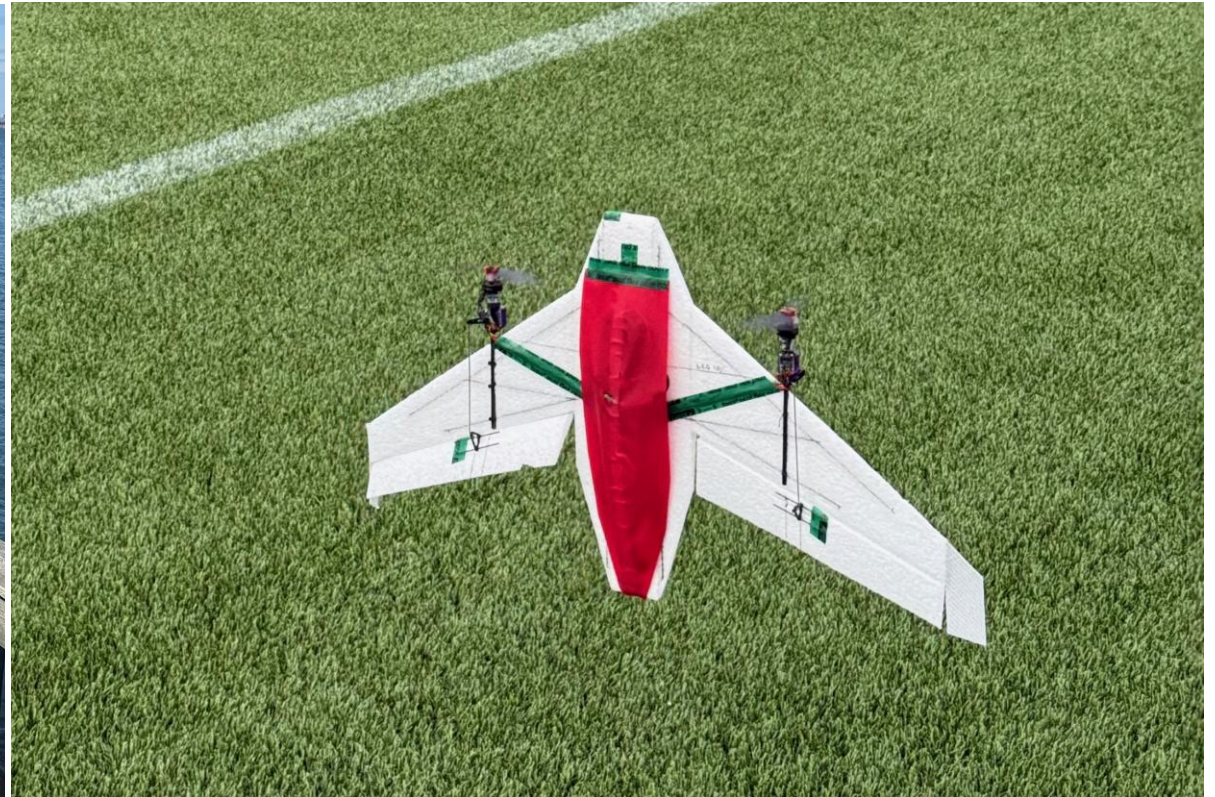
- Safe flight but also safe operation – Save Lives + All staff
- Be able to fly in most weather and other conditions beyond visual range
- Have Cybersecure PNK(t) to prevent disruption
- Communicate with control centre to avoid collisions and camera for extended Line of Sight and provide a comprehensive situational picture
- Can initially be carried by a 249g UAV
- Agile regulatory framework - does not compromise on safety but utilizes new technology
- Find the foundation to open the actors for implementation

Two Test Vehicles ca 249g

Catapult rapid launch



VTOL Vertical Take Off and Landing



Test Areas in Gothenburg

remote.aero

eosdrone3

92% / 16.12V

GoTo reached

Gimbal-mode POI

Target airspeed **V_{min} 12 m/s**

Airspeed 12 m/s (24 kn)

Groundspeed 7 m/s (13 kn)

Wind 6 m/s Direction **178°**

Target altitude **50 m (RTH)**

Altitude 60 m (AMSL)

Loiter radius **50 m**

arholmen

h264_libca...

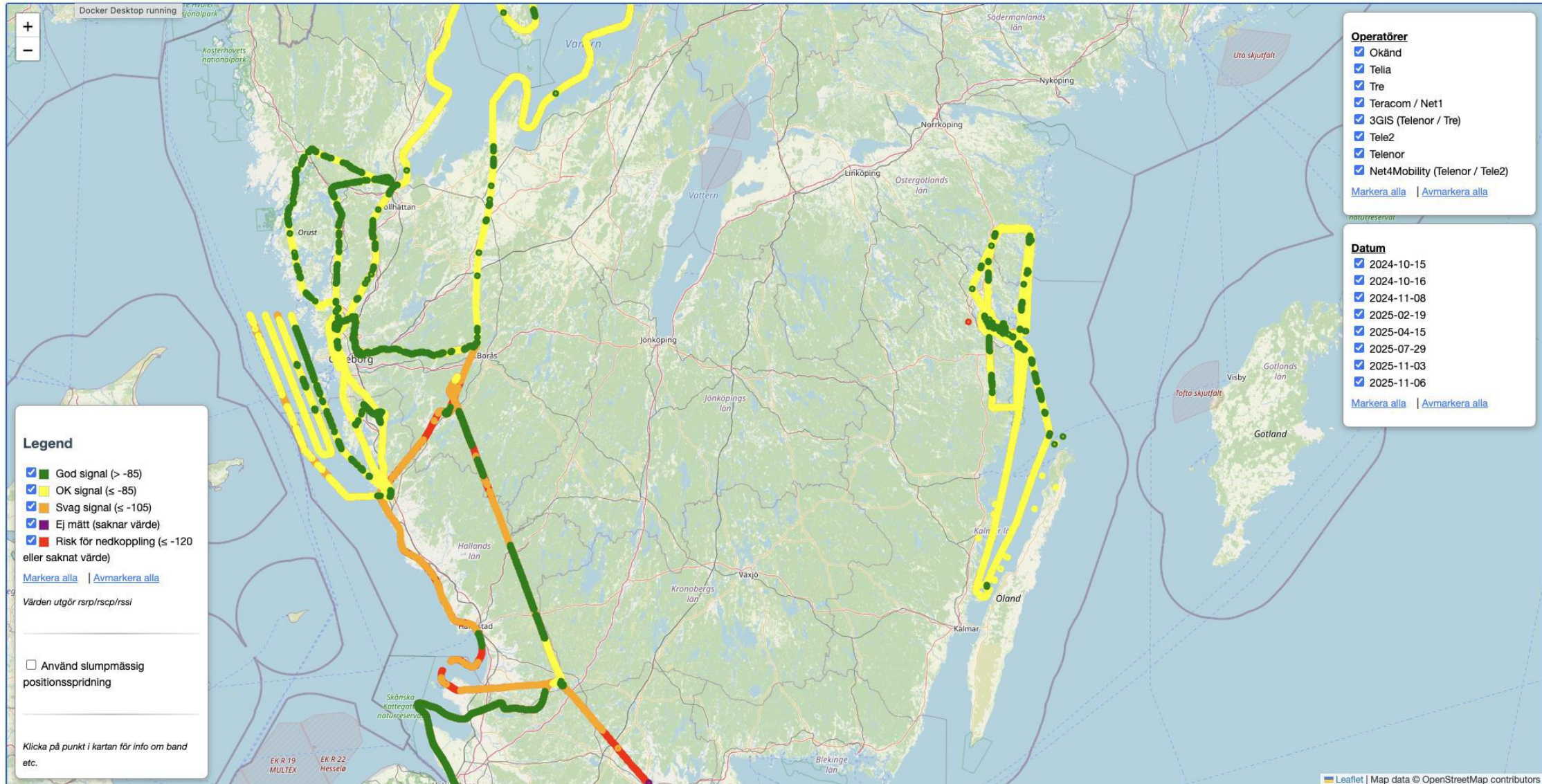
SWITCH CAMERA START VIDEO STOP VIDEO RESTART VIDEO REBOOT VIDEO

- VINGA**
 - > UAS X
 - GND - 700 ft
- ES R93**
 - > STYRSÖ X
 - RSTA GND - UNL ft
- ES R104B**
 - > KÄNSÖ X
 - RSTA GND - 9000 ft
- ES R104A**
 - > KÄNSÖ X
 - RSTA GND - 9000 ft
- ES R104**
 - > KÄNSÖ X
 - RSTA GND - 9000 ft

100 m

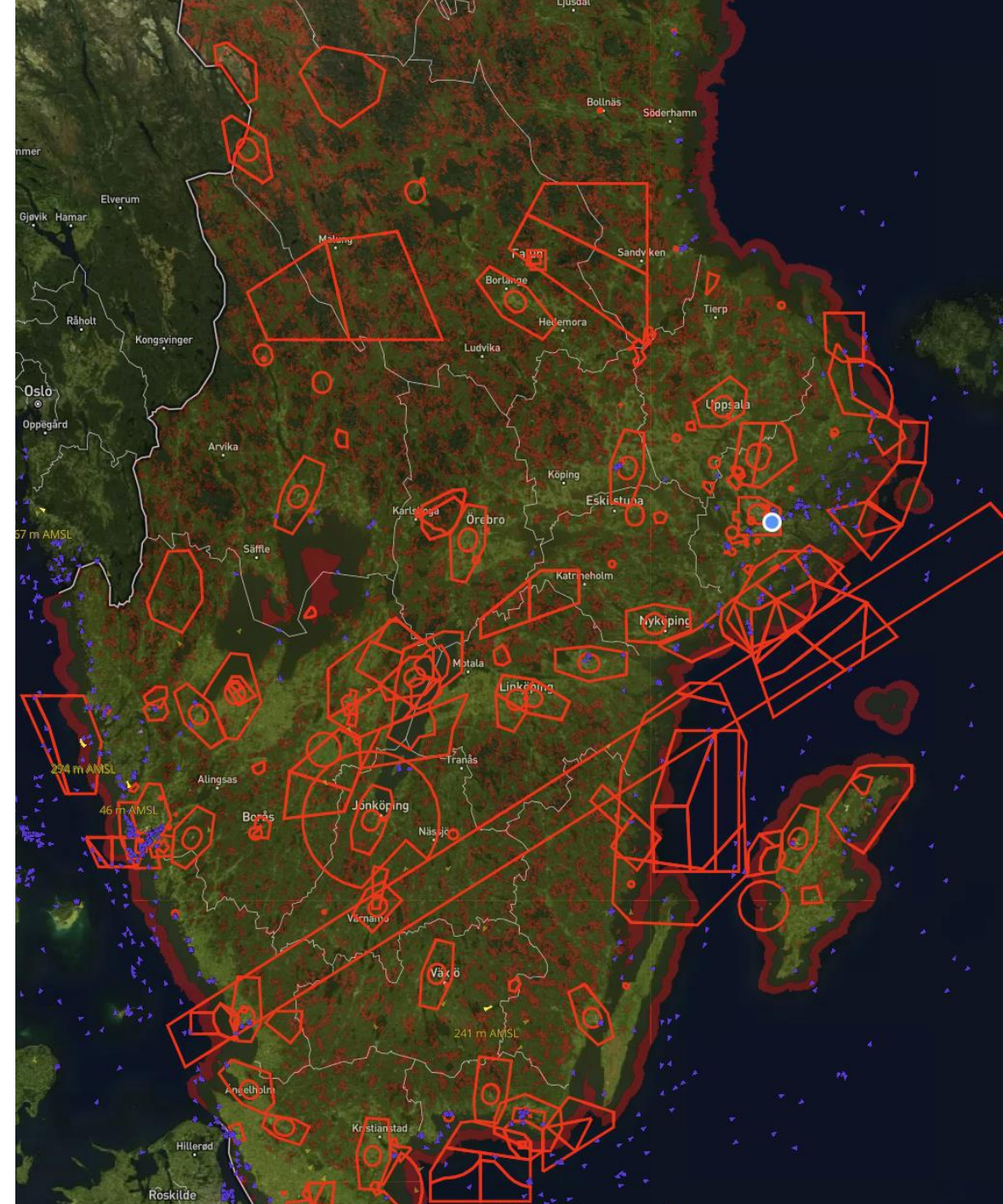
15/06/2020

Extended Measurements of Connectivity and QoS



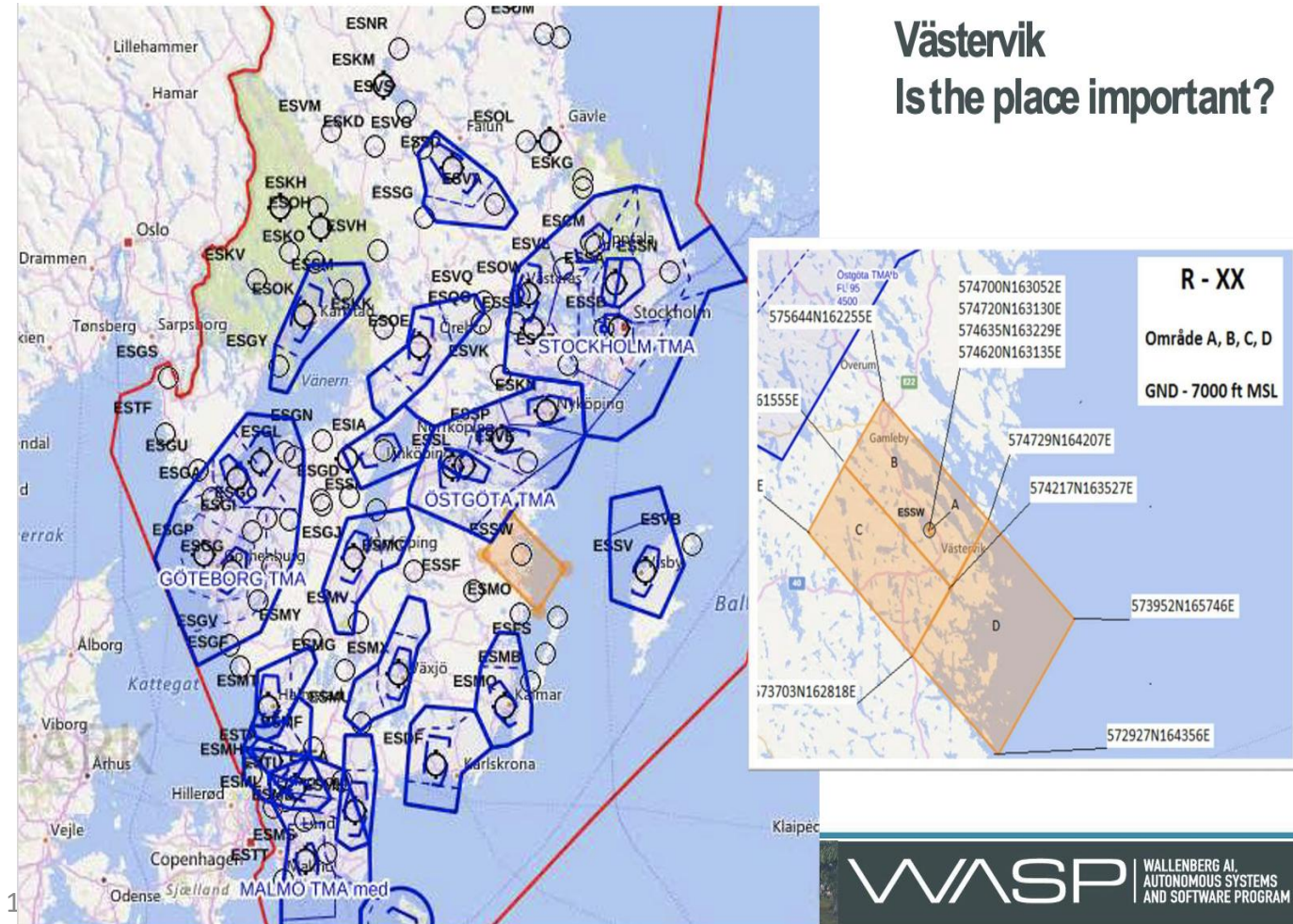
Lessens Larned

- Many sources of error, requires robust (joint) troubleshooting
- Dynamic planning requires other tools (SA)
- Application-specific behaviours
- Operator specific conditions
- Available bandwidth/signal strength
- Link loss and latency



To fly UAVs out of sight with autonomy requires;

- * Access to the Mobile Network which makes you independent of less secure radio - transmitters w. limited range.
- * Geographical area without obstacles for BVLOS but access to areas that you want to test on forest - land - sea
- * No prohibited or unwanted objects/activities that make it difficult to obtain permission to fly
- * Can be cancelled as an R area in the Geographical UAS zone when flying and testing without risk of collisions



Västervik
Is the place important?

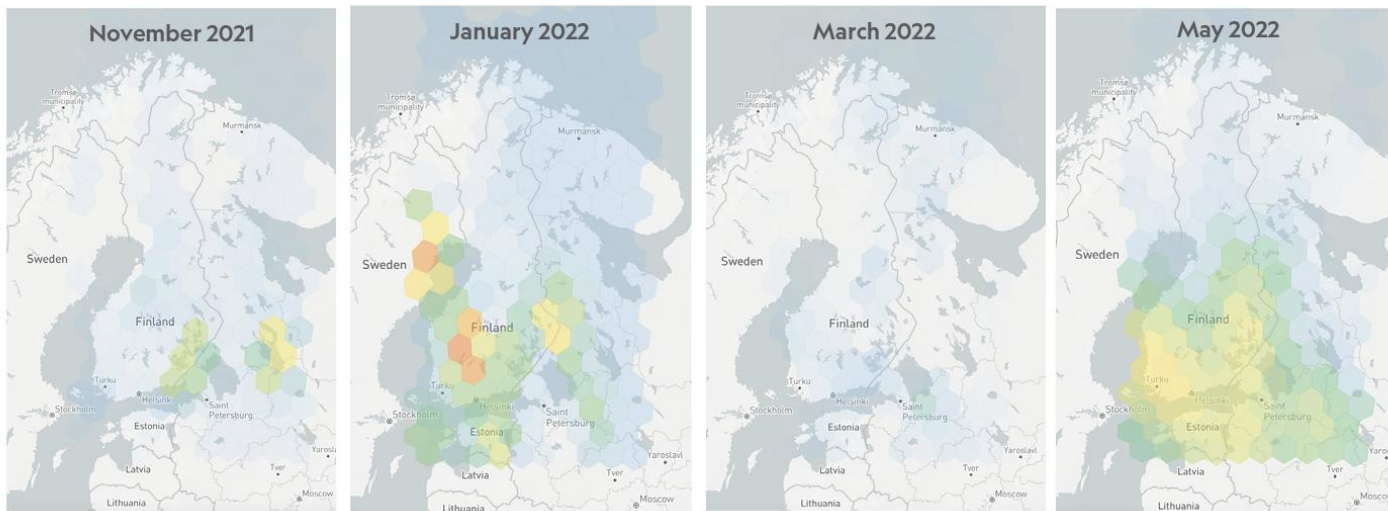
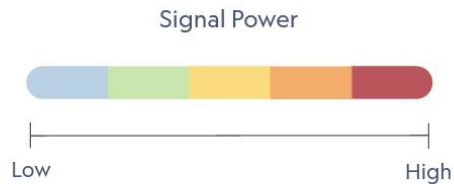
Västervik Drone Science Park, SE. Est 2017 with support from Innovation Authority VINNOVA
Acc Innovation, DroneRequest, SAAB, Combitech, Baracuda, KTH, LiU, FOI, SKYTEM (DK), Odense TB Universitetet Esbjerg WASP-WARA-PS, Trafikverket, Vattenfall, MSB, Polisen, SOS, Sjø, Kustb, GB MD, Royal Marines, Luftfartsverket, Södra, Telia, Tre, Tele2, Teracom Telenor, Ericsson

The airspace is possible to use for the largest, fastest and highest - flying UAVs with different sensors and for important tasks



FIGURE 1

Increase in GNSS Interference from November 2021 to May 2022 (GPS L1) in Finland and surrounding countries.

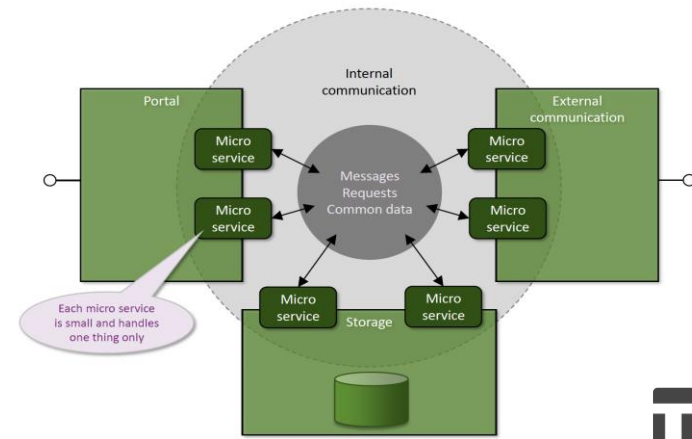


SWEPOS and STRIX to detect and correct Cyber-secure eID, navigation positioning and C3

Instead of building a monolithic component the Spatmos server is broken down into a number of internal micro services, sharing well defined interfaces. This makes it easy to expand or replace parts of the system.

Micro service advantages:

- Modular
- Flexible
- Adaptable
- Scalable



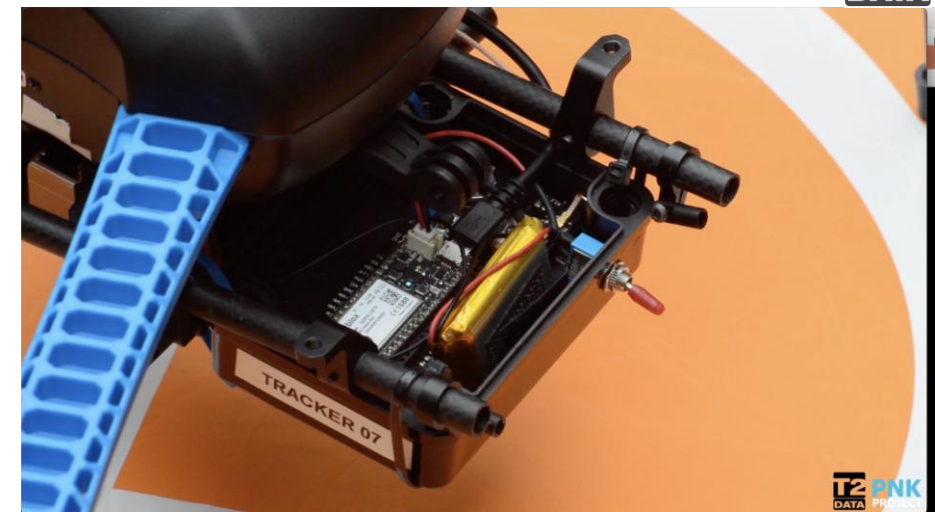
Protect, Detect and Mitigate GNSS Spoofing in Autopilots

Webinar on demand

Guest speakers:

DX4 autopilot **spirent** **zipline**

• SPOOFED



Störningar i GPS-system

per dag (Källa: gpsjam.org)

Dec 26 2023

svt

SVERIGE

ESTLAND

LETTLAND

LITAUEN

Kaliningrad

POLEN

Och det är Ryssland som pekas ut
som ansvarig för attackerna.

Achieving reliable augmented GNSS performance for autonomous UAS navigation

How to get GNSS reliability forecasts for the possibility of more frequent BVLOS flights

Line of sight to four satellites is a minimum requirement for reliable GNSS performance

Signal dynamics are constantly changing

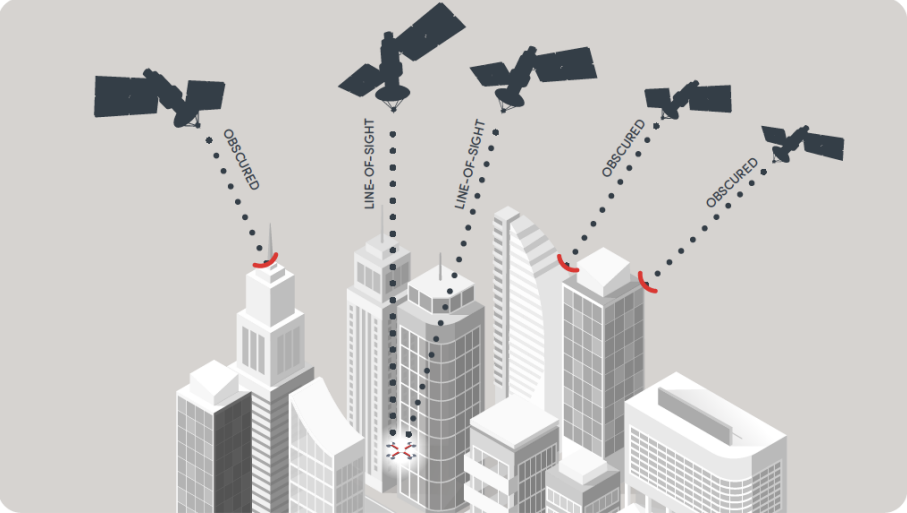
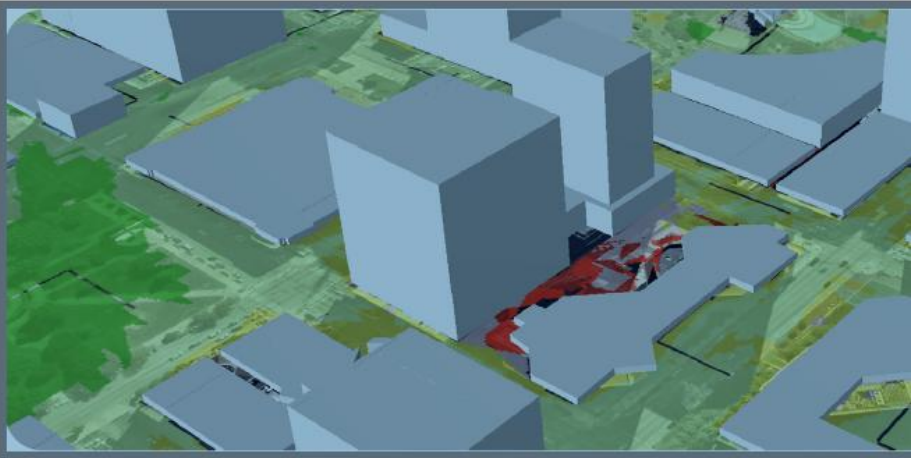
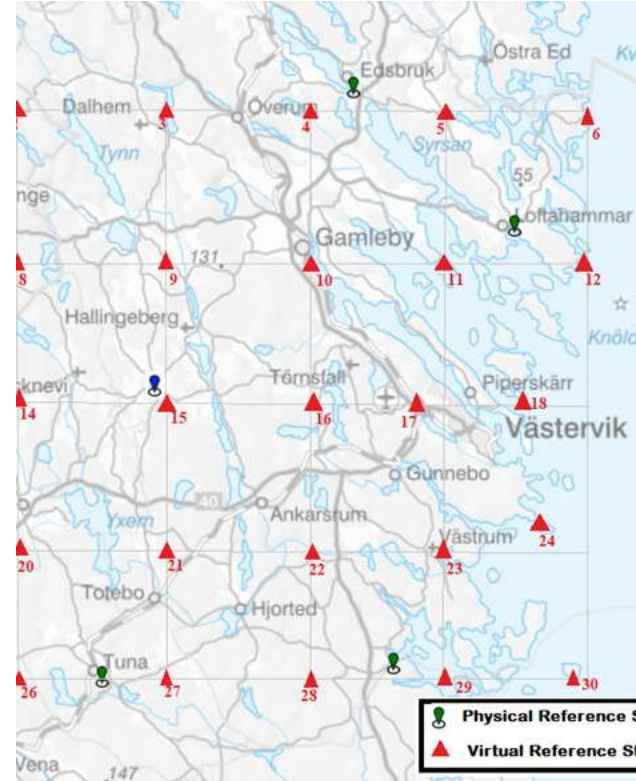


Figure 1: Satellite signals can be blocked by buildings, creating patches of poor GNSS reception



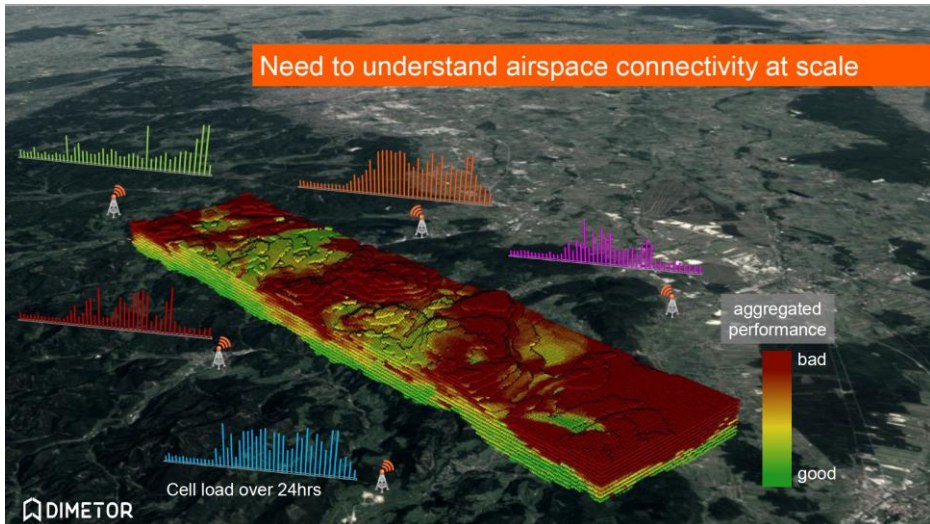
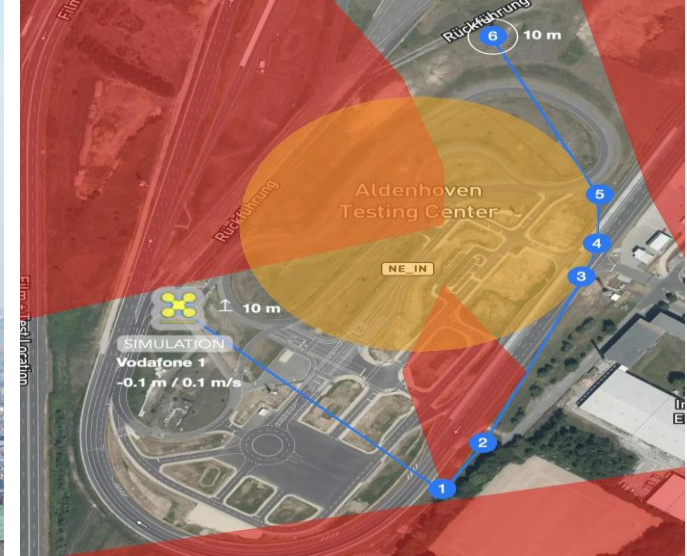
Quality of Service assured & Cybersafe GNSS Positioning via SWEPOS nRTK and 3GPP



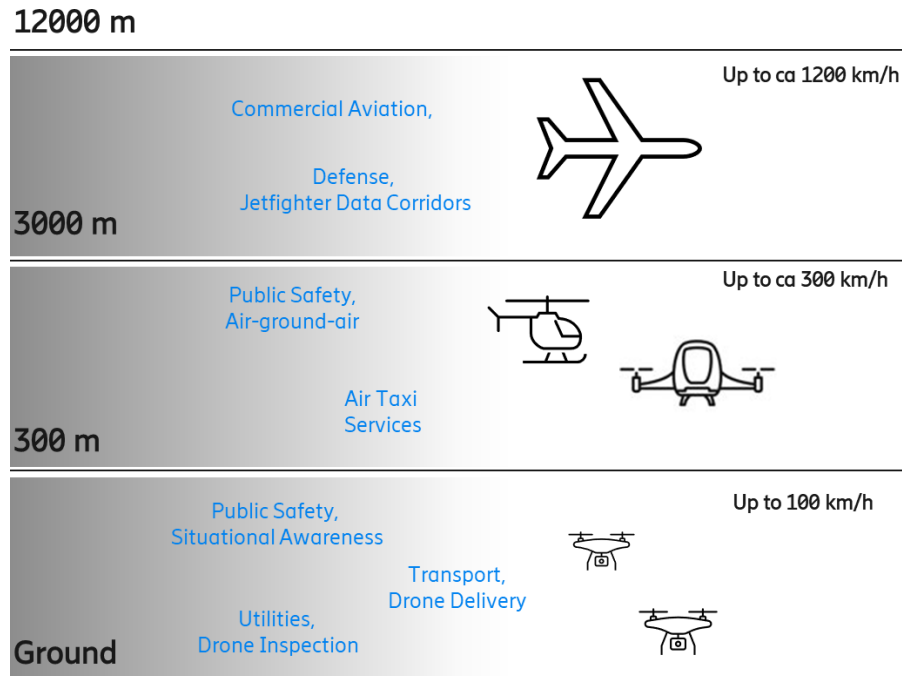
Redundant cm positioning, navigation and communication in real Time for UAVs and other autonomous vehicles also when GNSS – GPS/ Galileo /Glonass / Bei Dou / are not available or disrupted

GSMA Partners i PNK4UTM for BVLOS operations 4 - 5 - 6G

Telia, Tre, Telenor, Tele2, Teracom, Ericsson, RISE, AstaZero,



The result from the PNK4UTM shows that UXS can use the 4-5G networks

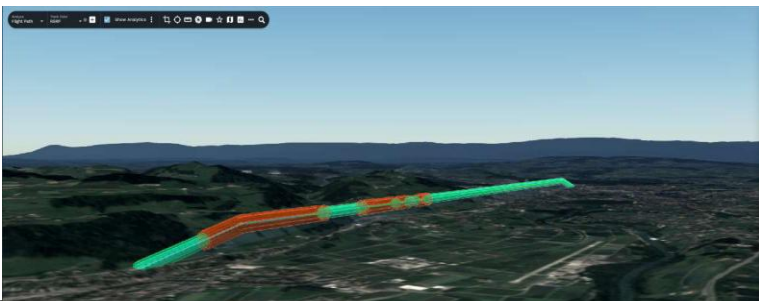


Medium Altitude AIRSPACE (up to 3000 m)

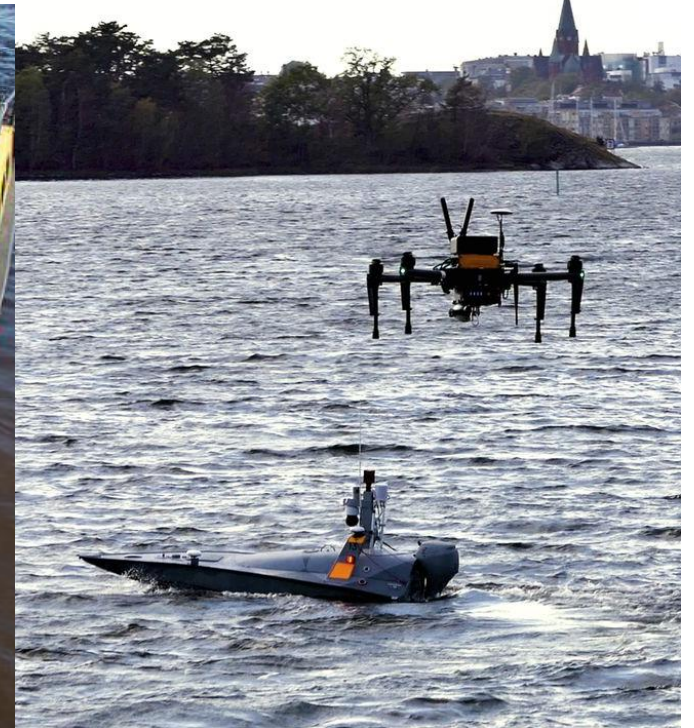
- Dedicated network designed for coverage in the air. Dedicated spectrum license.
- Existing Ericsson 5G RAN and 5G core portfolio. Massive MIMO beamforming is required.
- Doppler effect compensation for high speed
- Potential new Ericsson Digital Airspace Software Product to enhance performance (not mandatory)

Low Altitude AIRSPACE (up to 300 m)

- Utilization of existing CSP networks with enhancement
- Reuse existing spectrum license
- Upgrade RAN hardware to massive MIMO and beamforming to enhance coverage and quality
- Potential new Ericsson Digital Airspace Software Product to enhance performance (recommended but not mandatory)



SAR – UAS - Maritime rescue assisted with UAS



Shared airspace UAV and Air Force with Guardian UTM

Search for postcode...

UTM Zone: Vastervik Demo

Close Airspace

No-Fly Zones

Track Info (All): OFF



Aircraft

ID: SIMULATI...

HEADING

90.00°

SPEED

0.00m/s

ALTITUDE

328ft

CLIMBING

-

OPERATOR DETAILS

George Stanford

Contact Number:

+44 7850 240655

FLIGHT PLAN DETAILS

Title:

Simulated Flight 2.1: Powerline Inspection

Description:

BVLOS, x5 flights through the day assessing the powerline

Start time:

07:30 GMT

End time:

20:30 GMT

Approved Flight Plan Id:

fc9411b1-abb6-47b8-a4eb-02ad1f2441f9

LOCATION:

Latitude

57.79418°

Longitude

16.524467°

SOURCE:

AA.Surveillance.EventHubs.Writer

LAST UPDATED:

06:35:52

Congratulations ACC - Innovation & Västervik Drone Science Park SE Thank You!

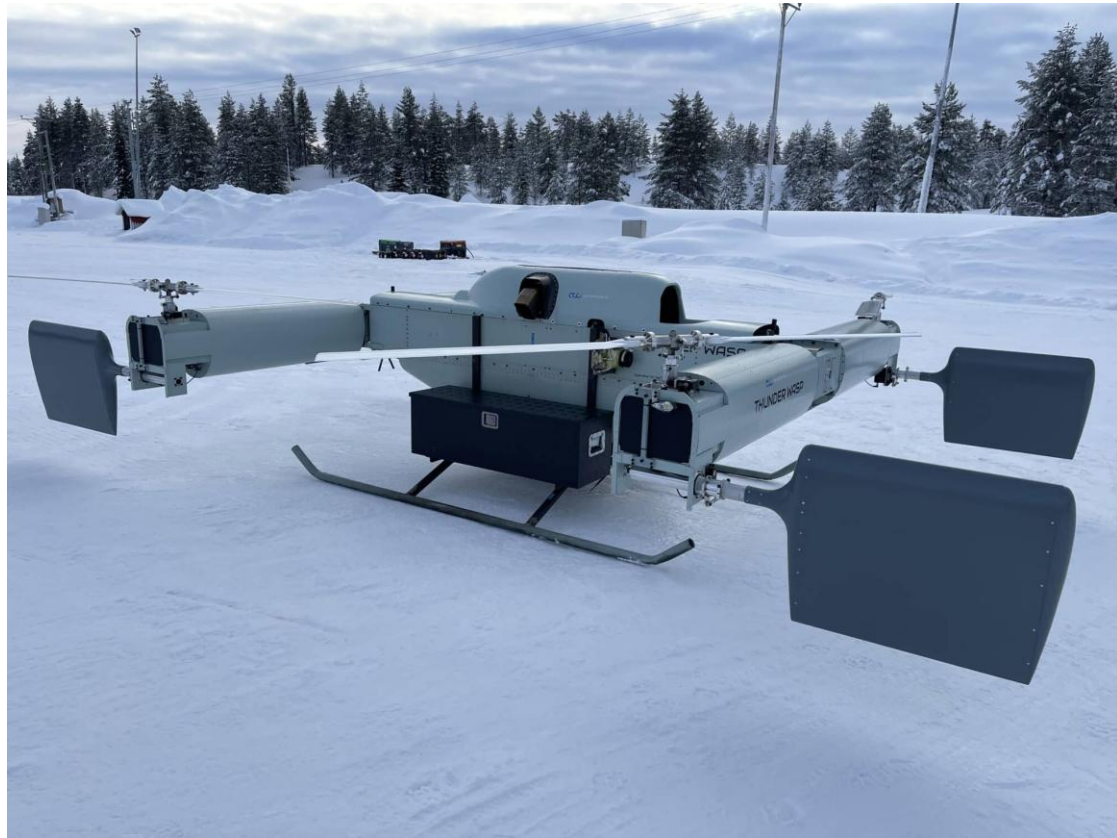
Telia, Tre, Telenor, Tele2,
Teracom, Ericsson, Dufour,
Lantmäteriverket/SWEPOS,
T2-data, Västerviks kom.
RISE, WASP Wara PS, MSB,
Swedish Police, SOS-alarm,
SjV, Coast Gard, FOI, TrV,
Altitude Angle, DIMETOR
Vinnova, EU ECEL JU
and all other participants....

Strategic
Partnership

Pioneering delivery of the heaviest
lift drone platform for the Royal Navy

Finnish defence company [Patria](#) and Swedish drone maker [ACC Innovation AB](#)

have signed a cooperation agreement to jointly develop a military version of the quadcopter-style Thunder Wasp GT drone for military use by [NATO](#) member nations.



Thunder Wasp in firefighting lifting 800 l water for use in Canada or maintenance of wind power mills in Europe



Thank you for your attention!

**And thanks to the Swedish Transport Administration
Vinnova and our project partners for your
contributions!**

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