FUTURE 6G NETWORK SERVICES

Vision Paper

U-space for simple & light density and light risk areas

Unlocking Rural Potential through Low-Risk Drone Integration

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Executive Summary

While current U-space frameworks focus on high-complexity urban environments, the immediate socio-economic impact of Unmanned Aircraft System (UAS) operations in rural areas is largely underestimated.

The Specific Operation Risk Assessment (SORA) methodology is often considered labour-intensive and complex for routine, low-risk operations involving significant volumes of Beyond Visual Line of Sight (BVLOS) UAS operations in rural areas with low air and ground risks. One of the most frequent raised questions by UAS operators is whether the expected designated U-space geographical areas and a range of digital services will actually help to simplify the planning and conduct of UAS operations in rural areas. The biggest challenge, though, is the long wait for the operational authorisation.

U-space Light is a concept that has been widely discussed in Europe recently. However, interpretations of this concept differ. One approach is to provision U-space services in UAS operation areas outside U-space geographical areas, making UAS operations safer and thus reducing the time required for UAS operation authorisation.

An alternative method is streamlining or simplifying the requirements for the U-spaces presented in the U-space regulatory framework, thereby enabling urban UAS operations, e.g., agriculture and forestry, infrastructure monitoring, logistics, safety and security, disaster and emergency response, without the prohibitive costs and extensive timelines associated with urban-grade infrastructure / dense populations.

A third approach is to streamline the processes for UAS operation authorisation and U-space flight authorisation to eliminate unnecessary complexity. Although this approach may not affect the processing time for UAS operation authorisation requests, it should reduce the overall burden of U-space-related complexity.

1. The Current Reality: The Urban-Rural Gap

Innovative rural use cases are often hindered by complex safety requirements applicable to high-density UAS operations in cities or economic zones. However, rural operations are naturally exposed to different levels of risks:

- **Air Risk (ARC):** Sparse manned and unmanned aircraft operations in some of the rural areas at low-level altitude simplify tactical deconfliction.
- **Ground Risk (GRC):** Low population density drastically reduces the probability of third-party injury.
- **The Vision:** By **2029**, rural areas in the Netherlands and Finland will benefit from a 'U-space Rural' framework, making automated drone flight the standard for sustainable regional development, furthering sovereignty and social acceptance.

2. Comparison: Why 'Rural' is Sufficient

The following elements demonstrate why the designation "rural" is sufficient:

- **Full U-space (Urban):** High Air and Ground Risk, complicated airspace design, UAS operations require leveraged Communication, Navigation and Surveillance (CNS) services. High compliance costs. This is a longer-term scenario.
- **U-space Light (Rural):** Typically, Low Air and Ground Risk, Low Operation Volumes. Non-controlled airspace. Scalable and cost-efficient. Easier and faster to achieve.
- **Synergy Rural-Urban:** Starting Rural could also help speed up the longer-term Urban U-space process. Rural areas can provide lessons learned and insights, and create a ground for replicable and scalable solutions.

3. Strategic Pillars of U-space Light

To remain effective yet lean, the **framework prioritises the same features as State-of-the-Art (SotA)**:

1. **U-space services** are provisioned as the U-space regulation demands.
2. A **range of additional non-regulated services** is provided as well, to increase the **safety and efficiency** of UAS operations.
3. Specific to the **U-space Rural Standard Scenario (STS)** is used by CAAs to **shorten the time of UAS operation authorisation significantly**.

However, foreseen boundary conditions are aligned with rural-supporting solutions: Less airspace-efficient, putting more towards operators, and a lower threshold for U-space organisation and certification.

1. **Strategic Conflict Detection and Strategic Conflict Resolution services are automated, and the** notification of the U-plan acceptance or the need to update it comes to the UAS operator from the USSP immediately. In rural areas, the number of economically viable UAS & USSP is much lower, which simplifies the initial boundary condition.
2. **Buffer: Increased separation minima** set for rural areas to have an excess of safety margin, to be considered as reduced risk. Trading airspace capacity in favour of operational simplification/cost is favourable in rural areas. Such safety margins may be used until **statistically significant data from past UAS operations will allow reconsideration of those**.
3. Tactical Conflict Prediction and Tactical Conflict Resolution services enhance the safety of UAS operations.
4. **Airspace**: in this area still work on pragmatic solutions is ongoing to ensure that manned and unmanned traffic can ‘see’ each other.

4. Targeted Impact & Use-Cases

- **Agriculture & Forestry:** Opening cases, e.g., on targeted spraying, crop analysis, forest and lake management.
- **Infrastructure & Inspection:** Faster, safer inspections of, e.g., wind turbines, power lines, and (rail)roads using automated BVLOS flights.
- **Logistics:** Faster, safer and more sustainable concept and keeping up or improving social inclusion standards in remote areas.
- **Safety & Security:** Borders, vital infrastructure, hazardous environments, patrol on, e.g., environment security, preventing damage, theft, threats.
- **Emergency & (natural) Disaster:** Rapid delivery of medical samples or Automated External Defibrillators (AEDs) to isolated communities, significantly reducing response times and disaster response and monitoring.

5. Call to Action: Accelerating the Rural Economy – Opening U-space Envelope

To turn this vision into reality, we propose three immediate steps for policymakers and industry leaders:

- **Designated 'U-space rural' Sandbox Zones:** EASA and CAAs need to speed up collaboration on establishing clear guidelines for the designation of rural U-space testing areas that can gradually be developed and designated as operational rural U-space geographical areas.
- **Streamline UAS operation authorisation by CAA and flight authorisation by USSP processes:** National governments, CAAs and industry leaders need to speed up establishing solutions for the Common Information Service for CAA–USSP data exchange and achieving highly automated, seamlessly integrated, time-efficient authorisation processes. On this topic, important work will be done in the SESAR SPATIO and RAXUS projects.
- **Enabling infrastructure:** National governments and industry leaders need to address market failure in rural areas by identifying opportunities to promote investment in the collaborative critical infrastructure, such as Communication, Navigation and Surveillance (CNS) using terrestrial and non-terrestrial networks

and Integrated Sensing and Communication (ISAC) to support BVLOS UAS operations. As an example, in the past regulations were passed to ensure fixed line / mobile coverage in rural areas, why shouldn't aerial coverage be the next frontier?

The time to act is now

A pragmatic U-space '**Rural**' framework will ensure that rural communities are not left behind in the aeronautical revolution.

About the authors

This vision paper about a pragmatic U-space framework for rural areas, was jointly authored by VTT Technical Research Centre of Finland, Drone Delivery Services and TNO who is leading the Dutch 6G Future Network Services program, to share a unified vision with key stakeholders.

VTT Technical Research Centre of Finland is a visionary research, development and innovation partner for companies and the society, and one of the leading research organisations in Europe.

Vadim Kramar is a seasoned researcher in the IAM and AAM domains. At VTT Technical Research Centre in Finland, Vadim plans and manages international Research, Development, and Innovation projects. Vadim explores the future of aviation, and his research interests include U-space/UTM, the application of UAS and VCA, CNS, cybersecurity, Counter-UAS, automation and AI, weather-associated challenges, and business implications. Vadim contributes to developing the IAM and AAM domains by participating in several national and international initiatives, including the International Forum for Aviation Research, IFAR, and the ICAO AAM Study Group. He serves the European Commission as one of the External Independent Experts.

Drone Delivery Services (DDS) drives innovation in autonomous aerial delivery. As a drone operator, DDS focuses on advancing projects and providing solutions for smart, safe, and efficient transportation of essential goods through the air. While global developments in drone technology— especially in medical applications—sparked the

company's inception, the road to full-scale drone delivery still faces regulatory and technical hurdles. DDS envisions a future where drones transport goods weighing up to 200 kilograms over distances of up to 30 kilometers and more, enabling intercity, island deliveries and offshore support. For now, DDS prioritizes projects with significant societal impact, such as delivering urgent medical supplies and maintaining connectivity in rural areas. These initiatives aim to address challenges such as declining access to healthcare and public services

Lars de Kloet is co-founder of the Dutch company Drone Delivery Services (DDS). He has many years of experience in the unmanned aviation sector. Both in the operations domain as in the higher level domain of public-privat collaborations. With regional, national and international key stakeholders. Opening envelops on topics as e.g. U-space and BVLOS flying. DDS is an experienced first mover in the drone industry. And WP lead in 6G Future Network Services project Transport Hubs - drones.

TNO is an independent public research organisation. With over 4,000 specialists, we work together with entrepreneurs, scientists, policymakers, individuals, and society as a whole to create a safe, healthy, sustainable, and digitally connected society.

Jos Berière has 16 years of mobile operator experience at KPN, TNO and as Independent consultant. He has been overall responsible for the 5G launch in the business market. Led operations for customer & vendors tenders, customer trials, standardization and multi-billion spectrum auctions & leases. Recently he started supporting the NGO SmartParks. He is also father of 2 sons and striving for a sustainable world through reducing footprint and mastering judo

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