THE MARKET FOR UAV TRAFFIC MANAGEMENT SERVICES 2023-2027

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EDITION 6.1 FEBRUARY 2023

www.unmannedairspace.info

UNMANNED AIRSPACE

Contents – V6.01

"The Market for UAV Traffic Management Services – 2023-2027" is written by Philip Butterworth-Hayes and published by Unmanned Publications Ltd, located at 61 Davigdor Road, Hove BN31RA, UK. Telephone +44 1273 724 238. Email: philip@unmannedairspace.info.

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Market overview

1.1 Progress on UTM regulations and business cases

A gap is starting to slowly develop between UTM implementation rates in the USA and Europe. It is not a gap of timescales, but clarity.

On 26 January 2023 the European Union's U-space regulation came into effect. EU Member States will now identify U-space airspace areas where drones will be able to fly increasingly complex operations – beyond visual line of sight (BVLOS), over people, autonomously and at night – supported by air traffic services provided by certified U-space service providers (USSP). USSPs will coordinate drone operations with the air navigation service providers (ANSPs) and operational data exchanges between USSPs, ANSPs and drone operators will be ensured by the Common Information Service Provider (CISP).

This is a considerable achievement for the European Aviation Safety Agency (EASA), which in December published the latest draft of Acceptable Means of Compliance and Guidance Material (AMC/GM), which gave the granularity of detail required for many (but not all) EU states to start planning the first designations of U-space areas. Of course, there are still many issues outstanding – not the least are when and how the first USSPs will be certified and what provisions there are for drones flying outside U-space areas. After all, U-space only makes sense in area of high traffic, with multiple drone operations creating a risk of collision. But for drone operators some of the most economically attractive business cases are missions to sparsely populated areas where U-space provisions might be economically unviable.

Meanwhile, in December 2022 the Federal Aviation Administration (FAA) announced its was moving towards an understanding on how to introduce oversight, rather than strict regulation, for UAS traffic management services provided by private sector (or third party) UTM service providers. According to Jay Merkle, Executive Director at the FAA's Unmanned Aircraft Systems Integration Office speaking at the GUTMA Harmonized Skies UTM US event on December 13 and 14, 2022. "Currently we do not have a regulatory framework that we can accept those third party services and give people credit apart from an individual operating certificate," said Jay Merkle. "The goal of our regulatory framework is to be to give credit for industry consensus standards in a way which will provide safety oversight over those services and service providers."

Unlike in Europe, the FAA has said it will not change any of the rules or regulations for traffic below 400 ft. It will be up to the industry to provide UTM services with new oversight arrangements from the regulator. It is therefore becoming clear that in the USA the routes to market for both UTM infrastructure providers and UTM service providers are more accessible through partnerships – or integrated with - drone operators seeking to extend BVLOS operations than via geographically U-space ecosystems, as in Europe.

In November 2022, for example, Percepto announced that the FAA had granted the company a nationwide waiver for operations, for automated drone-in-a-box technology used by electric utilities, oil & gas, solar power stations and mining operations. There are UTM-based eco-systems emerging in the USA, but they tend to be rare. In October 2022 Corpus Christi Police and Fire Departments began using Avision UTM platform to manage their drone operations in a first of its kind effort between state, county and city agencies to provide Texans disaster response services.

But just as the UTM market – in Europe at least with the publication of EASA AMC/GM guidance – has become more clearly defined so technology advances have developed to

Table one: Notable UTM achievements in 2022

Regulations
• In February the European Union Aviation Safety Agency (EASA) at the *Workshop on NPA 2021-14 – AMC/GM to support the U-space regulatory framework* outlined its proposals for implementing acceptable means of compliance (AMC) and guidance material (GM) to the U-space regulatory package (Regulations (EU) 2021/664, (EU) 2021/665 and (EU) 2021/666). U-space Coordinator organisation formed by EASA in February. • In March Australia's Civil Aviation Authority (CASA) published its draft RPAS and AAM Roadmap to provide a plan for the realisation of a long-term vision for the Australian RPAS and AAM regulatory regime and the integration of these technologies into the civil aviation system. • In March, the EU Commission published Regulation (EU) 2022/425, amending Implementing Regulation (EU) 2019/947. The updated regulation postpones the transition dates for the use of certain unmanned aircraft systems in the 'open' category and the date of application for standard scenarios for operations executed in or beyond the visual line of sight (BVLOS). • The BVLOS (Beyond Visual Line of Sight) Aviation Rulemaking Committee's (ARC) final report to the FAA was published in early March. • Spain's Ministry of Transport, Mobility and the Urban Agenda (MITMA)set up a National Action Plan for the Deployment of U-space (PANDU) 2022-2025, published in June 2022. • In June, Australia's Civil Aviation Safety Authority published its AAM, RPAS roadmap industry feedback • In August, the FAA placed document detailing compliance of remote ID UAS requirements on federal register • In August, the FAA approved the ASTMI Remote ID standard for means of compliance for unmanned aerial vehicles. • In September the FAA relaxed its rule on "any apparent noncompliance" of the Remote Identification (RID) of Unmanned Aircraft final rule (RIN 2120-AL31) published in the Federal Register at 86 FR 4390. • In September EASA published a new revision of the Easy Access Rules for Unmanned Aircraft Systems (EAR for UAS). • In November, the UK Civil Aviation Authority (CAA) and Department for Transport (DfT) established the Surveillance Standards Task Force with industry to develop surveillance specifications, including a national, voluntary standard for Electronic Conspicuity (EC). • In November the European Commission adopted the European Drone Strategy 2.0, which sets out a vision for the further development of the European drone market. • In November 2022, the Federal Office of Civil Aviation Switzerland announced that the Reg. (EU) 2019/947 & 2019/945 will enter into force on the 1st of January 2023, adopting EU regulations. • In November FAA published a fact sheet on Upper Class E airspace concept of operations • In November EASA revised Regulation (EU) 2017/213 Easy Access Rules for Air Traffic Management/Air Navigation Services including elements relating to air traffic control services in designated U-space in controlled airspace. • In December, EASA published ToR RMT.0230, the latest version of plan to introduce a regulatory framework for the operation of unmanned aircraft systems and for urban air mobility in the European Union aviation system.

- Also in December EASA published its first set of Acceptable Means of Compliance and Guidance Material (AMC/GM) to support the harmonised, safe and efficient implementation of U-space across the European Union.
- In December the Japanese government has eased regulations to allow automated, level-4 beyond visual line of sight (BVLOS) drone flights over residential areas.

Operational deployment

- In April AustroControl and Frequentis launched a drone management solution to enable the safe integration into Austrian airspace by 2023
- In June Australia's CASA chose OneSky to develop the nation's UTM flight information management system (FIMS).
- In July the final version of the SARPAS NG web-based system interface which allows drone operators to request access to Brazilian airspace was launched.
- In October the Port of Rotterdam Authority (PoR) has selected Airwayz as the partner to build the U-Space Airspace prototype for the port industrial complex. The partnership is set for a period of two years in which the U-Space services will be set up and the Airwayz UTM system will be configured to the ports' needs and requirements.
- In December Sweden's air navigation service provider Luftfartsverket (LFV) re-issued its "Call for Competition, UAS Traffic Management (UTM) solution for Sweden" (Reference number: Ä-2022-018144) with a new deadline data of 30 January 2023. The original tender was released at the start of October 2022 with a deadline of November 6.

Research

- In January NASA published an overview of its Extensible Traffic Management (xTM) research covering low altitude below 400 ft to high-altitude operations over 60,000 ft (designated as upper Class E airspace in the US).
- In October the fourth edition of the U-space Concept of Operations (ConOps) was published by the European CORUS-XUAM research project team, open to review and commenting. This new version is extending the edition 3 of the ConOps delivered in October 2019.
- In October the FAA approved the New York Unmanned Aircraft Systems Test Site for beyond visual line of sight (BVLOS) drone flights across the entire 50 miles of airspace within New York's Drone Corridor.
- In November the US Alliance for System Safety of UAS through Research Excellence (ASSURE) project A11L.UAS.9 published in an Initial Annual Report for the Small Unmanned Aircraft System (sUAS) Traffic Analysis. The publication presents the progress, findings, and preliminary observations on research tasks completed in the first of three years of this traffic analysis research project.
- In November the SESAR 3 Joint Undertaking started a series of new Digital Sky Demonstrators to facilitate the implementation of U-space at scale within the framework of the SESAR 3 JU research and innovation programme. With a combined budget of EUR15 million from the Connecting Europe Facility/CINEA, the three Demonstrators will take place at test sites in Belgium, France, Italy, Ireland and Spain over the next three years
- In November the Israel Innovation Authority (IAA) announced the start of a 60 million INS (USD17.5 million) second phase of the Israel's National Drone Initiative, which will examine the use of large cargo and passenger-carrying heavy drone flying in controlled airspace.

- In November NASA's Ames Research Centre has issued a request for information (RFI) from industry for comments and feedback on its proposals for a Discovery and Synchronization Service (DSS) that satisfies Urban Air Mobility (UAM) requirements.
- In December 2022 NASA's Ames Research Center published findings from evaluations carried out in 2021 relating to the application of Role-Based Access Control (RBAC) concepts to UTM in the context of Department of Defense (DoD) operations.
- In December the FAA selected drone company Xwing in the Crosscutting Operations Strategy and Technical Assessment (COSTA) project, exploring the management of large commercial UAS and general aviation (GA) when transiting complex operating environments, such as Fire Traffic Areas (FTAs) during wildfire suppression events.

Standards

- In April, ASTM published new international standard addressing UAS-UTM performance and interoperability
- In June, EUSCG published updated guide to UAS operations and manufacturing standards
- In June ISO approved its global requirement standard for UTM service providers
- In July, ANSI published its standards gap analysis, highlighting critical missing links in UAS standards development
- In September GUTMA announced the release of the July edition of the UTM Standards Report. The document features the most up-to-date information on the development of UTM standards and the related initiatives, including the work plan of the main global Standards Development Organizations (SDOs), including ASTM, GSMA-ACJA, EUROCAE, and SAE.
- In October GUTMA and GSMA released a new reference method for assessing cellular C2 link performance and RF environment characterisation for UAS. The document, which is the product of the Aerial Connectivity Joint Activity (ACJA), aims at supporting beyond visual line of sight (BVLOS) operations at scale by characterising the performances of the cellular link for different operations and in different situations and geographical environments.
- In December Joint Authorities for Rulemaking of Unmanned Systems (JARUS) published its latest, 2.5 version of its Specific Operations Risk Assessment (SORA) for comments.
- In December International standards agency ASTM Committee on Unmanned Aircraft Systems (F38) carried out a detailed mapping of relevant ASTM standards against key regulatory parts of the U-space regulation.
- In December JARUS published SORA Version 2.5 proposals – comments by March 6 2023

3.1 Australasia

In September 2022 the Australian government outlined a new UTM action plan and associated research programmes. Australia's Civil Aviation Safety Authority (CASA), Airservices Australia and emerging aviation technology are working together to develop a UTM system comprising a number of capabilities to support a wide range of use cases for government, industry and the community. This includes:

- The integration of capabilities such as establishing airspace 'no-fly-zones' to safeguard privacy, environmental and noise concerns;
- Drone detection capabilities to hold negligent or malicious UAS operators to account; and
- Safety frameworks such as Australia's Future Airspace Framework and the Remotely Piloted Aircraft Systems and Advanced Air Mobility Strategic Regulatory Roadmap.

Together, these capabilities will assist with the management of the emerging aviation technologies sector, so that Australia can harness its benefits, while reducing risks. According to the programme developers:

"As part of a new iMOVE study, the University of South Australia is working with the Department of Infrastructure, Transport, Regional Development, Communications and the Arts, to investigate the benefits of increased drone use in Australia, including:

- Providing an overview of Australia's drone sector and identifying lessons learnt from other countries;
- Assessing the demographic and geographic reasons behind increased drone uptake in Australia; and
- Identifying the key benefits and challenges to increased drone uptake for different communities.

"Findings from the study are anticipated for release in mid-2023, and will provide a greater understanding of the key benefits, and the factors or challenges affecting drone uptake in Australia. As the emerging aviation technologies sector continues to grow, there is expected to be significant benefits for Australia's workforce and productivity, with up to 10,000 jobs projected to be created over the next 20 years (Deloitte Access Economics, 2020). For more information and to stay up-to-date on this project visit iMOVE's website."

Supported by the Asia-Pacific Economic Cooperation (APEC), and being undertaken by Mirragin RAS Consulting, the APEC project is examining best practices for remotely piloted aircraft (RPA) and will inform the development of an international framework for APEC economies.

"As RPA use continues to grow across the Asia-Pacific region, there is expected to be an increase in noise impact concerns. In particular, this can affect residents in urban areas where the use of drones is higher and more widespread for everyday activities, including home deliveries. Currently, there are no consistent international standards for the measurement or regulation of noise emitted by RPA. The project will compare the different approaches to manage RPA noise undertaken by APEC economies to identify innovative solutions and practices that should be captured in a new RPA framework. Establishing a framework will make transferring RPA noise measurements and approvals across regions easier and reduce the regulatory burden for operators and manufacturers. Findings from the report are anticipated for release in mid-2023. For more information on the project visit APEC's website."

e 1: Creation of a geo-fence

4.2 Government investment in UTM/U-space

One important generator of funds for UTM service providers in the near term is investment in research by governmental agencies.

NASA, the FAA and the European Commission are picking up around half the costs of developing early operational UTM concepts, with industry providing the rest. In Europe, according to European Commission figures, this will mean industry will have to finance EUR2 billion of investment in UTM research alone up to 2035, a sum which requires considerable confidence that healthy returns will be made within a defined timescale.

The European Union's (EU) UTM programme will deliver around EUR123 billion in benefits, cost EUR4.095 billion to create and take until 2035 before all services can be accommodated, according to forecasts from the SJU. The SJU high-level European UTM roadmap has been developed in parallel with the work to integrate RPAS into civil airspace; RPAS integration work will cost EUR0.05 billion to complete and deliver benefits of EUR16.8 billion, according to SJU forecasts.

According to the organisation[1]:" *An estimated total of at least EUR200 million in additional R&D over the next 5-10 years, based on expectations of the market, is required to address remaining gaps related to Very Low Level (VLL) activities that represent the majority of future drone operations. This boost in R&D capabilities would complement on-going efforts for the integration of drones into controlled airspace. Priorities related to the successful integration into controlled airspace continue, as previously forecasted in the SESAR RPAS Definition Phase, to require close to EUR150- million over the next 5-10 years, of which the SESAR 2020 programme is presently addressing EUR40 million due to budget constraints*."

In November 2022 Europe's SESAR 3 Joint Undertaking started a series of new Digital Sky Demonstrators to facilitate the implementation of U-space at scale within the framework of the SESAR 3 JU research and innovation programme. With a combined budget of EUR15 million from the Connecting Europe Facility/CINEA, the three Demonstrators will take place at test sites in Belgium, France, Italy, Ireland and Spain over the next three years. Evaluations are currently underway as part of a call to select consortia of innovators and early movers, which with an estimated budget of EUR35 million, will be tasked with fast-tracking the uptake of U-space innovations across Europe as of 2023. More U-space funding will be made available between now and 2027, as the programme progresses.

European U-space providers will need to find EUR 2 billion in investment between now and 2035, air navigation services providers (ANSPs) EUR 0.7 billion and drone operators a further EUR 0.7 billion to develop a European UTM system, according to the latest European ATM Masterplan for drone integration published by the SESAR JU in March 2018.

According to the "Roadmap for the safe integration of drones into all classes of airspace" around EUR 1.28 billion will be required for ATC interface and airport adaption systems, EUR 0.98 for drone traffic management systems and EUR 0.38 for protection of airports and sensitive areas.

[1] https://www.sesarju.eu/sites/default/files/documents/reports/European_Drones_Outlook_Study_2016.pdf

Figure twelve: Likely stakeholder investments in UTM technology (Europe)

Stakeholders	Investment (billions)
U- Space service provider	Around EUR 2.0
Drone operators	Around EUR 0.7
ANSPs	Around EUR 0.7
Telecom/satcom providers	Around EUR 0.6
Airports	Around EUR 0.3
Airspace users	Around EUR 0.1
Others	Around EUR 0.2
Total	Around EUR 4.5

"European demand within the drone marketplace is valued at in excess of EUR 10 billion annually, in nominal terms, leading to a cumulative benefit of over EUR 140 billion by 2035," says the SJU study. "Civil missions for government purposes and commercial businesses are expected to generate the majority of this value on the basis of multi-billion product and service industries. Defence and leisure industries will continue to contribute to this marketplace and remain a source of high value in the near-term, representing together nearly EUR 2 billion in annual product-related turnover for the industry over the long term. The minimum infrastructure investment required to ensure safety and unlock the value at stake for Europe is attainable through relatively low investments, leveraging existing infrastructure and scaling-up through investments in automated and smart systems. The assessment has identified key investments by stakeholders amounting to nearly EUR 4.5 billion by 2035."

U-space service providers and drone operators are expected to invest the most across stakeholder groups. For U-space service providers, this is driven by the investments required to support new investment services in the ecosystem, while large investments for drone operators are required to ensure the drones are appropriately equipped to enable the required services. The scale of operations and growth in drones are expected to grow substantially, making the associated investment meaningful (the specific category fleet size will evolve from under 10 000 drones in 2015 to nearly 400 000 drones in 2050).

The military is not listed per se since this stakeholder is not integrated into the various roles, i.e. airspace user, ANSP, airport operator and drone operator.

Stakeholder inputs on required military investments (air and ground) were not fully available at the time of publication. A standalone assessment of available military data indicates that partial investment levels are in the order of EUR ~400 million.

5. Market forecasts for growth in the global UTM market – by value, geographic demand and sectors

5.1 How UTM services are currently being implemented worldwide

At the end of 2022 Antwerp Port was probably the most mature UTM operational eco-system in the world, with Switzerland and Dubai the most advanced nation states in developing such a system.

Progress towards implementing UTM systems to support more automated BVLOS drone operations depends on synchronised progress in regulations, technical maturity of systems, standards, market demand and clear-cut revenue streams. There is a path from current trials and operations to a mature drone/UTM-based industry. The first step involves moving drone operations from temporary danger areas (TDAs), where the drone operator has temporary but complete control of the airspace, to transponder mandated zones (TMDs), and then unsegregated airspace operations. Cities, ports and regions are also segregating low level airspace drone operations, then planning to increase the envelop to include crewed flights over larger areas.

States such as Dubai have already built TMD airspace areas where the airspace manager has a very high degree of control, where there is a high degree of compliance by airspace users and where there are significant ramifications if users do not comply. The next evolutionary leap is to integrate detect-and-avoid equipped drones into unsegregated airspace. There are technical issues to this – including making DAA systems small and light enough to be integrated within current drone platforms and to make them effective in flying against moving backgrounds, like the sea. But these are challenges that be overcome and need to be part of a long-term solution which can be deployed to detect flocks of birds, for example.

Understanding the operational limits of drones is also a challenge not always fully appreciated. Very few drones have performance specification sheets that closely match operational performance.

It is also important to close the gap between perceived regulatory risks and real-life drone operational risks. The current Specific Operations Risk Assessment (SORA) is time consuming for both regulators and operators and may not reflect actual risk profiles; SORA 2.5 is in the pipeline but many small drone operators consider this edition to be too weighted in favour of large drones.

Progress in these different areas suggest it will be 2024 when sufficient maturity is reached in all the different domains. While the USA and the European Union have both developed clear timetables for the development of their UTM services these timetables are providing unrealistic, partly because the regulations and standards which will underpin the deployment of UTM systems have yet to be fully agreed beyond local levels, partly because of implementation delays caused by the Covid-19 pandemic and partly because there is a lack of knowledge among regulators, States and ANSPs on technical and scalability issues.

In terms of national UTM maturity, Switzerland has emerged as a global UTM pioneer. In December 2020 UTM company ANRA Technologies launched a remote identification service called SmartSkies DroneID in partnership with the Swiss Federal Office of Civil Aviation (FOCA) and Swiss U-Space Implementation (SUSI) to remotely identify drones, enabling public safety organizations and -in 2021 - the general public to identify drones operating in their vicinity by providing the drone registration number and mission information, while additional operator details are available to qualified authorities upon request. This permissions-based approach

Table eight: Aviation functions that can be supported/hosted on a cellular network

- Redundant navigation/positioning
- Airspace RF monitoring (ADS-B, Mode-S, Flarm, Remote ID, common unlicensed UAV protocols
- Local area service to manned aircraft (eg similar to pending FAA RFI)
- RTK reference network
- Edge computing for DAA or for payload
- Motion analytics – eg report a flying object without proper remote ID
- Primary surveillance radar
- Real time population density for SORA
- UTM edge components – replanning using local interconnections
- Integrated UTM/C2 – each system helps the other
- UAV landing and charging
- Platform for other sensors (acoustic EO/IR etc)
- Realtime map of unlicensed congestion
- Local micro-weather
- Monitor report of GNSS jamming/spoofing

This means that MNOs can, theoretically, provide many of the functions in the UTM service arena that until today have been the exclusive preserve of aviation organisations (see table below).

Table nine: Potential UTM roles for ANSPs, USSPs, CAAs, MNOs and others

Who provides what services in a U-space eco system – how USS see the future	Who provides what services in a U-space eco system – how MNOs see the future
U1 e-Registration - CAA Electronic chip – MNO/ANSP/USSP Drone operator online registration - CAA Drone online registration - CAA Registration enforcement - CAA Registration Authority -CAA e-Identification – MNO/ANSP/USSP Drone Identification - MNO/ANSP/USSP e-identification enforcement – CAA/ANSP Identification Authority - CAA Pre-tactical geo-fencing – USSP/ANSP Geo-limitation database – CAA/USSP/ANSP Drone operator authentication and authorisation – CAA/ANSP	**U1** e-Registration - CAA Electronic chip – MNO Drone operator online registration - CAA Drone online registration - CAA Registration enforcement - CAA Registration Authority -CAA e-Identification – MNO Drone Identification - MNO e-identification enforcement – CAA/ANSP Identification Authority - CAA Pre-tactical geo-fencing – MNO Geo-limitation database – ANSP/MNO Drone operator authentication and authorisation – CAA/ANSP
U2 Tactical geo-fencing – USSP/ANSP/MNO? Live airspace data feed – USSP/ANSP/MNO? Area infringement notification – USSP/ANSP/MNO? Flight planning management – USSP/ANSP Automated FPL validation – USSP/ANSP Operations digital authorisation – USSP/ANSP Digital NOTAM – USSP/ANSP/SDSP Weather information – USSP/SDSP Low-altitude wind forecast – USSP/SDSP Actual low-altitude wind info - SDSP Weather info collection - USSP Weather hazard alerts – SDSP/USSP Tracking – MNO/USSP Radio Positioning infrastructure – MNO/USSP	**U2** Tactical geo-fencing – MNO Live airspace data feed – USSP/ANSP/MNO Area infringement notification – USSP/ANSP/MNO Flight planning management – USSP/ANSP/MNO Automated FPL validation – USSP/MNO Operations digital authorisation – USSP/MNO Digital NOTAM – USSP/ANSP/SDSP/MNO Weather information – SDSP/MNO Low-altitude wind forecast – SDSP/MNO Actual low-altitude wind info – SDSP/MNO Weather info collection – USSP/MNO Weather hazard alerts – SDSP/USSP/MNO Tracking – MNO/USSP Radio Positioning infrastructure – MNO/USSP Real-time tracking -MNO/USSP

Real-time tracking -MNO/USSP Tracking data recording - USSP Monitoring -USSP Air situation monitoring - USSP Flight non-conformance detection - USSP Area infringement detection - USSP Traffic info multicast- USSP Alert/Report line - USSP Drone aeronautical information management - USSP/SDSP/ANSP UTM-relevant static aeronautical data - USSP/SDSP/ANSP UTM-relevant dynamic aeronautical data- USSP/SDSP/ANSP Procedural interface with ATC -USSP/ANSP ATC/UAS coordination procedures – USSP/ANSP Flight notification procedures -USSP Emergency and contingency procedures – USSP/ANSP Emergency management -USSP/ANSP Emergency alert line – USSP/ANSP Emergency assistance information -USSP/ANSP Strategic de-confliction - USSP Strategic de-confliction - USSP **U3** Dynamic geo-fencing - USSP Dynamic geo-fencing – ANSP/USSP Collaborative Interface with ATC – ANSP/USSP Global air situation monitoring - USSP ATC alert notification -USSP/ANSP Tactical de-confliction -DO/USSP Dynamic capacity management - USSP Airspace capacity monitoring - USSP UAS traffic complexity assessment USSP/ANSP Demand/capacity imbalance detection – USSP/ANSP UTM measures implementation – USSP/ANSP	Tracking data recording – USSP/MNO Monitoring -USSP/MNO Air situation monitoring – USSP/MNO Flight non-conformance detection – USSP/other Area infringement detection – USSP/other Traffic info multicast- USSP/MNO Alert/Report line – USSP/MNO Drone aeronautical information management - USSP/SDSP/ANSP/MNO UTM-relevant static aeronautical data - USSP/SDSP/ANSP UTM-relevant dynamic aeronautical data- USSP/SDSP/ANSP/MNO Procedural interface with ATC -USSP/ANSP/MNO ATC/UAS coordination procedures – USSP/ANSP/MNO Flight notification procedures -USSP Emergency and contingency procedures – USSP/ANSP/MNO Emergency management -USSP/ANSP/MNO Emergency alert line – USSP/ANSP/MNO Emergency assistance information - USSP/ANSP/MNO Strategic de-confliction – USSP/MNO Strategic de-confliction – USSP/MNO **U3** Dynamic geo-fencing – USSP/MNO Dynamic geo-fencing – USSP/MNO Collaborative Interface with ATC – ANSP/USSP/MNO Global air situation monitoring – USSP/MNO ATC alert notification -USSP/ANSP/MNO Tactical de-confliction -DO/USSP/MNO Dynamic capacity management – USSP/MNO Airspace capacity monitoring – USSP/MNO UAS traffic complexity assessment USSP/ANSP/MNO Demand/capacity imbalance detection – USSP/ANSP/MNO UTM measures implementation – USSP/ANSP
Notes: Based on the SESAR U-space service level definitions *Key:* *CAA – civil aviation authority DO – drone operator MNO – mobile network operator* *ANSP – air navigation service provider SDSP – Supplemental data service provider USSP - UTM/U-Space service provider ND - Not decided*	

6.3 UTM for ports

The ability to fly BVLOS is an important capability that is being explored in the ports of Antwerp and Singapore, while ports of Denmark, Hong Kong, the Netherlands and Norway have already been testing BVLOS operations that travel as far as 16 km out to sea for security measures like spotting offenders and criminal activity. Today, industry players acknowledge that drones can be applied beyond current uses and the number of ports developing drone eco-systems is rapidly growin.

- The Port of Antwerp concluded through the EU Horizon 2020 SAFIR project that drones' ability to perform BVLOS flights offer "…an immense addition to safety as they were able to manage, inspect and control a large area in a swift and safe manner."
- In 2020, Hamburg Port Authority rolled out a drone program for infrastructure inspection and facilities monitoring.
- In the United States, the Police Department for Port of Los Angeles included drones in their security, emergency response, and search-and-rescue operations.
- In Chile, APM Terminals began using drones for operational efficiency, as well as monitor traffic flows and container stack efficiency.
- Port of Rotterdam began studying the use of autonomous trucks in the port and has been planning a large-scale deployment of the technology at the tail end of 2021.
- Around the same time, the Maritime and Port Authority in Singapore deployed drones for surveillance, detection, incident response and management, and has been exploring shore-to-ship delivery applications.

But it is in the North Sea ports of Northern Europe where most port UTM activities are focused. In March 2022 the Port of **Rotterdam** issued a market consultation for parties that can support the U-space prototype and in October 2022 the port selected Airwayz as the partner to build the U-Space Airspace prototype for the port industrial complex. The partnership is set for a period of two years in which the U-Space services will be set up.

According to a Port of Rotterdam press release:

"The Port of Rotterdam Authority believes that monitoring the lower airspace and offering UAS traffic services will in future greatly support drone services and allow them to thrive. More and more drone operators offer these services to the vast Rotterdam port community that counts over 3,000 companies.

"Drone services, including surveillance, inspection, incident control, combating crime and drug smuggling, are already making the port area safer and will increase efficiencies across many other port processes. A step further from existing services are delivery drone flights, for instance, delivering parts on board a ship, or take cargo samples before the ship arrives in the port. U-Space services will accelerate these flights. Yet another step further is the hybrid port of the future, in which drones will play a role in freight and passenger transport alongside vessels, trains and trucks.

The Port of Rotterdam is preparing its airspace and procedures for the future and has taken on an investigative role in the expected rise in volume of air traffic, says the port. The prototype will provide answers to questions about how to organise and control the low altitude airspace in the port in a way that ensures safety whilst expanding opportunities for commercial growth and better processes. It will also help determine the role that the Port Authority will play in low-level airspace and answer questions such as: Will the Port of Rotterdam Authority, as port manager, in future manage the airspace as a regular port operation, just as it does for maritime transport, or would another agency be better placed to ensure a safe airspace?

This followed a July 2022 announcement by Airwayz Drones that it had successfully executed a proof of concept demonstration at **Ashdod Port** as a part of 500 Global and PoA Innovation accelerator programme that aims to integrate innovative technologies and sustainable applications into the largest cargo port of Israel. The demonstration showcased Airwayz UTM's ability to manage multiple fleets of drones, reacting safely and efficiently to three potential scenarios that a bustling port could face.

According to a company press release:

"In the first scenario, multiple autonomous drones connected by Airwayz UTM/USSP ran regular patrols across Ashdod Port whilst intelligent software identified the images in real-time, allowing the port's operator teams to monitor the site with faster response capabilities as well as complete situational awareness. The port's security was tested further in the second scenario by autonomously sending two drones to a point of interest. This provided operators with a clear view of the area and allowed a more accurate assessment of the situation.

"During the third test, a rogue drone was brought into the scenario. Using Airwayz UTM/USSP combined with ground sensor technology, the system quickly and easily detected the unregistered drone and autonomously dispatched a system drone to investigate further. Airwayz UTM/USSP efficiently integrates multiple systems and uses its AI-based software to react quickly and avoid all collisions, including even unregistered drones, providing a critical security solution for ports and any other hubs requiring similar security.

In February 2022 **Antwerp** Port Authority announced it had selected the 6th NeTWorK consortium, a collaboration between DroneMatrix, Proximus and SkeyDrone, for the roll-out of a large-scale and innovative drone project.

In the framework of this project, called "D-Hive – Operational drone capacity for the Port of Antwerp", a network of drones capable of performing automated flights from strategic locations in the port, is being developed. Via a unique platform, the Port Authority can draw up flight plans and routes remotely, set the purpose and desired output (photos, measurements, live stream, etc.) of the flight, and manage authorization requests.

The drones are deployed without manual intervention in the port to support its core processes and optimize overall operational excellence. This includes, for example, the detection of oil slicks and floating debris, infrastructure inspections, safety coordination, vessel traffic management support, calamity and incident support, site monitoring, environmental inspections and asset management.

The 6th NeTWorK consortium was founded at the end of 2020 by the hardware and software developer DroneMatrix, the telecom operator Proximus and the (drone) air traffic service provider SkeyDrone. Together, the three partners implement drone solutions from a service model in which drones can perform missions 'as a service' for business purposes and are also working together on the development of drone networks. The complementarity between the three parties enables the creation of a range of services fully geared to the demands of the market.

DroneMatrix, which is acting as the main contractor in the project, supplies both hardware and software for the drones. The company is also responsible for the operation of the flights.

SkeyDrone, a subsidiary of skeyes and Brussels Airport Company, is providing continuous monitoring of the operational ground and air risks. Integrating various static and dynamic data sources (such as position data from air traffic and ships) it determines the safest and

7.5 Communications

MNOs, UTM service providers, satellite communications providers are all vying for early market positions in this sector. There are a number of completed communications systems available and they all have strengths and weakness. We are still at the very early stages of understanding all the issues. What frequency spectrum is appropriate for UAS? How do we develop and test a communication system? What are the security vulnerabilities that might exist in such a communication system?

For controlling drones within a UTM system, a three-way communications system is required. The UAS needs to be able to communicate its position to its operator and the airspace manager. The pilot/flight manager needs to be able to dynamically alter the UAS' trajectory in case of emergencies. The airspace manager needs to be able to communicate airspace status information to the pilot/flight manager and receive confirmation that messages have been received and understood.

While mobile network communications are generally regarded as the most appropriate media to provide operational communications for the drone eco-system there are many hurdles to be overcome before these can be licensed and certified for safety of life and commercial communications. In particular, the issue of whether 5G will be the most appropriate format for this is under intense scrutiny at the moment.

During 2022 a number of trials took place around the world to assess 5G communications for UTM operations.

After one year of preparation and live trials in 2021, the first virtual roadshows of the SESAR Gulf of Finland 2 programme with external partners from Sweden, Denmark took place on April 8 2022 and Latvia took place in April 26.

According to Gints Jakovels, LMT Innovation Lead, 5G will play a critical role in the successful incorporation of UAVs in common airspace. "At the GOF2.0 Roadshow in Riga, LMT main goal was to demonstrate how mobile networks can support the safe inclusion of UAVs into the common air traffic by enabling UAV-to-UAV and UAV-to-ground communication. This is crucial for flight risk assessment and hence successful deployment of drone technologies," said Jakovels**.** "Demonstration showed that we can achieve it using existing aviation systems in combination and with integration of new technological solutions as UTM, cellular network and network remote ID."

The key lessons from both virtual trials, conducted in Latvia and Sweden-Denmark proved that in order enable safe UAV flights, especially in controlled airspace requires both user awareness in airspace and will for change, acceptance, and involvement from crewed aviation. From the outcome of trials, it is inevitable that there must be common information flow, including cellular network prediction and availability to ensure safe communication channel between all stakeholders.

In May 2022, in Australia, the SkyLink UAS team in partnership with the Place Companions team completed a trial that would enable BVLOS drone medical delivery flights at a 5G site using SkyLink UTM micro providers and UTM cloud platform powered by ASTRA UTM. This provided integrated oversight of live UAV telemetry data from the project drones with other simulated drones and real manned aircraft activities near the 5G test site, according to the SkyLink press release.

The system enabled simultaneous operations in a safe manner via flight authorisation and traffic information provided over the OPTUS 5G mobile data network in Victoria Australia. The operations were also remotely monitored from one of SkyLink UAS regional Australia UTM air

7.11 SORA

In December 2022 the Joint Authorities for Rulemaking of Unmanned Systems (JARUS) published its latest version of its Specific Operations Risk Assessment (SORA) for comments.

According to JARUS:

"This document recommends a risk assessment methodology to establish a sufficient level of confidence that a specific operation can be conducted safely. It allows the evaluation of the intended concept of operation and a categorization into 6 different Specific Assurance and Integrity Levels (SAIL). It then recommends operational safety objectives to be met for each SAIL."

"The SORA is recognized by EASA as Acceptable Means of Compliance to obtain an Operational Authorisation in the specific category under EU Regulation 2019/947," according to European U-space consultants and providers Involi (https://involi.com/involi-news/impact-of-sora-2.5-on-your-operational-authorisation-application). "As a result, the new developments introduced by JARUS will be subject to an evaluation by EASA before developing a decision on its adoption in the EU regulatory framework. This process and the potential changes of the EU regulation are not expected before Q4 2023.

"So in a nutshell, there is no short-term impact on UAS operators currently involved in the Operational Authorisation process," said the company. "However, it's time to prepare for what comes next…As highlighted in Natate Di Rubbo's presentation at EUROPEAN DRONE FORUM, the SORA 2.5 update improves and simplifies the current version of the framework, making it easier for drone operators to understand and comply with the requirements.

These modifications include:

1. Changes in the SORA process
2. Update of ground risk chart based on the Quantitative Ground Risk model
3. Simplification and clarification of texts in the main body.
4. Updates to Annex B (ground risk mitigation),
5. Updates to Annex E (operational safety objectives) with OSO reordering
6. New Annex F explains the quantitative model of ground risk
7. New Annex I collecting all the glossary of the SORA process

On the Air risk side, no changes are introduced in the SORA 2.5."

In November 2022, the Federal Office of Civil Aviation (FOCA) selected Dimetor, the creator of AirborneRF, in collaboration with Sunrise GmbH to work in partnership on a project to operationalize a dynamic assessment of air & ground risk for drone operations to support and digitize SORA authorization in Switzerland. The project main goal is to leverage information available at mobile network operators systems in regard to dynamic airspace connectivity and population density for strategic and tactical risk assessment in an automated process.

Also in November 2022, ANRA Technologies and Hover UAV announced they are one of the recipients of the Australian Department of Infrastructure, Transport, Regional Development, Communications, and the Arts, AUD32.6 million Emerging Aviation Technology Partnerships programme.