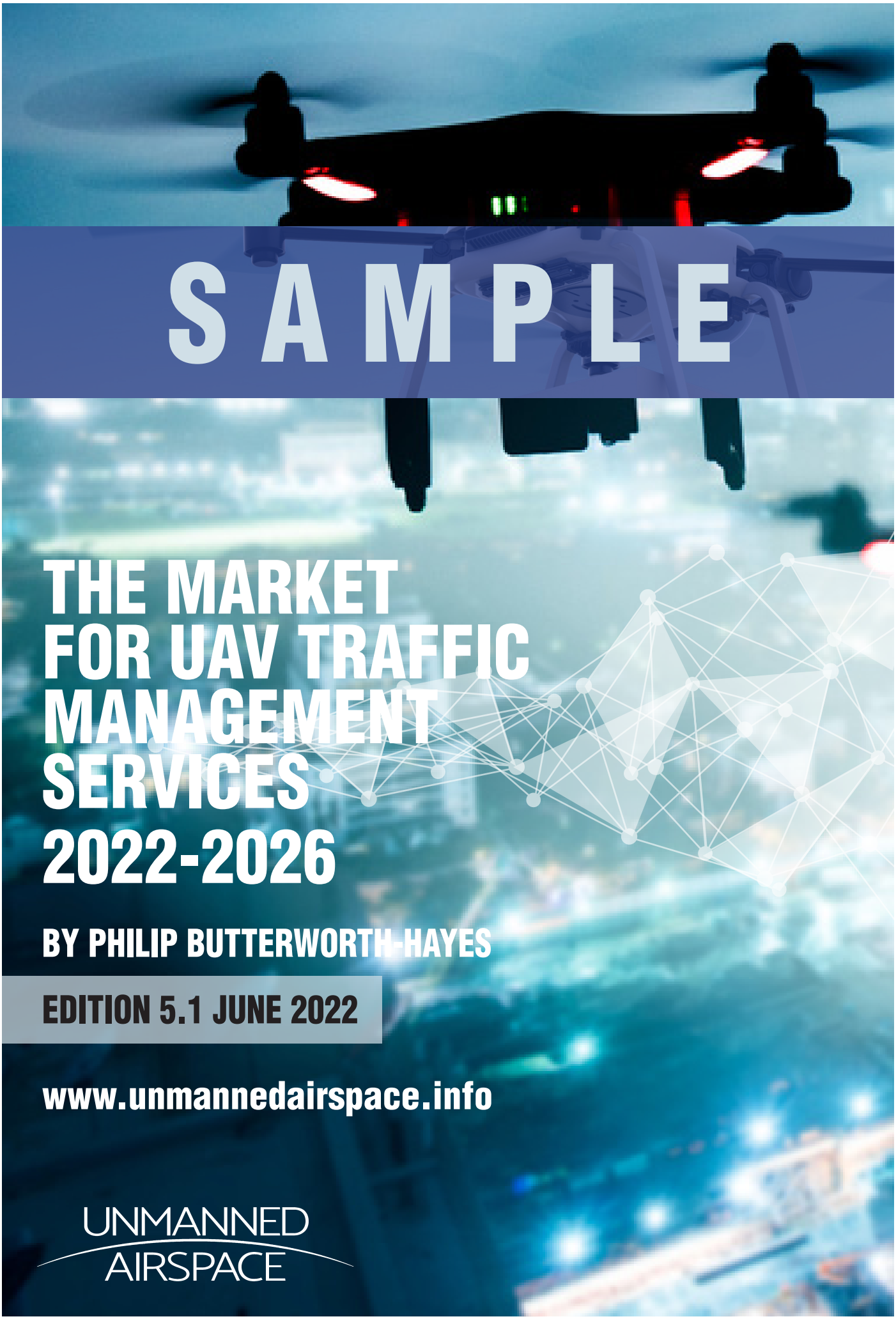

SAMPLE

THE MARKET FOR UAV TRAFFIC MANAGEMENT SERVICES 2022-2026

BY PHILIP BUTTERWORTH-HAYES

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Market overview

1.1 Progress on UTM regulations and business cases

At the start of 2022 the Dutch government undertook a study to examine what kind of U-space architecture/governance structure would best meet the needs of the Dutch drone industry. The study authors broke down the competing architectures into four types: participation, management, open market and integration.

- The participation model is based on an equal cooperation between the state, local authorities, existing implementing organisations and market parties in which the design and maintenance of the U-space ecosystem is jointly and step-by-step ensured (this model is applied in Switzerland and Belgium).
- The management model is based on the premise that there is a significant public interest in the creation of U-space in the Netherlands and that this will not or insufficiently get off the ground without a pulling role of the state (Poland and France follow such a model).
- In the market model, the national government opts for a restrained role (this is the model being applied in the USA).
- The integration model aims to align the design of unmanned traffic management (UTM) as much as possible with the current (ATM) management of the airspace (in the UK this method of implementation is chosen).

"In order to be able to determine how well the proposed scenarios meet the objectives of the Ministry of Infrastructure and the Environment, an assessment framework has been developed with five main criteria: participation, incentive, uniformity, organisation and costs," continues the study text, "It is obvious to choose the participation scenario as a starting point, in line with Switzerland and Belgium. The reason for this is that the end goal of all scenarios is the same (namely full integration of manned and unmanned air traffic), the market of UAS is still (far) from mature and the Ministry of Infrastructure and water Management wants to stimulate the innovation of (the use of) UAS. In the participation scenario, no mandatory design choices need to be made in advance, which gives the most flexibility in a market that is still developing both in terms of application and technology. This scenario also offers room to gradually form the picture of which U-space design is the most suitable for the Netherlands. This could mean, for example, that in the long term the participation scenario will turn into a management scenario and even later into an open market scenario. In addition, the government has an active role in the participation scenario, which is in line with the desire to give space to innovative applications of UAS and at the same time to safeguard the public interest. Finally, the participation scenario is a scenario that can be started relatively easily, quickly, on a small scale and without high start-up costs (neither for the government nor for the market)."

Table one: Competing U-space governance structures

Theme	Criteria	State direction	Open market	Integration	Participation
Participation	Support	0	0	-	+
Incentive	Accessibility of the market	+	-	-	0
Uniformity	EU level	0	-	+	0
	National	+	-	+	0
Organization	Local customisation	-	0	-	+
	Manageability	+	-	+	0
	Scalability	0	+	-	0

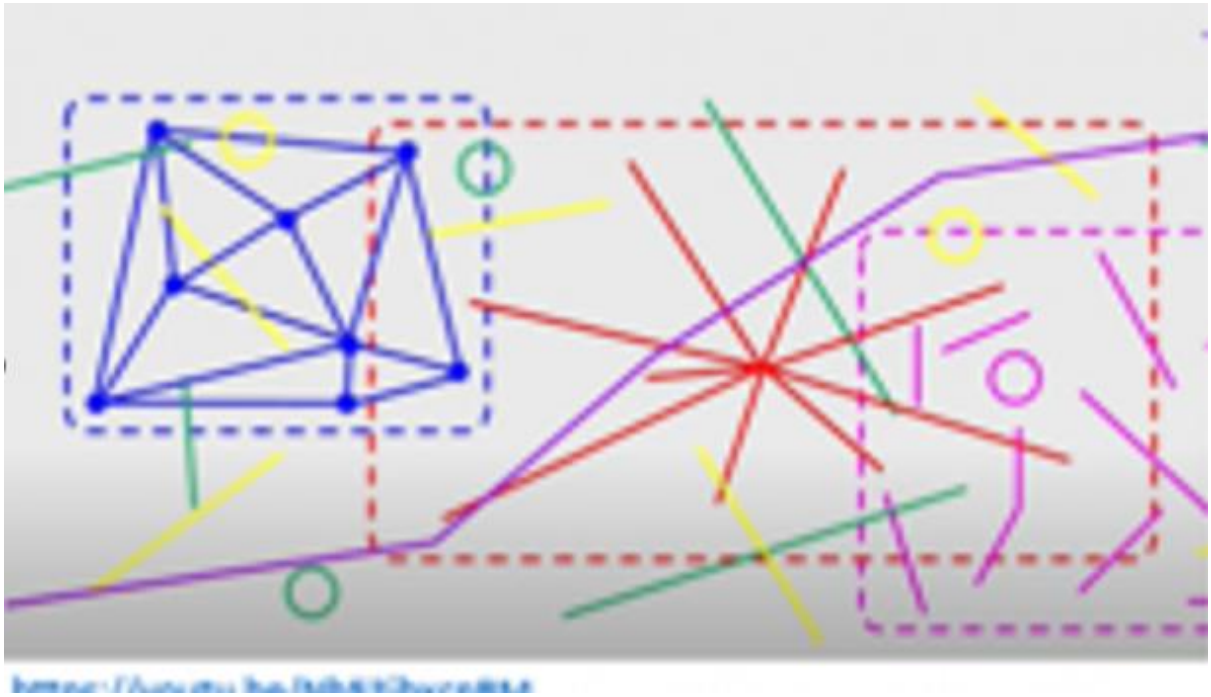
	Future proofing	0	+	-	+
Costs	Cost scenario	0	0	-	+
	Cost state	-	+	0	0

This study was important for a number of reasons, one of the most important being the integration of technology and rules development alongside the potential cost and revenue implications. For while there has been considerable progress in the last six months on defining the rules and procedures for U-space/UTM implementation there is still considerable uncertainty over the revenue potential and costs for setting up these services.

In May 2022 UTM service provider (USP) Skyward announced it would be cease operations in June, the second major US USP to exit the market following the take-over of AirMap by DroneUp. The concern among many in the industry is that although the revenue streams for deploying UTM technologies are becoming slightly clearer the revenue from operating UTM systems are far less obvious.

In March 2022 the Global Uncrewed Traffic Management (UTM) Association (GUTMA) hosted a European U-space policy summit "*From rules to market: Can we achieve a competitive UTM services market?*" There are, according to Koen de Vos, Secretary General of GUTMA, three distinct but interlinked markets under construction: the drone services, the drone operations and the U-space services markets. They are a pyramid. "Most of the value is created in the drone services market and the challenge for this sector is business development, integrating drones into industrial value chains." How can we make U-space an efficient enabler to create down-stream value creation, is the key question, he asked? To have a large base of this pyramid we need competition to drive innovation, to keep the costs down for drone operators and service providers.

Most of the discussions were around which would be the first commercial drone markets required to be supported by UTM (Rural? Suburban? Short-range delivery flights or longer range mapping and surveillance?)

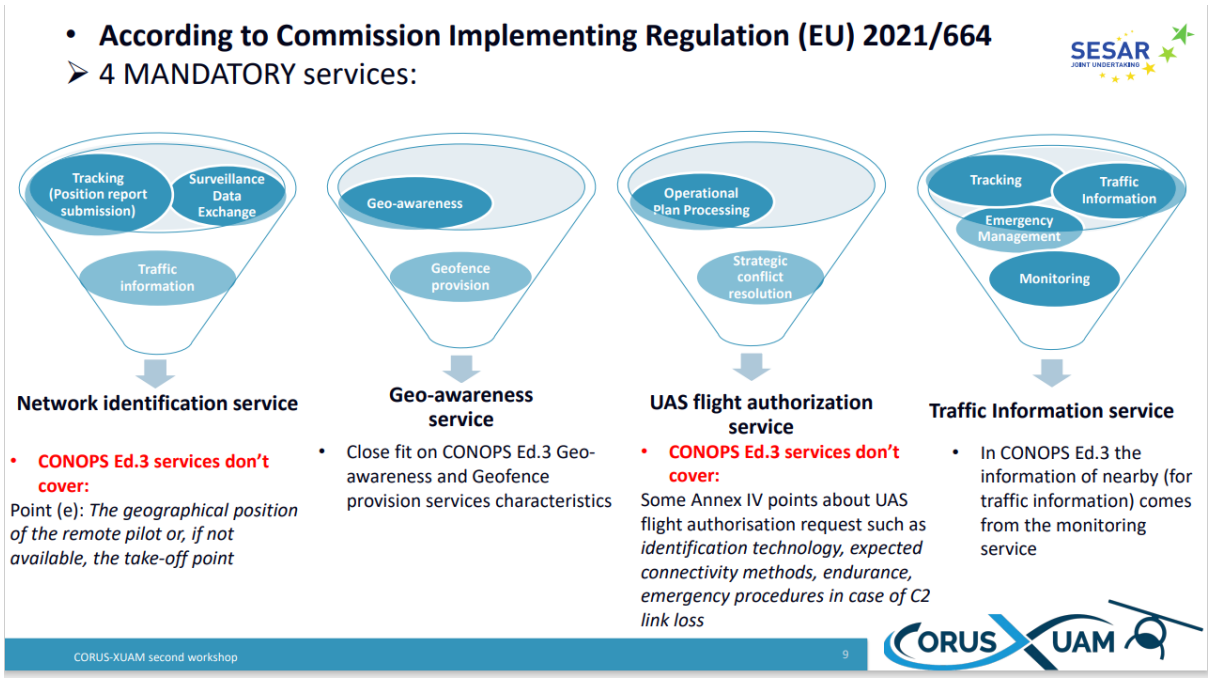


U-space areas will have to accommodate many different types of operations – from long range surveillance flights (purple), drone delivery operations from a central distribution centre (red), point to point operations (green), training flights (yellow) etc – image courtesy of Larissa Haas. Switzerland's FOCA

According to Amit Ganjoo of IT provider ANRA speaking at the event, there are three circles to implementation – technology, standards and regulations – and the first use cases will be where there is an intersection between all three of them. He cited Switzerland's FOCA as one way of ensuring regulators and operators were fully in sync. "FOCA pulled in a lot of industry players to identify where technical means of compliance lined up with the U-space regulations."

According to Thorsten Indra of Hamburg's HHL Sky, who is supporting the development of a drone eco-system in Hamburg port, the best way to start is with a vertically separated airspace and one or two initial operators. "Early on there may be only a small community that has a need to have U-space established. As they see the benefits then others will join. We need round tables with users to get their buy-in but also establish each other's needs."

However, none of these discussions made clear what the revenue opportunities were for USPs operating core, mandatory UTM services (see below) either in a monopoly or competitive environment or value-added services beyond these. Some UPSs have started to examine how to derives additional value from individual industry segments (parcels delivery, long range BVLOS pipeline inspections etc), tailoring their offerings to guarantee the most reliable end-to-end service packages beyond the core UTM services.



Section two: A growing demand for services

2.1 The market for commercial drones

Industry forecasters are continuing to offer widely different views of the scale and predicted growth rate of the commercial UAV sector. The small UAS market, based on the latest forecast-of-forecasts, is predicted to grow at an average of 23.23% compound annual growth rate over the next few years. However, perhaps more importantly from the UTM market viewpoint, BVLOS market for drones will grow at a rate of 71.1% CAGR globally, according to Drone Industry Insights.

Table four: Drone industry forecasts

Forecaster	Market value	Years	Market	Growth rate
ABI Research	USD92 billion by 2030	2020-2030	Small UAS	CAGR 25%
Analysys Mason	USD8 billion in 2030	2022-2030	Cellular connected drones	-
FACT MR	USD278 billion in 2032	2022-2032	Total UAS market	CAGR 25%
FAA	-	2020-2040	Commercial UAS fleet	CAGR 20%
Frost & Sullivan	-	2019-2023	Global commercial UAS fleet	CAGR 4.3%
DRONEII	USD26.3 billion in 2021-USD41.4 billion in 2026	2021-2026	Global drone fleet	CAGR 9.4%
Gartner	-	2019-2020	Global commercial UAS fleet	CAGR 50%
GAI	USD58.5 billion by 2026	2022-2026	Global UAV fleet	CAGR13.9%
Grand View	-	2021-2028	Commercial drones	CAGR 57.5%
Fortune Business Insights	USD 22.55 billion by 2026	2020-2026	Global sUAS fleet	CAGR 15.92%
International Data Corporation (IDC)	-	2020-2025	Global drone industry (including software)	CAGR 33.3%
MarketsandMarkets	-		Drone services market	CAGR 23.8%
MarketandMarkets	USD13.9 billion in 2021 to USD 40.7 billion by 2026	2021-2026	Global UAV market	CAGR 16.4%
Teal	USD18.9 billion by 2030	2021-2030	Global civil UAS fleet	CAGR 14.1%
Technavio	-	2021-2025	Commercial drones	CAGR 36.73%

As each forecast measures slightly different aspects of the market over different timescales it is difficult to reach any firm conclusions about the value the drone industry today and in the near future. Taking a conservative view of the forecast of forecasts, however (using data from the table below and further data from the following text), industry forecasters suggest that, on overage, the 2022 market commercial drones and services is around USD8.5 billion and will rise to USD19.4 billion in 2026.

Teal Group's 2021/2022 World Civil UAS Market Profile and Forecast projects that the US will integrate unmanned systems into its national air space within the next decade, but it is difficult to specify in which year that will occur. The US has made significant strides over the last year says Teal Group, publishing regulations for UAS operations at night and over people. The lack of a regulatory regime for beyond visual line of sight operations, though, continues to hold back market growth.

The report forecasts that non-military UAS production will jump from USD5.6 billion a year to USD18.9 billion by 2030, a 14.1% compound annual growth rate in constant dollars. Total civil UAS purchases will reach USD121 billion over that decade.

Civil Unmanned Aerial Systems (UAS) will be the most dynamic growth sector of the world aerospace industry this decade as nations open their airspace, commercial applications take off, and civil governments adopt systems for new roles in border security and public safety.

According to the report, commercial drone use will drive the market as consumer drone purchases slow and government purchases remain a small but growing portion of the market. "Major corporations have really begun to figure out how to employ UAS in their daily business, and have been rewarded," said Jeremiah Gertler, Teal Group's senior analyst and author of the study. "At the same time, near-saturation of the consumer market and the growing capability of lower-end, especially 'prosumer' drones have led UAS manufacturers to search upmarket for their next big opportunity. That means a greater focus on more sophisticated, higher-value units," Gertler added.

The greatest potential appears to be the delivery market, which has the possibility of touching every household in the world. At the same time, it will also have to operate in the most complicated regulatory environment, with not just national bodies but localities and even homeowners' associations having a say in whether and when delivery drones appear in neighbourhoods. Delivery is expected to be the leading sector in the United States by 2030. Agriculture will be the leading sector overseas by 2030 thanks to heavy Chinese investment in subsidizing agricultural drone spraying and increasingly capable but more affordable UAS moving into the sector, particularly for smaller farms.

Industrial inspection has begun to emerge as a major commercial drone market over the next decade. Construction will be the largest portion of that industrial inspection market, according to the Teal study. All 10 of the largest worldwide construction firms are deploying or experimenting with systems and will be able to quickly deploy fleets worldwide. Industrial inspection also includes other major segments such as energy, mining and railroads. Other important commercial UAS segments include general photography, communications, insurance, and entertainment.

Civil governments are deploying an increasing number of unmanned systems. The United States and European governments have growing programs to deploy systems to protect land and sea borders. The United Nations and other peacekeepers are deploying systems to provide protection. Use by law enforcement, particularly in the United States, is soaring.

The pandemic has spurred development of delivery drone systems and has encouraged companies to adopt UAS to do distance inspections of facilities. Yet the regulatory environment has artificially stifled demand, keeping UAS out of a number of valuable roles as nations struggle to figure out how to incorporate unpiloted aircraft into their air traffic

In September 2021 the **French** transport ministry in partnership with the Defense Innovation Agency (AID) has launched a call for projects to accelerate the implementation of the "U space" programme first introduced in 2018.

The call is the fourth part of the Transport Innovation Agency (AIT) Propulse programme announced on 30 August 2021 and the first to also be supported by the Defense Innovation Agency (AID). It is a response to both civil and military issues and aims to create a coherent and effective airspace environment.

A project to develop a miniaturized system on board a drone to support integration of unmanned and manned airspace is among five projects selected by the French Ministry of Transport as part of its Propulse acceleration project. Measurement of radar antennas by drone' is a U-space programme sponsored by the French aviation agency DGAC. The Ministry of Transport is supporting accelerated development of the five projects over a five month period and providing funding of up to EUR100,000 per project.

The "U-space" programme designates the future management of air traffic for drones, with a high level of automation and digitization, guaranteeing a safe integration of drones in airspace from a safety and security point of view. safety, but also respectful of the environment and protection of privacy.

The French *U-space Together* call for projects aims to experiment on a very large scale with solutions for air traffic management services for drones, at very low altitude, in almost the entire territory of mainland France. It has five packages aimed at meeting a variety of technical and operational challenges linked to the rise of drones in France and in Europe.

In May 2020, France's air navigation service provider DSNA announced the eight companies selected to UT) services for its *U-Space Together* pre-operational programme. DSNA has already selected 11 civil partners using digital solutions to support pre-operational services at 12 sites. The eight UTM companies are:

- Airbus, Clearance and X-One Technology
- AirMap
- Altitude Angel
- Clearance
- Innov'ATM/Hologarde
- Sopra Steria-Clearance-ENAC
- Thales
- Wing

Each company has been designated a unique area of restricted airspace in which to deploy a UTM platform, the success of which will be appraised by DSNA during the trial period. Trails will be carried out using Minimum Viable Product (MVP) solutions. U-space Together aims to deploy a fully operational U-space system in France by 2023.

In June 2021 Clearance and Thales announced they were working together to interconnect their respective platforms to allow drone pilots to create a flight plan on the Clearance platform and, with a single click, to transfer their request to the relevant air navigation services and prefectures, through the use of the Thales TopSky solution – UAS Airspace Manager, to offer a complete and interoperable solution for both remote drone pilots and authorities at Lille and Rennes airports.

Drone services company Clearance has combined with airport services company Edeis to put in place appropriate tools to plan the use of airspace in and around airports. The services aim to support drone remote pilots and AFIS (Aerodrome Flight Information System) agents

Table 14: UTM service providers and commercial contracts with ANSPs, civil aviation and military authorities for operational UTM systems

Date	UTM service supplier	Client	Country	Contract details
April 2016	Exponent/Astra UTM	Dubai Civil Aviation Administration	Dubai	Public launch of the Exponent Portal software which allows DCAA officials and other local authorities to track the location, speed and height of drones.
2017				
July	Unifly	DFS	Germany	UTM deployment with mobile app in July 2017
August	AirMap	Kansas Department of Transportation (KDOT)	USA	The AirMap UTM platform is deployed in Kansas where drones will be mobilised for disaster recovery, search-and-rescue, agriculture, construction, package delivery, and more.
August/ September	AirMap	States of Texas and Florida	USA	Temporary UTM set up in wake of hurricanes Harvey and Irma
September	Kongsberg Geospatial	Public Services and Procurement Canada (PSPC)	Canada	A contract to produce an Emergency Operations Airspace Management System (EOAMS) for evaluation by Canadian government agencies for safely managing drones at emergency and disaster scenes.
October	Skyward	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
October	Unifly	Danish Transport, Construction and Housing Authority	Denmark	Launch of "Droneluftrum" app centred on interactive map based on Unifly software
November	AirMap	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
December	AirMap	Airways New Zealand	New Zealand	Drone operators use AirMap's iOS and Android apps to request airspace approvals required by New Zealand's Civil Aviation Authority at Christchurch, Queenstown, and Wanaka airports, and on public lands in the Christchurch City, Selwyn, and Queenstown Lakes District Council, including parks and reserves.
December	Rakuten AirMap	Chiba City	Japan	Chiba City is the first city in Japan to deploy the Airspace

				Management Dashboard from Rakuten AirMap.
December	Unifly	Austrocontrol	Austria	UTM deployment with mobile app
2018				
March	Unifly	Belgocontrol and the Belgian Civil Aviation Authority	Belgium	Launch of droneguide.be, a digital platform based on Unifly software.
March	Wing	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
March	Rockwell Collins	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
March	Deutsche Telecom	DFS	Germany	The UTM system is based on the DFS multi-sensor tracker Phoenix, which was developed by DFS and is in use to display radar data for air traffic control.
March	AirMap, SITAONAIR, senseFly and PX4	Skyguide	Switzerland	The contract is to develop and deploy a national drone traffic management system for Switzerland.
March	Altitude Angel	NATS	UK	A strategic partnership to develop UTM solutions that can be integrated and interact with conventional air traffic control.
March	DroneRadar consortium	Polish Air Navigation Services Agency and Polish Civil Aviation Authority	Poland	The consortium comprises DroneRadar JSW Innowacje, dlapilota.pl Sp. z o.o., Creotech Instruments S.A, FlyTech UAV Sp. z o.o., Aerobits and WIZIPISI. The consortium cooperates closely with the PANSA to create a nationwide UTM system
May	Unifly	UNICEF	Malawi	Unifly has set up the first UTM in Africa, supporting UNICEF's humanitarian drone corridor in Malawi.
May	Leonardo	ENAV	Italy	Leonardo will lead the industrial team that includes subsidiary Telespazio and IDS – Ingegneria Dei Sistemi.
July	Avetics, Garuda Robotics, Nova Systems,	CAAS	Singapore	

	Wilhelmsen with OneSky			
August	AirMap	ANS-CR	Czech Republic	ANS CR is deploying AirMap UTM to manage authorisations for drone flights in the controlled airspace around Václav Havel Airport Prague.
December	AirMap	DGAC	Mexico	The General Directorate of Civil Aeronautics (DGAC) and Mexico City are working with AirMap to facilitate drone-pilot access information on flight rules and restricted areas.

2019				
January	Exponent	AirShare	New Zealand	
June	Airspace Drone	DCA	Monaco	
August	Airspace Drone	DGAC	Haiti	
November	Airspace Link	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
November	Avision	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
November	Botlink	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
November	Collins Aerospace	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
November	DroneUp	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)

November	Simulyze	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
November	Skygrid	FAA	USA	Approval to give commercial drone operators instant access to controlled airspace with the Low Altitude Authorisation and Notification Capability (LAANC)
December	Happiest Minds and ANRA	Ministry of Civil Aviation	India	
December	Altitude Angel	LVNL	Netherlands	

2020				
January	Frequentis and Altitude Angel	Avinor	Norway	
February	Unilfy	NAV CANADA	Canada	
May	Airbus, Clearance and X-One Technology AirMap Altitude Angel Clearance Innov'ATM/ Hologarde Sopra Steria-Clearance-ENAC Thales Wing	DSNA	France	
May	Frequentis, Robots Expert	EANS	Estonia	
June	Altitude Angel	Cranfield airport	UK	
July	Altitude angel	Canadian drone flight training institute, Sugu Drones	Canada	
November	IDRONECT	Civil Aviation Directorate (CAD)	Malta	
December	Innov'ATM	DSNA -Paris Airports	France	Innov'ATM is implementing its UTM systems at Paris/Charles de Gaulle, Orly and nine general aviation airfields in the Île de France region.

2021				
May	Astra UTM	Fintraffic	Finland	
May	Aeroscript	St Petersburg	Russia	Aeroscript, the company which has developed the Skyarc technology platform. Tactical deconfliction will be available in 2024-2025. The base services are to be fully operational at the end of 2022 in St Petersburg, along with other big cities in Russia. .
May	Altitude Angel	Snowdonia Aerospace Centre	UK	
May	Airwayz UTM	Ayalon Highways	Israel	
July	Droniq/DFS	Port of Hamburg	Germany	
August	Indra, with Airbus and Unifly	ENAIRE	Spain	
September	Aeroscript	Sakhalin Region Development Corporation	Russia	
September	FuVex. UPNA, Naitec, Naturgy and Sistemas de Navarra, Civil Protection and Emergency teams.	General Directorate of the Interior	Spain	A regional UTM and management project to coordinate drone flights, manned aircraft operations and ground-based first responder missions has been launched In Navarra, Spain.
September	Altitude Angel	Drone Center Sweden	Sweden	The Swedish Transport Administration has selected Altitude Angel to supply its GuardianUTM Enterprise platform at Sweden's 2,400km² Drone Center in Västervik on Sweden's south-east coast.
October	Altitude Angel	Dublin Airport	Ireland	
November	Universitat Politecnicia de Valencia	Valencia regional authority	Spain	

Table 16: 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 **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 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	**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 – 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 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 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	**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*	

The following reports from individual MNOs and associated companies - from the GUTMA/GSMA Connected Skies series of webinars and other sources – outline UTM and aviation connectivity plans of individual MNOs.

Wing

Intermittent communications based on mobile network operator (MNO) cellular networks can support highly automated UAS delivery operations, according to Reinaldo Negron, head of UTM at Wing, speaking at the first "Connected Skies," webinar on 18 March, organised by the Global UTM Association (GUTMA).

"There are many questions about what level of performance you need but for us the performance of cellular depends on the concept of operations, the automation of the aircraft and the role the pilot plays in managing all these; we have shown that intermittent communications can support our types of operations," said Negron. Wing is operating package delivery services in Christiansburg (Virginia, USA), Helsinki (Finland) and Melbourne (Australia).

"When we started, we planned to operate via 4G and LTE… when we moved to remote and rural we found that 3G was sufficient for the telemetry and monitoring processes that we have. As you look at a highly automated operation you can use a wide range of cellular to support that and 3G can work for us. Our model of being able to connect with multiple mobile network operators (MNOs) has been great and we have been able to repeat this in Europe, Australia and the USA. It's not easy to get onboarded with an MNO – it involves integration and flight testing – but it is an achievable and repeatable process at a point where we can scale today for operations."

KPN

"We focus on business first and technology second," said Sander Barake, Innovation Lead at Dutch MNO KPN. KPN has been involved with the Dutch Drone Delta, working with partners to build a drone eco system in the Netherlands. "Connectivity is a real good basis for us but it's just a basis; we see data handling and data exchange will create real value." In answer