A drone is shown in silhouette against a dark blue sky, with its red lights glowing. Below the drone, a cityscape is visible through a semi-transparent blue band. The word "SAMPLE" is written in large, white, sans-serif capital letters across this band. The background of the entire cover is a blurred cityscape at night, overlaid with a white network diagram consisting of interconnected nodes and lines.

SAMPLE

**THE MARKET
FOR UAV TRAFFIC
MANAGEMENT
SERVICES
2021-2025**

**BY PHILIP BUTTERWORTH-HAYES
AND TIM MAHON**

EDITION 4.01 JULY 2021

www.unmannedairspace.info

**UNMANNED
AIRSPACE**

Contents – V4.01

Executive summary	4
1. Market overview	6
2. A growing demand for services	11
2.1 Overview of high-level forecasts for commercial drone operator services by sector, value, geography and platform numbers	11
3. A country-by-country and regional guide to programmes creating the procedures and protocols required for UTM	22
Introduction	22
3.1 Africa	23
3.2 Australasia	28
3.3 Europe	34
3.4 Far East	81
3.5 Latin America and the Caribbean	97
3.6 Middle East	100
3.7 North America	104
4. Financing UTM	124
4.1 Different approaches to financing UTM systems	124
5. Market forecasts for growth in the global UTM market – by value, geographic demand and sector	135
5.1 How UTM services are currently being implemented worldwide	135
5.2 Business opportunities for UTM service providers	139
5.3 Business opportunities for mobile network operators	152
5.4 Air navigation service providers and UTM business opportunities	160
5.5 UTM market forecasts by value, geographic demand and sector	164
6. The Urban Air/Advanced Air Mobility UTM market	167
6.1 Introduction to the UAM market	167
6.2 Governmental and inter-governmental urban air transport research and collaborative programmes	186
6.3 Commercial company research programmes	196
6.4 UTM for ports	198
7. Current and emerging technologies	202
7.1 Drone registration	204
7.2 Geo-fencing	207
7.3 Surveillance, tracking and identification	213
7.4 Detect-and-avoid	222
7.5 Communications	233
7.6 Block chain	242
7.7 Parachute systems	246
7.8 Integrated counter-UAS systems	249

7.9 High altitude operations	257
7.10 Global navigation satellite systems	258
8. The role of regulators, certification and standards agencies – likely scenarios for developing the regulatory framework for UTM	261
8.1 GUTMA	261
8.2 The International Civil Aviation Organization (ICAO)	263
8.3 European agencies	271
8.4 National regulatory bodies, drone councils and JARUS	279
8.5 Standards organisations	284
8.6 The International Air Transport Association (IATA)	303
8.7 Industry trade associations	304
9. UTM – Different approaches to defining the concept	307
9.1 The elements that make up a UTM system	307
9.2 The US vision: NASA's UTM	312
9.3 The European Union vision – U-space	318
9.4 China's UOMS concept	330
9.5 Japan's Aerial Industrial Revolution	332
9.6 Nanjing Technical University's UTM concept	334
9.7 ONERA's Low Level RPAS Traffic Management system (LLRTM)	335
9.8 Technology provider and other UTM concepts	336
9.9 A6 Alliance	339
Appendices	
Appendix one : An index of UTM service providers	342
Appendix two: Drones Amsterdam Declaration	362
Appendix three: FAA UPP lead participants	364

"The Market for UAV Traffic Management Services – 2021-2025" 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. Additional material is supplied by Tim Mahon. All rights reserved. No part of this document may be reproduced, stored in retrieval systems or transmitted in any form or by any means, electronic, mechanical, or otherwise without the prior permission of the publisher. Infringements of the above right will be liable to prosecution under UK criminal law. While every care has been taken in the compilation of this report to ensure its accuracy at the time of publication (December 2020), the publisher cannot be held responsible for any error or omission or any loss arising therefrom.

Market overview

Our previous forecast for the global UTM market 2021-2025 (published in December 2020) predicted a global market worth USD 844.4 million, with relatively modest growth levels in 2021-2023, then rapidly accelerating values thereafter as regulations and standards allow for regular, automated, commercial BVLOS operations in North America and Europe. This was a lower figure than in previous forecasts,

The survey noted the negative impact that the Covid-19 pandemic had had on many market sectors and the slow uptake of UTM and U-space regulations, standards and procedures by States around the world.

"The relatively slow growth in the UTM market has been confounded by a slowing down in UTM implementation plans, also as a result of Covid-19 in many cases," we wrote. "In September 2020 Eurocontrol issued a new edition of the U-space services Implementation Monitoring Report which assesses implementation progress of the main elements underlying the provision of U-space services enabling very low level (VLL) drone operations in the 30 Single European Sky (SES) area member states. The results of the overall analysis show a non-uniform, slow implementation progress of the 16 U-space services expected to be provided in phases U1 (2019) to U3 (2025) of the U-space framework. However, the rate of planned activities increased compared to 2018, indicating that a larger number of stakeholders is taking steps forward into the implementation of many U-space services."

"Eurocontrol notes negative completion trends were detected for a number of service elements compared with the last report edition. Such findings are due to the enlargement of the scope of the survey from the 28 EU Member States (ref. 2018) to the 30 EU SES Member States. The image above the overall U-space services completion rate evolution taking into account the average progress of implementation of different service elements among SES Member States...7% of Member States reported to have implemented E-registration by 2019, 43% plan to implement in by 2021 and 46% by 2025."

In its assessment of the drone market in 2020 Drone Industry Insights (Drone II) noted that although investment into the drone industry reached new record in 2020 with USD2,338 billion, UTM investments fell marginally to USD13 million, which we believe under-estimates the global investment value in U-space/UTM. According to the company, "North America continues to be the dominant region for investing in drones with 62% of investment value across the world. This is, however, a decrease from last year's share of 71% of drone investments, which means that other regions are receiving more investments. The region that gained the most ground in this regard was Europe, which gained 8% from its share of the value. Nevertheless, the other regions such as Asia, Middle East and South America also gained share from the overall investment value. The only region to lose ground was Oceania."

The first six months of 2021 has seen a turnaround in the prospects of the global UTM sector, as new regulations from the Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA), among others, on UTM/U-space have been put in place, outlining a clear road map for industry to follow to put in place a framework to support automated drone operations beyond visual line of sight (BVLOS) by 2023/2024.

In April 2021 the European Commission adopted the U-space package.

"These regulations introduce new services for drone operators, allowing them to carry out more complex and longer-distance operations, particularly in congested, low-level airspace (below 120m), and when out of sight. The U-space creates and harmonises the conditions needed for manned and unmanned aircraft to operate safely, to prevent collisions between

The Market for UAV Traffic Management Services – 2021-2025. Edition 4.01 July 2021
www.unmannedairspace.info

drones and other aircraft, and to mitigate the risks of drone traffic on the ground...The U-space is included in the '[Sustainable and Smart Mobility Strategy](#)', unveiled in December 2020. The Strategy lays the foundations for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises. With drones a clear part of the future transport landscape, these regulations cover the roles and responsibilities of the organisations involved in the definition of U-space, the provision of U-space services, and the minimum necessary services required for manned and unmanned aircraft to operate within the U-space. The regulatory package will enter into force in April and will become applicable as of 26 January 2023.

But there is considerable work to be done before individual States can implement these high-level rules at an operational level. Swiss regulator FOCA started down this road with the launch of networked remote ID at the start of 2021. ATSM F3411 provides the standard, and USSPs are heavily involved in developing the guidance material. FOCA oversees a master agreement signed by all participants which is accessed via the Swiss U-Space Implementation (SUSI) website. The regulator can arrange/revoke access as necessary.

Chapter V, articles 14, 15 and 16 of the regulation address USSP requirements and their obligations, nominating the national regulator as certification authority (unless the role is transferred to EASA). It also includes a sample template in the Annex. It is based on regulation 2017/373 common requirements for ATM service providers and follows a similar format, for example requiring service providers to demonstrate safety assessment, monitoring of safety performance and compliance. Two application models are envisaged: Multiple U-space providers; and a state-designated single Common Information Service provider (CISp). The regulation also includes extra obligations, for example to regulate change management, subcontracts, personnel requirements, security of facilities, operating manuals and record-keeping. It specifically addresses cyber security and will be subject to new EASA transversal security requirements which are currently under development and will apply across all aviation domains.

Also in April 2021 new rules took effect in the USA for remotely identifying drones and allowing operators of small drones to fly over people and at night under certain conditions.

"Today's rules are an important first step in safely and securely managing the growing use of drones in our airspace, though more work remains on the journey to full integration of Unmanned Aircraft Systems (UAS)," said U.S. Secretary of Transportation Pete Buttigieg.

According to an FAA press statement the Remote Identification ([Remote ID](#)) rule provides for identifying drones in flight and the location of their control stations, reducing the risk of them interfering with other aircraft or posing a risk to people and property on the ground. The rule provides crucial information to our national security and law enforcement partners and other agencies charged with ensuring public safety. It applies to all drones that require FAA registration.

The [Operations Over People](#) rule applies to pilots who fly under [Part 107 of the Federal Aviation Regulations](#). Under this rule, the ability to fly over people and over moving vehicles varies depending on the level of risk (PDF) a small drone poses to people on the ground. Additionally, this rule allows [operations at night](#) under certain conditions provided pilots [complete certain training or pass knowledge tests](#).

In other positive news, air navigation service providers have been given new tranches of investment to build their UTM capabilities. There has also been an acceleration of development in urban air mobility (UAM) UTM research; once it becomes clear how competition for tactical UTM services will be organised and the role that cities and regions might play in

Section two: A growing demand for services

2.1 Overview of high-level forecasts for commercial drone operator services, by sector, value, geography and platform numbers

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 a forecast-of-forecast, is predicted to grow at an average of 27.7% compound annual growth rate over the next few years – but this study suggests growth rates are likely to be much smaller, perhaps slightly over 7% in 2021 over 2020 (see section 5.5).

Professional aerospace market forecast companies are still showing wide variations in the predications for the civil UAS market over the next few years – the highest is Finbold's 67% CAGR and the lowest is Frost & Sullivan's 4.3% CAGR.

Forecaster	Years	Market	Growth rate
ABI Research	2020-2030	Small UAS	CAGR 25%
FAA	2020-2040	Commercial UAS fleet	CAGR 20%
Frost & Sullivan	2019-2023	Global commercial UAS fleet	CAGR 4.3%
DRONEII	2020-2024	Global drone fleet	CAGR 13.0%
Gartner	2019/2020	Global commercial UAS fleet	CAGR 50%
Grand View	2021-2028	Commercial drones	CAGR 57.5%
Fortune Business Insights	2020-2026	Global sUAS fleet	CAGR 15.92%
International Data Corporation (IDC)	2020-2025	Global drone industry (including software)	CAGR 33.3%
Market and Markets	2021-2026	Global UAV market	CAGR 16.4%
Teal	2019-2028	Global drone industry	CAGR 15.6%
Finbold.com	2018/2019	Venture capital funding in drone enterprises	CAGR 67%

By while long-term, most estimates remain bullish, short-term pandemic impacts have depressed demand, say some forecasters. While this has accelerated the demand for medical delivery services it has also slowed the expansion of other sectors, such as construction monitoring and environmental protection, as has been evidenced in the October 2020 findings of the AW-Drones analysis of near-term professional drone services in Europe (*Survey on European UAS Operations and Operation Risk Assessment Methods Conclusions* https://rps-info.com/global-uas-ops_interim-survey-results_201113/download/) which concluded that:

“It is anticipated that the percentage of drone flight operations taking place in the 10 principal current Market Sectors will decrease from 86% to 79%, which indicates that there is more activity in the other Market Sectors. ‘Aerial Photography, Audio Visual Production, Advertising’ has exchanged first position with ‘Construction & Real Estate’. ‘Mining & Exploration’ has replaced ‘Cinema & TV Industry’ in the tenth position. The activity volume in the following Market Sectors is anticipated to change as indicated:

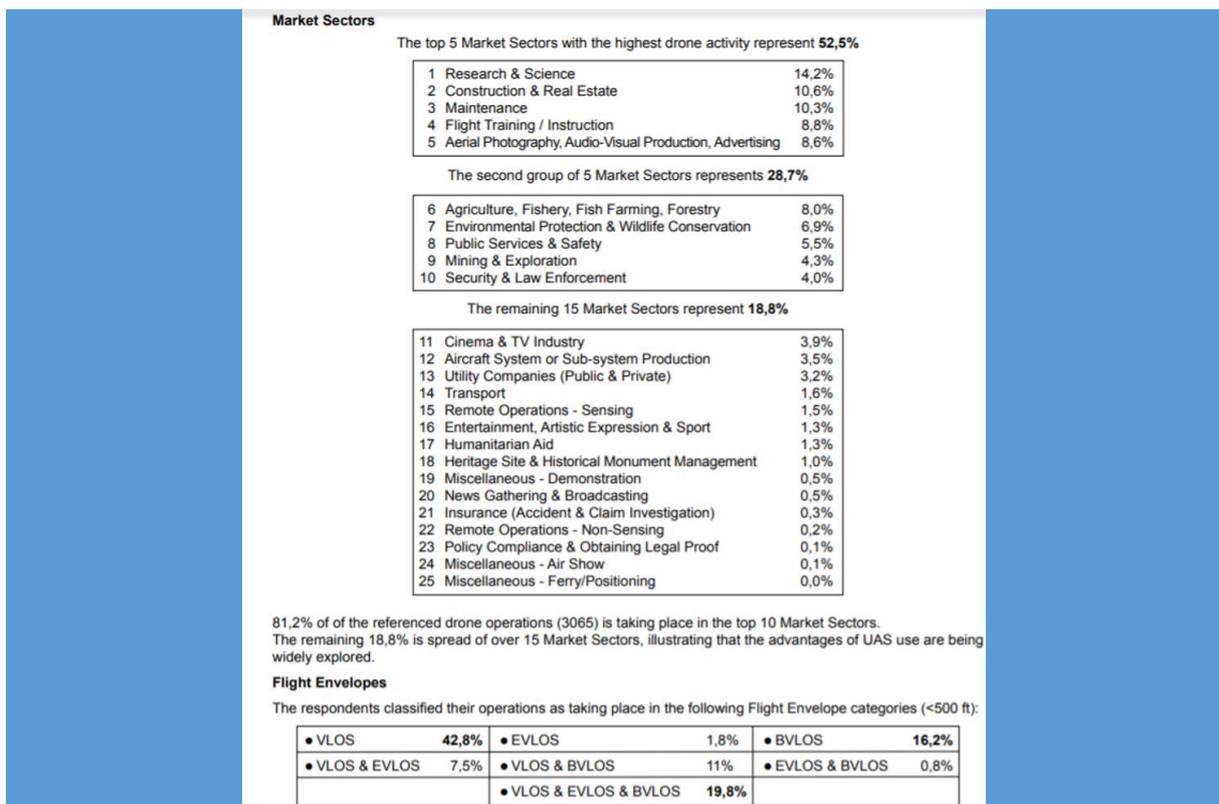
The Market for UAV Traffic Management Services – 2021-2025. Edition 4.01 July 2021
www.unmannedairspace.info

- Maintenance Stable
- Construction & Real Estate - -26%
- Agriculture, Fishery, Fish Farming, Forestry +26%
- Security & Law Enforcement Stable
- Research & Science +9%
- Public Services & Safety Stable
- Flight Training & Instruction +12%
- Environmental Protect. & Wildlife Conservation -17%"

According to the June 2021 **MarketandMarkets** UAV forecast report:

"The situation has altered drastically post COVID-19. Due to intermittent lockdowns and imposition of social distancing protocols worldwide, there has been halts in production of UAVs due to shortage of raw materials and staff to carry out manufacturing operation in 2020. In 2021 as well, due to re-emergence of second wave of infections, the UAV production is hampered and it might need more than six months to get back to pre-Covid 19 production scale or to retain normal functioning of UAV supply chain."

The conclusions of the **2020 Global UAS Ops survey, conducted by Blyenburgh & Co** in the context of the EU-funded AW Drones project suggested that in the near future a significant decrease in visual line of sight (VLOS) operations (42% to 25.7%) will take place and a significant increase in beyond visual line of sight (BVLOS) (from 19.8% to 34.2%) will take place.



Section three -A country-by-country and regional guide to programmes creating the procedures and protocols required for UTM

Private and recreational air traffic, aerial work and unmanned air traffic will obtain more access to controlled airspace without hindering other air traffic as a result of **Belgium's** Airspace Vision 2030. Unveiled by air navigation service provider (ANSP) skyeeyes on 19 July 2019, the future airspace vision is supported by Belgian's three independent air traffic control operators: skyeeyes, Eurocontrol MUAC (above flight level 245), and Belgian Defence.

The complex airspace structure and Belgium's geographical position prevent the use of the potential full capacity of airspace. It is a limited but very busy airspace with many users: commercial and military aviation, aerial work, private and recreational air traffic, unmanned air traffic. The current lay-out in different zones for different users causes disadvantages for each of them: airports cannot always use their full capacity, airlines cannot always fly the most direct routes, military airspace is too limited for the future generation of (fighter) aircraft and there is too little uncontrolled airspace for recreational air traffic.

The airspace vision 2030 brings advantages for all users of the Belgian airspace. The main progress for everyone is the capacity extension of airspace.

By 2030, the Belgian airspace will form one whole that can be used in a flexible and dynamic way. More efficient use of airspace guarantees sufficient capacity for all users with a minimum of limitations. Such an airspace structure – and the management of it – converges with the European objective of Single European Sky.

It should be possible to activate, deactivate or allocate certain airspace zones to one specific user for a limited period in time. That way, for instance military airspace or airspace for aerial work could be restricted or the periods in which it is used could be limited for the benefit of other air traffic. Military operations would thus be guaranteed but the total capacity of airspace for other users would be extended, allowing them to better plan their flight routes. That predictability again increases the efficient use of airspace.

Private and recreational air traffic, aerial work and unmanned air traffic will be integrated in airspace without jeopardising safety. According to a press statement, via the current skyeeyes droneguide app pilots can verify where and when they can fly with which device and professional users can even obtain the necessary authorisations and notify their flights to the competent authorities. Various projects are now up and running to test practical applications with drones in real circumstances: inspection flights in the port area, delivery of medical supplies, collaboration between safety services, ... Apart from the technical possibilities and obstacles (such as drone detection) it yields a tremendous amount of knowledge for skyeeyes with regard to managing unmanned air traffic.

In January 2020 skyeeyes created a subsidiary Skeydrone in which it will pool all its drone-related activities, including UTM services.

According to the company:

"The skyeeyes Board of Directors decided to create a commercial subsidiary called SkeyDrone. This skyeeyes subsidiary shall group all drone-related initiatives in a separate organisation. The company will among other things offer air navigation services for unmanned aircraft. The regulatory framework in this new market is in a final phase of development on European

The Market for UAV Traffic Management Services – 2021-2025. Edition 4.01 July 2021
www.unmannedairspace.info

level. SkeyDrone will not be the only player on this market, but with the expertise of the mother company skeyes as air navigation service provider for the manned aviation, the acquired experience with drones and the collaboration within the sector, SkeyDrone undoubtedly has an important role to play. Moreover, SkeyDrone will focus on services for securing critical infrastructure (such as airports) against drone intrusions.

“But also within skeyes an expertise regarding drones will remain. That way in the long run skeyes wishes to act as a CISP/CIF (Common Information Service Provider/ Common Information Function): a central player who via an open platform provides information involving manned and unmanned flights to e.g. other air navigation service providers who will manage unmanned air traffic. International, commercial companies for example manage their own unmanned fleet.”

In the first phase of creating the company skeyes will be the only shareholder in the new company but in a second phase, “public and private (industrial) partners will be sought in order to decrease the share of skeyes, but especially to add the necessary knowledge and competencies to the mix.”

“Our efforts for the drone sector are situated in a broader strategy with regard to innovation. In our other activity domains we are examining how we can proceed in an innovative way as well in the interest of all our clients,” said Johan Decuyper, CEO of skeyes. “Regarding drones we are most certainly among the frontrunners in Europe. Proof of that is the support that we receive from Europe and our advice to governments that serves as the basis for drone-related regulation. That way, we promote the interests of aviation in our country and we remain responsible for the safety of all the traffic in the Belgian airspace.”

In September 2019 skeyes and the Belgian Civil Aviation Authority released Droneguide PRO – a system which automates the administrative process for drone registration, flight approvals, dynamic airspace management and other UTM functions. It allows professional drone operators and pilots to access airspace via a web based application.

At the request of skeyes and the FPS Mobility and Transport, Unify developed a specific Droneguide version for professional drone users. The updated version contains all the features they need to plan and manage their flights. Marc Kegelaers, CEO of Unify, said: “As of today and based on Unify’s technology, functions like registration, geo-awareness, dynamic airspace management, flight planning, strategic de-confliction, multi-level flight approval processes etc... are no longer items on a wish list, but are functions that are available to drone operators as well as national and local authorities....Until now, professional drone operators were required to manually request their flight approvals and derogations. For drone operators, this meant a lot of paperwork and administrative delay.

“With the new automated process, drone operators are able to conduct their business in a more efficient and streamlined manner. Drone operators and pilots can now fully focus on flying and securing projects, with Droneguide PRO simplifying the administrative aspect.”

skeyes and the Federal Public Service Mobility and Transport are launching an extended version of the Droneguide application, according to a Unify press statement. Professional drone users in Belgium are required to notify their flights via this application. Recreational drone users can find information about the regulation and all they need to know to use their drone. They can also check where it is allowed to fly. Droneguide is very successful: every month, some 18,000 drones users (unique visitors) use the application.

With the new system, according to Unify, pilots can plan their operation and obtain validation via the online tool or via the mobile application. They can also notify their flight to

the authorities. New Class 1A flight requests are taken into account during the validation process. For active applications, the documents of the request file can be displayed. For their part, the authorities receive an overview of all planned operations and see all active operations on the map, including those that are about to start.

Class 2 operators can also plan their flights via the tool. However, they are not required to make a flight request or to notify their flights. Nothing changes for recreational drone users.

Until now, professional drone users have notified their flights via an online form. Derogation requests even had to be sent by e-mail using a Word document. From now on, both actions will have to be carried out via the application. A transition period is scheduled until 11 December 2019 at midnight. During this period, requests may still be processed using the "old method" on an exceptional basis. From now on, users can submit all their requests via the application, but also view their flights via Droneguide maps, manage their entire fleet and keep an overview of their flight history. To use the application, professional drone users must first register via CSAM. The FPS Mobility and Transport provides secure access via eID, itsme, mobile application or SMS. A main access manager controls the use of all the features of the application and can also designate optional access managers.

In April 2021 the Port of Antwerp has become one of the first seaports to initiate UTM in a busy and complex port environment and is the first non-aviation authority to become a fully-fledged geozone manager, according to a news release. As geozone manager, the port will be responsible for managing ground risk related to above-the-ground activity, with respects to operational and working drones, overall safety and seamless integration of processes required; all of which are intended to ramp up productivity and efficiency of port operations.

On display at the 2019 World ATM Congress in Madrid was the latest developments to the AMC Portal from **Croatia** Control Limited (CCL), the world's first airspace booking tool/UTM system, according to the company. The AMC Portal is a web-based tool designed to inform all airspace users of the current and near future airspace status and has been in operational use in Croatia since June 2017.

According to Vlado Bagarić, Director General of CCL, writing on the company's website: "As the tool was being created, a special emphasis was put on our new airspace users – the drone operators, whose time is yet to come....our solution also enables direct communication through an internal messaging system between the user and the national ASM system, which is only one among its multiple other capabilities.

"Put simply, the AMC Portal is the first implemented operational tool for the real-time airspace management of all activities, and as such it dictates the pace of development for the competitors, and at the same time it simplifies the regulation-making process for the regulator...

"The principle is simple. In essence, the prescribed user data is collected during the registration process. Following a successful registration, the user does not need to submit additional data anymore. In a simple way, they can submit their requests to use certain airspace structures, see the rules they must abide by, and activate and deactivate the reservation. All of that is contained in various charts on the Portal with the purpose of informing other airspace users before conducting the activity."

In August 2018 AirMap announced that its UTM services are being deployed by Air Navigation Services of the **Czech Republic** (ANS CR) to deliver situational awareness and authorisation capabilities to the country's growing community of drone operators.

ANS CR is deploying AirMap UTM to manage authorisations for drone flights in the controlled airspace around Václav Havel Airport Prague. Operators using the AirMap for Drones mobile application can view up-to-date airspace conditions, advisories, and regulatory information; create flight plans, and very soon will also be able to request authorisation to fly in controlled

The Market for UAV Traffic Management Services – 2021-2025. Edition 4.01 July 2021
www.unmannedairspace.info

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

UTM service providers and commercial contracts with ANSPs, civil aviation and military authorities

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 "Dronelufftrum" 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)

5.3 Business opportunities for mobile network operators

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
<p>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</p> <p>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</p>	<p>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</p> <p>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</p>

<p>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</p> <p>U3</p> <p>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</p>	<p>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</p> <p>U3</p> <p>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</p>
<p><i>Notes: Based on the SESAR U-space service level definitions</i></p> <p>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</p>	

5.5 UTM market forecasts by value, geographic demand and sectors – 2021-2025

Our forecast for the global UTM market 2021-2025 is for a market worth USD1.27 billion, of which USD433 million will come from award of strategic national UTM development programmes and USD 844.4 million will be derived from tactical UTM operational charges.

This is based on a top-down view of the global UAS market, taking into account the most reliable and conservative commercial UAS market forecasts from section two and applying bottom-up estimates of UTM as a percentage of the overall commercial drone market.

To this we have added estimates for strategic national UTM deployment programme awards and strategic research programmes (see table at the end of this section for national operational UTM programme awards).

Revenue to UTM/ATM companies on developing strategic national UTM deployment and research programmes

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
UTM value USD million	10.0	32.0	61.0	35.0	45.0	47.0	64.0	89.0	110.0	123.00

From the table above it is clear that States drew back from operational UTM deployment programmes after 2018 for a number of reasons, including uncertainty over regulatory developments and standards and a lack of maturity in key technologies to support more automated BVLOS flights. The COVID-19 pandemic has also slowed the capacity of regulators and ANSPs to develop new programmes and investments in areas which rely on income from traditional commercial aviation sources,

However, it is now becoming clear that with FAA and EASA UTM/U-space regulations now in place and many European States now able to access EU funding mechanisms for UTM deployment, a more consistent growth in national UTM deployment can be expected from 2021 onwards.

Teal Group's *2020/2021 World Civil UAS Market Profile and Forecast* produced in October 2020 forecast that non-military UAS production will total USD108 billion in the next decade, soaring from USD5 billion worldwide in 2020 to USD18.4 billion in 2029, a 15.6% compound annual growth rate in constant dollars. In April 2020 Frost & Sullivan published its latest market analysis for the global commercial drone sector, *Global Commercial UAS Market Outlook, 2020*, concluding that the industry is transitioning from a nascent to a growth stage. "With the surge in demand for commercial drones by the professional segment, unit shipment is estimated to rise at a compound annual growth rate (CAGR) of 4.5%, reaching 2.91 million units by 2023 from 2.44 million units in 2019. By 2023, North America will remain the largest market for commercial UAS with a total of 32.3% unit demand, followed by APAC and Europe at 29.1% and 23.3%, respectively.

Forecast global expenditure on civil drones and infrastructure, business and hobbyist, with compound annual growth rates

	2021	2022	2023	2024	2025
Value (USD billion)	5.37	6.06	7.27	8.87	11.35

6.4 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 growing.

- The Port of Antwerp concluded through the EU Horizon 2020 SAFIR project that drones' ability to perform Beyond Visual Line of Sight (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.

Antwerp and Hamburg are developing UTM systems to manage drone operations.

The Port of Antwerp has become one of the first seaports to initiate UTM in a busy and complex port environment and is the first non-aviation authority to become a fully-fledged geozone manager, according to a news release. As geozone manager, the port will be responsible for managing ground risk related to above-the-ground activity, with respects to operational and working drones, overall safety and seamless integration of processes required; all of which are intended to ramp up productivity and efficiency of port operations.

Under new European legislation, ports now have the authority to coordinate and manage drones in their airspace, especially with regards to ground risks posed.

According to the press statement:

"With the help of drones, ports can increase safety, enforce compliance, and optimise operational efficiency, all with minimal interference to existing infrastructure and process. Port of Antwerp has picked up on this, and as drone traffic in their airspace continues to increase, there is a need to control their airspace and differentiate friend from foe.

"Port of Antwerp has identified specific requirements for its role as a geozone manager, such as the ability to simultaneously handle a multiple workflow, multi-layered authorisation process and robust real-time surveillance and detection capabilities. Given the vast area of responsibility within this busy seaport, it is the first time that a geozone management system of this scale and complexity will be created.

"As such, Unifly has been appointed as technology partner to develop the Port's Unmanned Traffic Management (UTM) platform. Unifly has a proven track record rolling out UTM systems at a national level in Belgium, Canada and Germany among others. The Belgian company