BIS Research
Emerging Technology Market Intelligence

Global UAS Traffic Management (UTM) System Market

Focus on Stakeholders Analysis, Key Technologies Enabling UTM, and Country-Wise UTM Concepts

March 2019

Executive Summary

BIS Research is a leading market intelligence and technology research company. BIS Research publishes in-depth market intelligence reports focusing on the market estimations, technology analysis, emerging high-growth applications, deeply segmented granular country-level market data and other important market parameters useful in the strategic decision making for senior management. BIS Research provides multi-client reports, company profiles, databases, and custom research services.

Copyright © 2019 BIS Research

All Rights Reserved. This document contains highly confidential information and is the sole property of BIS Research. Disclosing, copying, circulating, quoting, or otherwise reproducing any or all contents of this document is strictly prohibited. Access to this information is provided exclusively for the benefit of the people or the organization concerned. It may not be accessed by or offered to, whether for sale or otherwise, any third party.

Preface

In the current era, drones largely encompass a broad scope of application areas, ranging from agriculture, public safety, delivery of goods, photography, and surveillance. As the need for unmanned drones continues to further rise, there is an urgent requirement of establishing a system for safely managing unmanned aerial vehicles (UAVs) in the airspace. Currently, NASA is actively partnering with FAA and other unmanned aircraft systems (UAS) industry stakeholders to develop a research platform what is commonly known as unmanned traffic management system for safe integration of small UAS (sUAS) into low-altitude airspace.

Since 2014, NASA, along with UAS community partners, industry leaders, various governments, and academia are actively developing and testing the unmanned traffic management research platform. Many successful tests and demonstrations for communication prototypes, beyond visual line of sight (BVLOS) operations, mission planning, and longer range application only goes on to prove that in the near future, a commercialized market for unmanned traffic management is gradually emerging. This growing need for the UTM services has also resulted in development of regulatory framework for the deployment drones around the world. This regulatory framework is expected to include operational limits, key responsibilities of the stakeholders, aircraft requirements, etc. Government and regulatory authorities have made some exemptions in 2018 with regard to the operation of commercial UAVs that has been a driving factor in the UAV market growth. The U.S.-based Federal Aviation Administration (FAA) and Germany-based European Aviation Safety Agency (EASA) are two prominent regulatory authorities that are actively working towards creating more opportunities for the commercial drone business.

This market research study offers a wide perspective of the unmanned traffic management system, its major types, key important elements in the ecosystem including communication infrastructure, UAS service suppliers, UAS operators, key technologies for the unmanned traffic management system, global market for unmanned traffic management system, regulatory framework for unmanned traffic management, business opportunities for key stakeholders and UAM concepts. The study provides a detailed analysis of the market dynamics, applications and region-wise scenario of unmanned traffic management. The research is based on extensive primary interviews (in-house experts, industry leaders, and market players) and secondary research, along with the analytical tools that have been used to build the forecast and the predictive models.

All rights reserved at BIS Research

This study was designed to answer some of the most crucial questions about the unmanned traffic management market:

- What are the key enabling technologies that supplementing the unmanned traffic management system?
- What are the major business opportunities for the key stakeholders in unmanned traffic management system market?
- What is the impact of unmanned traffic management system on urban air mobility?
- What is the regulatory framework for the unmanned traffic management system?
- How can beyond the visual line of sight (BVLOS) be a game changer in the drone industry?
- What are the emerging trends in unmanned traffic management system?
- What are the regional market trends according to different regions?
- Which are the key companies that has made substantive funding in different start-ups in the unmanned traffic market space?
- How is the industry expected to evolve in the forecast period?

The report highlights the key driving and restraining forces for this market. It is based on discussions and interviews with the top management of leading unmanned traffic management systems and end users. The global unmanned traffic management system market is expected to play out differently for all region, therefore, this report segments the market accordingly and breaks down the industry regionally as follows: North America, Europe, Asia-Pacific, and Rest-of-the-world. Each region analysis details the individual push and pull forces in addition to the key players from that region.

BIS Aerospace and Defense

March 2019

All rights reserved at BIS Research

Table of Content

All rights reserved at BIS Research

All rights reserved at BIS Research

All rights reserved at BIS Research

All rights reserved at BIS Research

All rights reserved at BIS Research

All rights reserved at BIS Research

List of Figures

All rights reserved at BIS Research

All rights reserved at BIS Research

All rights reserved at BIS Research

List of Tables

All rights reserved at BIS Research

List of Acronyms

Acronyms	Descriptions
ACAS	Airborne Collision Avoidance System
ANSP	Air Navigation Service Provider
ANAC	National Civil Aviation Agency
ATC	Air Traffic Control
ATM	Air Traffic Management
API	Application Program Interface
ASTM	American Society of Testing and Materials
BSS	Broadcast Satellite Service
BVLOS	Beyond Visual Line of Sight
CAAC	Civil Aviation Administration of China
CAAS	Civil Aviation Authority of Singapore
CAB	Civil Aviation Bureau
CAGR	Compound Annual Growth Rate
CALT	China Academy of Launch Vehicle Technology
CAST	China Academy of Space Technology
CAO	Certificate of Authorization
COTS	Commercial Off-The-Shelf
CORUS	Concept of Operations for European UTM
DAA	Detect and Avoid
DARPA	Defense Advanced Research Projects Agency

All rights reserved at BIS Research

DOD	Department of Defense
DSRC	Dedicated Short Range Communications
EO	Earth Observation
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FSS	Fixed Satellite Service
GCAA	United Arab Emirates General Civil Aviation Authority
GLVI	Gesellschaft für Luftverkehrsinformatik
GNSS	Global Navigation Satellite System
GSLV	Geosynchronous Satellite Launch Vehicle
HD	High Definition
ICAO	International Civil Aviation Organization
ICD	Interface Control Documents
ISRO	Indian Space Research Organisation
IPP	UAS Integration Pilot Program
LAANC	Low Altitude Authorization and Notification Capability
LTE	Long-Term Evolution
LIDAR	Laser Imaging Detection and Ranging
LLRTM	Low Level RPAS Traffic Management
MAV	Micro Aerial Vehicle
NASA	National Aeronautics and Space Administration

All rights reserved at BIS Research

NATS	National Air Traffic Services
NOTAM	Notice to Airmen
NSSC	National Space Science Center
NUAIR	Northeast UAS Airspace Integration Research Alliance
RTT	Round Trip Time
RPS	Radio Positioning System
SARP	Standards and Recommended Practices
SEASAR	Single European Sky ATM Research
SLVs	Small Launch Vehicles
TCL	Technical Capability Level
TFR	Temporary Flight Restriction
UAM	Urban Air Mobility
UAV	Unmanned Aerial Vehicle
UAS	Unmanned Aerial Systems
UNICEF	United Nations International Children's Emergency Fund
UOM	Civil UAS Operation Management System
USS	UAS Service Suppliers
VLOS	Visual Line of Sight
VLL	Very Low Level
VTOL	Vertical Take Off and Landing

All rights reserved at BIS Research

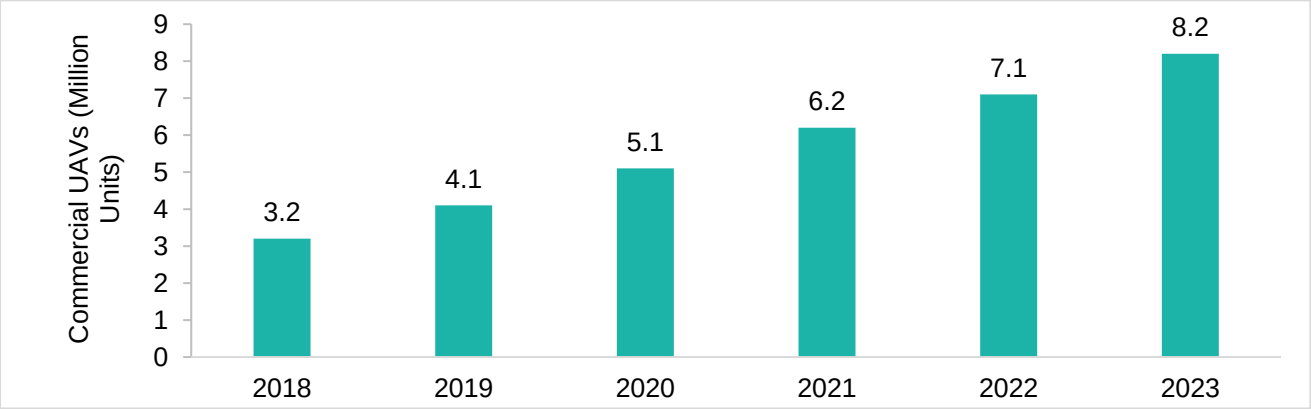
Executive Summary

Flight technology has changed the contours around the domain of aviation. Aviation is one of the most key innovations of mankind that has brought forth various kinds of modern technologies- from propulsion systems to artificial intelligence and modern communications- which have opened numerous windows of opportunities.

The first unmanned aerial vehicle (UAV) was developed in the third decade of 20th century which was primarily used for military application. Ever since then, UAVs have evolved to a large extent in the technological sphere. In the past decade, UAVs have undergone significant developments such as considerable reduction in weight, size, and cost, enhanced battery life, and increased degree of autonomy in its operation. These developments have led to a wide scale of adoption for diverse range of applications across commercial and non-commercial end users.

Unmanned aerial vehicle (UAV) can be defined as an aircraft system that can be controlled using a remote or an on-board computer system. UAVs are a part of unmanned aerial system (UAS) that include a UAV, a controller on ground and a communication system between UAV and controller. The companies working in UAV industry are working towards the development of fully autonomous UAVs which will eliminate the need of a ground-based controller in future. This will enable the UAVs to perform the tasks assigned to them without the need of any human intervention. This will reduce the operating cost of UAVs and will make them one of the most cost-effective solutions across varied range of commercial applications.

Figure 1: Global Commercial UAV Market, 2018-2023



Source: Expert Views, Secondary Research and BIS Research Analysis

Note: The above numbers exclude hobbyist drones

All rights reserved at BIS Research

Unmanned aerial vehicles (UAVs) have emerged as a powerful tool for various military and non-military applications. These systems have constantly been evolving at a rapid pace, due to its expanding growth in the commercial sector. Moreover, the growing prominence of drones as a service has enabled various commercial sectors with increased advantages. Technology is one of the key drivers for its increased adoption in the commercial market. Reductions in the power, drone components and form factor finally have allowed drones to carry heavier payloads resulting them in being highly versatile for consumer and industrial market.

UAVs have emerged as a cost-effective solution for a wide range of commercial applications such as precision agriculture, surveying, aerial photography, and mapping, among others. Moreover, the rising prominence of drone-as-a-service has enabled various business opportunities in the commercial sector. Additionally, their ease of usability has also led to their popularity among hobbyist end users as well.

Interestingly, the drone market has gradually flourished in various parts of the world especially in the U.S and Europe. The major UAV manufacturers and service providers across globe are in the process of launching their products after studying the needs of consumers across commercial and military end users. This will help the manufacturers and service providers to exactly provide consumer-centric innovative tools and applications required by the end users. In addition to this, the exemptions provided by government and regulatory authorities for the operation of commercial UAVs have also worked as a driving factor for the growth of the UAV market.

Passenger and delivery drones, and other unmanned vehicles have the potential to effectively address today's issue of traffic congestion, along with attempting to improve transportation facilities and logistics, and to create new and efficient products along with their services. Since there has been an increase in the number of drones and other aircrafts, it will be a challenge to manage and maintain such an increasingly diverse airspace. Although it is anticipated that the number of drones are gradually going to increase, it will be prime responsibility to efficiently integrate aircrafts while maintaining safety and security of the end users.

As the unmanned drones are rapidly on a rise, it is evident that there is an impending need for management services to control and manage these drones. The overall concept was devised by NASA in 2013 for integration of drones in low-altitude airspace. Based on this concept, NASA along with FAA, has worked out since then by refining overall capability of the system to become functional. NASA envisions two types of unmanned traffic management (UTM) systems: portable systems and

All rights reserved at BIS Research

persistent systems. Portable systems will have the ability to move in majority of geographical areas and support operations such as precision agriculture and disaster relief, while persistent UTM systems would mainly support low-altitude operations and provide continuous coverage to a particular geographical area. Since 2016, NASA is leading most of research and development initiatives in the UTM arena and has been involved in testing its UTM platform with various industry partners under its testing capability level (TCL) program. Similar degree of research is taking place in Europe to develop and design unmanned traffic management system. The drone market in Europe envisions drone services for 3D mapping, infrastructure, geo-fencing and delivery of good in the coming futures. Since 2016, U-space in Europe is gradually developing a new set of services which to support safe and efficient secure applications of drones in airspace. There is a fixed time frame according to which these services are expected to be launched in Europe. In addition to this, other countries such as China, Singapore, Japan and Australia are also making considerable efforts to develop their respective unmanned traffic management system.

The UTM system is an upcoming phenomenon that is envisioned to skillfully manage drone traffic in the lower level of the airspace. The system is primarily being developed for small-sized drones (i.e. drones with weight up to 55lb) that will fly 400 ft. above the ground level. UTM system is envisaged to be a system of several subsystems which will work together to provide an end-to-end service. The UTM system will be connected to different data providers to accumulate the real-time information of weather, airspace traffic, drone registration, and credentials of drone operators, among others.

In spite of all the strict regulations set by the government institutions and regulatory authorities regarding the usage of UAVs in the commercial space, the UAV manufacturers all over the world have successfully sold their products across different commercial applications such as agriculture, mining, photography, filming, product delivery, and wildlife research, among others. However, the use cases of UAVs in most parts of the world is majorly limited to the visual line of sight (VLOS) operation. The governments of different countries are taking appropriate measures to incorporate UAVs into the airspace for beyond visual line of sight (BVLOS) operation. BVLOS has numerous operations ranging from government to commercial segments. BVLOS comprises of several application areas. Some of them have been listed below in the figure:

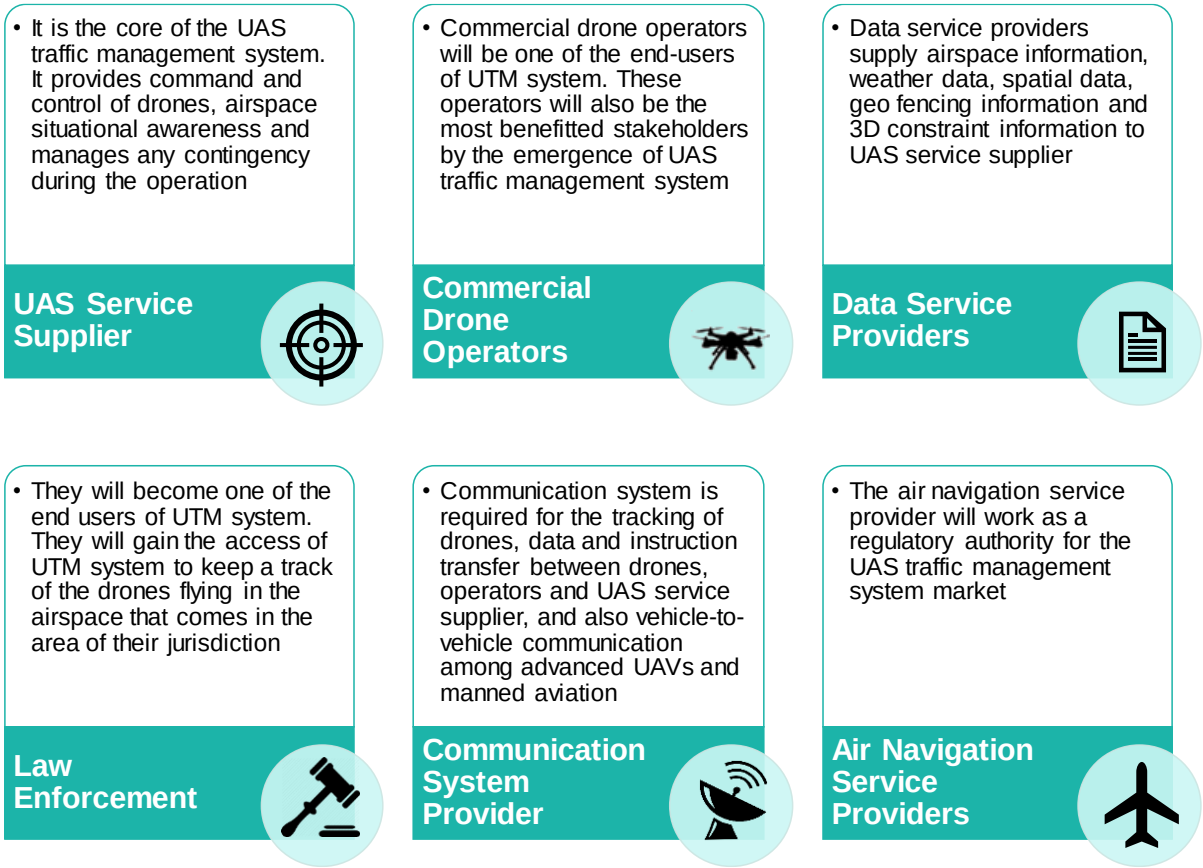
All rights reserved at BIS Research

Figure 2: Application Areas of BVLOS

Source: Expert Views, Secondary Research and BIS Research Analysis

The unmanned traffic management system comprises of various actors whose roles are diverse according to what they serve in the ecosystem. The following figure depicts different stakeholders and their roles in the UTM system:

Figure 3: Stakeholders Role in UTM



Source: Expert Views, Secondary Research and BIS Research Analysis

All rights reserved at BIS Research

UAS Service Suppliers (USS) are the biggest investable opportunity for companies in the UAS traffic management ecosystem. They will invest substantial amount in order to set up a robust traffic management system that will safely incorporate drones in the airspace. UAS service suppliers will support all drone operations in different environment (public places, urban and remote areas, and others). The UTM platform is designed to make full use of live and virtual capabilities.

External data sources are expected to provide all forms of data such as terrain maps, obstacle data, weather data and impact models, and airspace information. They also provide operational data such as surveillance data and Notice to Airmen (NOTAM) information.

There are various technological paths which are enabling the UTM system to expand. Detect and Avoid systems, vehicle-to-vehicle communications, drone tracking, and remote identification are some of these technologies. Technologies such as cell/wireless, Automatic Dependent Surveillance-Broadcast (ADS-B), satellite Ku band, beacon-based systems, and others can be used for communication and presents a wide opportunity for communication service providers to communicate with the other aerial entities in the UTM market.

Table 1: Key Technologies Enabling UTM

Enabling Technologies	Core Functions
UAS identification and registration	UAS needs to register in accordance with the rules provided by FAA and regulations prior to operating in airspace. Airspace managers have the responsibility to identify each UAS operating in the air space. There should be a direct communication between pilot and airspace managers in case the UAS operation is aborted or airspace is not available. For the identification of rogue drones, a non-cooperative surveillance capability system needs to be established.
Pre-flight planning management tool	USS's and airspace managers ought to provide operators with accurate up-to-date picture of the airspace for the operation that is going to be carried out. The data supplied will mostly be on weather, terrain and other obstacles hindering the operation. Other data information includes different UAS, no-go area etc. This system needs to be dynamically organized so the operator needs flight approvals instantaneously before starting the operation. Geo-fencing as well as geo-caging will be implemented with other automated approval by the pilot in case of any flight rerouting happens in the airspace.

All rights reserved at BIS Research

Collision Avoidance	Sense-and-avoid system is needed to maintain separation and to avoid dynamic and static obstacles. All these services will be provided by USS.
Communications	The primary means of communication between operators, FAA, and other stakeholders will be achieved through Automated Programming Interface (API). In case of emergencies, operator/manager can dynamically alter the change in operation.
Navigation	The UAS need to be able to navigate itself with precision in all conditions. In case of failure of operation, it needs to come back to base or a nearby safe area, complying to all UTM standards.

Source: Secondary Research and BIS Research Analysis

The widespread development of UAS traffic management system is expected to have considerable impact on the overall drone industry. Examples include public safety, deliveries, surveillance, news collection, etc. Moreover, the rise in drone applications is eventually expected to have a significant impact on several fronts, such as package delivery, infrastructure maintenance, agriculture management etc. Unmanned traffic management system can offer significant benefits to the drone operators, as it enables BVLOS applications. There are some psychological barriers associated with flying object and a major barrier amongst these is safety. This is due to reason that most of the respondents are hesitant that drones will be safe. However, this barrier can be overcome through manufacturers and regulatory authorities, ensuring that drones are safe for any recreational or non-recreational purposes and drones have well-documented safety records. The following figure depicts some of the major impacts of UAS traffic management system:

- **Social:** Social impact of the UAS traffic management system market is expected to be noteworthy. UTM system will help the incorporation of more number drones into the airspace that will be used for several applications such as package delivery, agriculture, and mapping, among others. The usage of drones will increase productivity in all these areas, which will in turn benefit the end users.
- **Environmental:** The UAS traffic management system will promote the usage of drones in applications where conventional methods are currently preferred. The drones will reduce the number of vehicles used for delivery, agricultural inspection, firefighting, rescue missions, and forestry. In the future, this will considerably reduce the pollution caused by bio-fuels used in these vehicles
- **Economic:** The UAS traffic management system will increase the market penetration of drones which will in turn take down the cost incurred by manual labor and also it will improve the overall productivity. In the long run, this will improve the return on investment in several businesses such as e-commerce.

All rights reserved at BIS Research

The whole system is expected to be designed in a digital framework. Drones and other aerial vehicles are going to generate significant amount of data such as flight route, trajectory of drones, mission information, etc. This data can be of valuable use to get valuable insights to help optimize travelling and mission planning. As drone applications are becoming widespread, there is a need of service delivery model in the unmanned traffic management ecosystem. This model will manage the fleet of drone in the low altitude airspace. As the fleet of drones in the airspace will increase, there will be huge amount of data that a drone will acquire through surveillance and inspections. Such a resilient information flow between drones and flight management provider requires a solid infrastructure for transferring billions of data packages. For this, cloud infrastructure can be leveraged at some points providing flexibility, scalability in order to deliver world-class services quickly. Blockchain technology can skillfully deliver a solution through its innovative framework which can be used by different stakeholders in commercial drone business. Future drone solutions need to be allocated with cryptography that will support confidentiality, authorization and secure/protected communications among drones and through different gateways. Blockchain identifiers can also be used for identity management to protect drone user information and any confidential data about the mission objective. These identifiers will notify the public on information but won't be releasing any personal data about the drone operators unless operators are involved in unauthorized flights. The ultimate goal of the blockchain technology is to develop an independent and self-directed system that will manage and monitor end to end drone operations.

UTM Market Snapshot

Globally, the market for UTM is rapidly evolving with regard to UAS Service Suppliers (USS), which is one of the major components of the UTM ecosystem. UAS Service Suppliers (USS) have a viable business opportunity as most of them are emerging start-ups trying to enter the UTM industry with their own UTM system. They will invest substantial amount in order to set up a robust traffic management system that will safely incorporate drones in the airspace. In order to generate revenue, the USS are expected to charge two types of fees from UTM system end-users:

- One-time subscription fee
- Per flight charges

This charge would include fees for registration, flight approvals, area of flying and for other services. The per flight charges is further likely to differ, based on the value-added services such as mission planning, and risk assessments, among others provided by the UTM service providers.

All rights reserved at BIS Research

From 2020, the market starts to emerge particularly in the U.S., as the testing is currently underway at various locations in the country. The market scenario in other countries would differ, as there are different rules and regulations for UAS operations. Based on the expert interviews and research, it is expected that approximately a few dollars to hundred dollars will be charged per connection to the drone operator. By 2030, it is expected that approximately 14.2 million drones would be airspace and assuming 200 dollars per connection, the market size will reach around $2.83 billion. However, the predicted fee charged to the drone operator might completely vary, as the market starts to flourish.

Competitive Landscape

The competitive landscape of the UAS traffic management system market includes different strategies undertaken by the key stakeholders to gain market presence. As the system is currently under development and testing phase, therefore, all the stakeholder companies are working together to assist government and regulatory authorities for drafting rules and regulations. Some of the strategies adopted by the companies are new product launches and developments, partnerships, collaborations, and acquisitions. Some of the key players in the UTM ecosystem are:

- Unifly
- Skyward.io
- 3D Robotics
- Airware
- Altitude Angel
- Analytical Graphics, Inc.
- DeDrone
- DJI Innovation
- Gryphon Sensors
- Kittyhawk.io
- Microdrones
- PrecisionHawk
- SenseFly and
- vHive
- AirMap

All rights reserved at BIS Research

The funding scenario in unmanned traffic management market is quite noteworthy. Most of the funding is likely to come from sources such as seed money from the public sectors, investors, and companies with adequate cash reserves that are committed to drive the market and willing to invest in the coming future. The companies are mostly focusing on hardware, support services, or operations. Companies such as Blue Innovation from Canada, Colibrex from Germany, and Aerodyne from France are actively offering support in various operations broadly covering software and services related to navigation, UTM, and security, as well as the construction and maintenance of infrastructure and inspections of railways and pipelines. A funding of US$371 million have already been raised by companies providing UTM and navigation services from venture capitalists, private equity, and private angel investors in the year 2017. Boeing Horizon X also invested $32.5 million in a Texas-based Artificial Intelligence (AI) company SparkCognition.

Numerous investments have taken place in the recent past in the UTM space, which shows the degree of interest of industry leaders in this platform. However, the challenge lies in coordinating these endeavors, keeping in mind the regulatory and infrastructure framework in order to support these services.

It is anticipated that as the technology further develops, the UTM architecture will need more degree of clarity through necessary procedures undertaken by both government and private players.

All rights reserved at BIS Research

BIS Research Offerings:

We're on a mission to harness the potential of disruptive technologies to make businesses thrive in today's digital age. With a vision to be a leading and a preferred knowledge partner for corporates and institutions worldwide and assist with market intelligence in the area of emerging technologies, advisory, and other innovative solutions.

Syndicated Reports

BIS Research's syndicated offerings assist our clients in getting a firm grip on the forces transforming their industry including technological and scientific innovation. The research reports helps senior executive devise strategy for a sustained growth, innovation planning and technology scouting.

Know More

Custom Research

BIS offers customized research solution leveraging on its in house analyst team and network of over 5000 industry experts to help executive deep dive across a new technology area.

Know More

insight Monk
... deep expertise

insight Monk

Through our vetted community of specialized experts such as senior executives, scientist and other key opinion leader we help our client get real world perspective on technology, market and end user segments.

Know More

Annual Subscriptions:
Quite often, we have clients that have ongoing business intelligence needs and require adequate market data and forecasts across a wide range of emerging technology sectors on a frequent basis. Annual market research subscriptions from BIS Research are ideal for the ongoing requirements (for quality market data and forecasts), of corporates, universities or colleges, and research institutions.

Know More

All rights reserved at BIS Research

Disclaimer

BIS Research provides valuable market intelligence to an exclusive group of customers in response to orders. The report is licensed only for the customer's internal use and is subject to restrictions set henceforth. This document and its contents are confidential and may not be further distributed, published, or reproduced, in whole or in part, by any medium or in any form for any purpose, without the expressed written consent of BIS Research. The customer will neither disclose the contents of the report, whether directly in any media or indirectly through the incorporation in a database, marketing list, report or otherwise; use or permit the use of information to generate any statistical or other information that is or will be provided to third parties; nor voluntarily produce the information in any legal proceedings.

Market reports are based on the expectations, estimates, and projections, as of the date such information is available at. Recommendations, if any, contained in this report may or may not be suitable for all investors or businesses. The market conclusions drawn are necessarily based upon a number of estimates and assumptions that, while considered reasonable by BIS Research as of the date of such statements, are inherently subject to market fluctuations as well as business, economic, and competitive uncertainties and contingencies.

For more details regarding permission, please contact us:

Email: sales@bisresearch.com

Tel: +1 510 404 8135

All rights reserved at BIS Research

BIS RESEARCH INC.

39111 Paseo Padre PKWY, Suite 313 Fremont, CA 94538 -1686

E-mail: info@bisresearch.com | Call Us: +1-510-404-8135

Global Delivery Center

Tower B First Floor, Tapasya Corporate Heights, Greater Noida Expressway,

Sector 126, Noida, U.P., 201303, India

Tel: +91 120 4261540 / 4261544

www.bisresearch.com