Guidelines for Creating an Unmanned Aircraft System (UAS) Program

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Contents

Revision History

Date	Version	Notes	Author
04/18/17	V2	Section 1.5 Certifications – change to clarify authorized airspace when flying under a COA	Ober

Executive Summary

Unmanned Aircraft Vehicles (UAV), commonly referred to as drones, is one of the fastest growing emerging technologies, with a tremendous potential to revolutionize many aspects of public safety. Unmanned Aircraft Systems (UAS) is an all-encompassing term that recognizes both the UAV and all the elements including the aircraft, the ground-based controller and control station, data links, and other support equipment which provides the system of communications connecting the two.

Just as the UAS is a combination of multiple parts to be fully functional, considerations for a successful UAS program go far beyond choosing the vehicle itself. An agency planning to implement its own program should also anticipate the need to create policy, obtain authorization, implement a training program, allocate funding, develop a data storage plan, address public perception and privacy issues, and possibly establish relationships with neighboring entities to maximize the productiveness of the program.

The purpose of this report is not to deliver an all-inclusive process for the establishment of a UAS program, but instead to provide recommendations and considerations, as well as links to current information in what is a rapidly growing and changing environment.

1. UAS Program Planning

As with any new addition to agency capability, a UAS program is a blend of equipment, staff/resource planning, training, governance, and robust policy and standard operating procedures to ensure safe operations in conformity with FAA regulations, and to safeguard individuals' privacy, civil rights, and civil liberties. The agency must also evaluate the authority and jurisdiction of the intended use of a UAS fleet while considering the legal risks, liability concerns, and potential claims associated with the intended operations.

1.1 Mission

Perhaps the first step in developing a public safety agency UAS program is defining the types of missions that would be most beneficial for the department, or that the agency expects or anticipates becoming involved in. It might be that Search and Rescue (SAR) missions and accident reconstruction are of primary importance, whereas others may be considering a program for surveillance and situational awareness. Defining a concise mission plan will also help guide the establishment of privacy policies which can aid in the public perception of transparency. The public may have concerns about open-ended investigative type missions as it may be perceived as an infraction of their privacy.

Public safety entities will find that the use of UAS is more useful, cost effective, and often safer than using manned aircraft or ground personnel. Many agencies use UAS in some of the following ways:[1]

- Public Safety

[1] NASCIO report - Unmanned Aerial Systems, Governance and State CIOs

- Incident Management
  - Situational Awareness
  - Surveillance[2]
  - Search and rescue
  - Firefighting and fire spotting/observation
  - Fire Investigation (aerial and infrared photography)
  - Communications augmentation
  - Delivery of EMS Supplies, such as a defibrillator
- Local Emergency Management
  - Public safety
  - Pre- and post-disaster photos
  - Search and rescue
  - Inspection of Buildings and homes impacted by severe weather/earthquakes
- Traffic
  - Accidents and accident recreation
  - Traffic conditions monitoring
- Geographic Information Systems (GIS)
  - Precise surveying and mapping
- Infrastructure Inspection
  - Radio Transmission Tower Inspection
  - Bridges
  - Pipeline route inspection
- Public Buildings, Facilities and Asset Management
  - Fish and Wildlife
  - Migration
  - Endangered species
- Environment and natural resources
  - Monitor air quality
  - Erosion
  - HazMat readings
  - Radiological reading nuclear power plants
- Cultural
  - Historic sites
  - Public Affairs
  - Video and photos of state events or parks
  - Promotion
- Agriculture
  - Drought conditions
  - Disease in crops
  - Insect infestations

[2] Refer to Section 6 for more detail.

- Livestock monitoring
- UAS Communications payload

The most common state agencies to use UAS are the departments of transportation, emergency management, environment/natural resources, public safety, commerce, and agriculture. State colleges and universities may also conduct research on UAS or want to utilize them for other purposes.

1.2 Aircraft Selection Considerations

Although cost is often a primary motivation in choosing an aircraft, a number of other factors carry considerable weight during the planning process. Various models offer features that may better suit a particular mission set, and some are designed to operate in certain environments and for specified operations, hence the importance of conducting due diligence in understanding the intended operations before procurement.

Considerations for selecting the aircraft itself include:

- Camera system that can be controlled from the ground and that can produce the quality of photographs and videos necessary for the missions the UAS will be flying.
- GPS-based navigation, coupled with a programmable flight management system that allows for relatively precise flight planning.
- Capacity for autonomous or semi-autonomous flight for tasks such as avoiding obstacles, following a moving target on the ground, or mapping a defined area.
- Battery life and flight time need to be sufficient to meet the needs of the anticipated missions without having to return for recharging.
- Ability to operate in the anticipated operational environment. Weather conditions for the area, including precipitation levels and frequency, temperature extremes, and wind conditions all affect a successful choice.
- Safety features such as a low battery warning system, wind monitoring system to alert the ground operator when winds are not safe to fly in, and intelligence response mechanism (auto return) that instructs the drone if communication is lost with the controller.

Other features that may impact your final decision include single user operation, portability, if the UAS is network ready, and can it handle interchangeable payloads for increased functionality in a variety of missions. Additional detail for UAS aircraft selection can be found in section 7.

1.3 Resource Allocation/Staffing

Depending on the mission-type chosen, there may be a need to consider resource re-allocation and additional staffing. If the primary mission is accident reconstruction and resources are normally dedicated to the task, then adding a UAS capability may be considered as adding a tool to complete the task already part of the job. Likewise, if SAR is the mission type then a UAS capability may reduce the time and effort required.

The number of personnel on the flight crew will vary greatly depending on the size and mission of the program, however most will consist of a remote pilot in command (RPIC) and flight observer at minimum and many agencies have added additional crew to increase operational capacity and safety. Additional crew members may include a team leader, camera and remote sensor operator to control the camera independent of the pilot and to monitor images, a second pilot to control the aircraft at the command pilot's direction allowing the RPIC to serve as the decision maker for operations in general. A large team may also include a more senior officer to act as liaison between with other personnel on the scene, local air control, etc. It is important to note that few if any of the team members will be committed full time to the program and their commitment to the agencies UAS program can be in addition to their normal duties. However, if the flight team resources normally performed other tasks then backfill of those positions may be required.

After evaluating the attendant risks and benefits, some agencies may consider contracting for services or lease a UAS owned and operated by a third party (outside service provider) as opposed to creating a full program either initially or permanently, depending upon the number and type of missions they anticipate performing.

1.4 Consider Multi-agency Sharing

The benefits of creating a multi-agency UAS Program are extensive and should always be considered during the planning phase. Agencies with limited resources may find the time and cost associated with creating a proprietary UAS program to be prohibitive, especially if the anticipated volume of missions is not sufficient to justify the investment required. Agencies without those limitations may envision an expanded set of potential missions requiring a larger program or more advanced equipment.

Creating a multi-agency program can:

- Help defray costs, both start up and ongoing.
- Increase usage which in turn will increase proficiency for the entire team.
- Reduce confusion by limiting the number of UAS at a single scene, and ensuring they are in communication with each other.
- Increase availability of both equipment and personnel during an emergency.
- Provide for a single policy to govern use, documentation, and evidence/video retention.
- All the agencies become eligible to operate under the same Certificate of Authorization (COA), eliminating the need to certify independently.

1.5 Certifications

Certification and regulations surrounding UAS are relatively new and still evolving. Agencies should always check for the current status for their area prior to beginning a UAS program.

Currently, certification requirements vary depending on whether the agency decides to develop a UAS program in house or to contract with a commercial UAS service provider. If electing to go with the provider, the provider can operate under its Part 107 Remote Pilot Airman certificate rule. Public safety agencies can also be certified to fly pursuant to a blanket public COA, which allows for flights within the geographic area specified in the COA[3], self-certification of the UAS pilot and the ability to obtain emergency COAs under special circumstances.[4]

Though Part 107 rules are more restrictive than a COA, it is recommended that public agency operators should also pass the Part 107 air knowledge test as it provides additional information and offers the opportunity to fly under Part 107 rules if/when it is appropriate and necessary. With public COA self-certification and Part 107 operators can fly under either set of rules but operators must select which set of rules they are flying under at the time of flight as the two can't be mixed and matched.

The Part 107 certification requirements and process is straightforward is explained clearly on the FAA website.[5]

It is important to note that if the agency is intending to combine the UAS program with an existing aviation program, pilots who are currently certified under FAA Part 61 will still need to certify under Part 107. The FAA offers a free online class for this certification which also allows for training credit hours.[6]

2. Policy Development

As with the implementation of any new technology, developing and vetting detailed policy and procedures is critical. The agencies policy should clearly state how the technology will be used, address privacy issues, assure legal and ethical use of the technology. and provide a vehicle for accountability. Policy should also address considerations for individual missions, documentation, authorization guidelines, and training.

2.1 Documentation

Policy considerations regarding documentation should be written to include documentation related to the actual missions, as well as training records, maintenance records, video and still imagery storage records, flight tracking records, and operator activity records among other topics. The policy should not only address the documentation itself, but also the retention and storage of each. It should be kept in mind that the purpose of the documentation will be both for flight program records and the public safety records for incident and evidentiary purposes.

Documentation needs addressed by the policy should include:

- Pilot training records including both initial and recurring training documentation.
- Maintenance records and airworthiness certification on the UAS.
- UAS obtained data on flight tracks, operator activity logs, etc.

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[3] Revised April 18, 2017 to clarify authorized airspace when flying under a COA.
[4] In the past, public agencies could apply for and operate under a Section 333 exemption. Agencies with a current Section 333 Exemption can continue to fly under their exemption until such time as it expires, however they are no longer being issued.
[5] https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/
[6] https://www.faasafety.gov/gslac/ALC/course_content.aspx?pf=1&preview=true&cID=451

- Mission specific documents:
    - Agency Incident Report.
    - Mission planning documents for Preflight Briefing.
    - After Action report.
    - Video storage tracking.
- Preflight Briefing Checklist to ensure the following is covered:
    - Review of the mission's goals and expected outcome.
    - Review of current and forecasted weather conditions.
    - Review of current Notice to Airmen (NoTAMSs) and Temporary Flight Restrictions (TFRs) that have been issued for the proposed flight area.
    - Identification of mission limitations and safety issues such as battery charge, GPS strength, and potential for radio interference.
    - Review of proposed flight area, including maximum ceiling and floor.
    - Review of communication procedures between Pilot in Command, Observer, and other personnel used to support the mission. Including verifying cell phone numbers used to communicate with Air Traffic Control in the event of a flight emergency.
    - Review of required video or digital images.
    - Execution of approved Preflight Checklist on the UAS and GCS to ensure the equipment is ready for the mission.
    - Review of privacy issues specific to the mission, i.e., has a search warrant been obtained, etc.
    - Other recommended procedures by the agencies various governing bodies.

2.2 Video/Still Imagery Policy Considerations

As video becomes more universally used in the public safety community, it has also become increasingly apparent that there are factors beyond the technology itself that need to be considered. In the case of UAS, the use of video may involve both streaming video and still imagery. With the possible exception of storage, the policy considerations for each are identical. Privacy concerns are present in the entire video lifecycle. Organizations deploying UAS programs should first develop policies that clearly indicate how video will be captured, analyzed, retained, and disclosed, as each of these activities can have a significant privacy impact.

UAS programs differ from agency to agency depending on location, size, and mission focus, but the development of a written policy including considerations for video is an essential part of a successful program. Video policy considerations should include provisions for both video and still imagery and address the following:

- Security of the Video Feed. This was reported as a problem with the active shooter in Chattanooga when someone flew a drone over the incident site taking pictures of the victims.
- Video retention. The main challenges agencies face in the increasing use of UAS has less to do with flight technology and everything to do with the vast amount of data that will be created as a result. The increasing use of UAS means "big data" sensors are airborne, versatile, and inexpensive, and generate incredible amounts of data in the form of digital video, photos, GPS coordinates, and sound. Today a drone, using a standard camera to capture video and photos, can produce half a terabyte of data an hour and agency policy needs to address storage in addition to security.

- Privacy. Privacy concerns are present in the entire video lifecycle. Agencies deploying UAS video systems should first develop policies that clearly indicate how video will be captured, analyzed, retained, and disclosed, as each of these activities can have a significant privacy impact.
- Chain of evidence. Video obtained during the UAS mission should be treated according to agency policy for all physical and non-physical evidence.
- Disclosure/Sharing of the video. Video obtained during a UAS mission is considered public record and subject to the same local/state/federal regulations and guidelines (including HIPAA) governing the disclosure/sharing of any agency record.

More detailed information on the laws surrounding the use of video, as well as information on retention, security, and sharing can be found in the recently published *Policy Considerations for the Use of Video in Public Safety*.[7]

2.3 Risk Assessment

There are risks associated with establishing a UAS program that should not forestall any agency looking to create a program, but that need to be considered in the planning process. Though there are many benefits resulting from public safety use of drones, it is important to understand that there are also risks, many of which have not yet been fully explored, because the use of UAS is so new.[8]

- Volunteers. Public entities should be particularly cautious about accepting services using drones owned and operated by volunteers. A company that operates drones as part of its business is regulated by the FAA and cannot be considered a recreational user for regulatory purposes when providing services to a public entity, even on a volunteer basis. Thus, professionals must comply with all FAA requirements even if they are not being paid for their services.
- Piloting Error. As with any area of operations within the agency, it is vitally important the adequate and document training be provided to help guard against and limit any liability that may arise as a result of pilot error.
- Mechanical or Technical failure of the drone. A UAS crash during use causing physical damage to property or personal injury. If a crash occurs on personal property, the landowner would have to give permission for retrieval.
- Maintenance and storage.
- Security of data and flight control frequencies. An unauthorized breach of the UAS technology systems, including data and control systems, could lead to a liability for the agency for failing to adequately protect against cyber-jacking of its owned or contracted UAS.
- Unintended privacy breach or civil rights violation. Even if the agency does not use such private information in any direct way, the mere recording of information could be cause for privacy concern.

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[7]http://www.npstc.org/download.jsp?tableId=37&column=217&id=3711&file=VQiPS_Policy_Considerations_v4_160623.pdf
[8]http://www.nlc.org/Documents/NLC-RISC/Drones/Drones%20Issue%20Analysis%20July%202015%20FINAL.pdf

3. Cost Considerations

3.1 Flight Team

Another major decision is to decide whether to build the program in house with the purchase of equipment and devote the time and resources for training or contract with an outside service provider. The contract approach will avoid upfront costs and may be reasonable if the agency is not sure they would gain value from a UAS program. If considering using the services of a volunteer see section 2.3 on risk assessment.

These decisions help focus the program so it becomes easier to incorporate the use of UASs into day-to-day operations.

If the decision is made to utilize a contracted UAS service provider, care should be taken to assure full integration into the Incident Command System (ICS) for flight in and around emergency incidents that address the UAS pilot interface, coordination, and communications as well as information for the Incident Commanders regarding integration of this new asset. One way to introduce contract operators to the NIMC ICS framework would be to require them to take the ICS introductory training.

3.2 Training

The cost of initial and ongoing training varies greatly depending upon the size and scope of the program. Some agencies may elect to send their flight crew through a course specifically designed to train public safety UAS pilots from one of the many companies that offer certification and training while some may decide that in-house training supplemented with training provided by the vendor of their specific aircraft will meet their requirements. Commercial courses range from online to classroom instruction with simulator and hands-on training and can range from basic to mission specific. Classroom courses may require travel by the students, though many companies will send the instructor to the site instead. Due to the number of options available, it is impossible to provide exact training cost estimates associated with establishing a new UAS program but it is important that any training program includes the following:

- Part 107 Certification Training
- System Knowledge (Aircraft, Ground Control Station, Flight Management System)
- Airspace
- Aerodynamics
- Emergency Procedures
- Flight Operations
- Regulation
- Weather
- Safety
- Flight Instruction
- Flight Training
- Agency Policy and Procedure
- Mission Specific Training if applicable

Agencies should plan on flying in a designated remote area until the UAS team achieves proficiency in flight operations and fly with sufficient frequency to maintain proficiency. Additional training may be required for video and sensor operators.

3.3 Initial Equipment Purchase or Contract for Hire

The following are considerations for public agencies planning to utilize commercial aircraft operators:

- The commercial operator meets the FAA Part 107 requirements.
- A contract exists between the public agency and the civil aircraft operator.
- The public agency decides before each mission that the mission is public serving.

If going in house, the costs of the UASs, ground stations, spare parts, extra batteries, and training all need to be considered.

High-end commercial UASs may cost as much as $100,000 plus $15,000 for spare parts, batteries, and maintenance. However, with the boom in consumer drones the prices have gone down considerably with the higher end “pro-sumer” going for less than $5,000 with many of the features which made the commercial drones more capable for public safety missions. Although the flight times may be less (27 minutes versus 100 minutes) depending on which mission type is most likely to be performed, it may make more sense to go with many inexpensive UASs and more batteries than with one or two relatively expensive commercial UASs.

Further, the high volume consumer market has brought the cost of high-resolution 4K video down considerably and introduced consumer price IR capability. The range in pricing is daunting and should be validated with actual demonstrations under the projected condition of the agency’s planned mission requirements.

4. Public Perception and Privacy

In today’s public safety video awareness environment, public perception can make or break a UAS program and operators should always use this technology in a responsible, ethical, and respectful way. This should include a commitment to transparency, privacy, and accountability. There are several documented instances when a fledgling UAS program has been suspended or abandoned due to public outcry. Therefore, it is imperative to engage the agencies public affairs department early in the planning process to ensure a positive public perception of the new program even prior to the first deployment. It is important to maintain transparency with the community whenever possible. Put out a press release announcing the program’s goals and purposes and invite open communication. This will show the community that the aircraft will be a tool to serve the public rather than something to be feared.

Federal agencies are required to follow the guidance laid out in the Presidential Memorandum: Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of

Unmanned Aircraft Systems.[9] This memorandum sets out guidelines on collection and use, retention of data, dissemination, civil rights and liberties protections, accountability, and transparency, and may serve as a useful reference tool for state and local governments that wish to set up a UAS program.

Prior to deployment, the public should be informed of:

- The purposes for which UAS will collect covered data.
- The kinds of covered data UAS will collect.
- Information regarding any data retention and de-identification practices.
- Examples of the types of any entities with whom covered data will be shared.
- Information on how to submit privacy and security complaints or concerns.
- Information describing practices in responding to law enforcement requests.

5. Legal Concerns

Technology frequently evolves more rapidly than the regulations and laws to govern its use. While it can be argued that the data collected from UAS is no different from that collected from manned aircraft, privacy advocates have some concerns. For one, UAS are smaller and quieter than manned aircraft, so it may not always be obvious to a person that they are being monitored. In addition, it is less expensive to gather data using UAS instead of manned aircraft, and much more data will be gathered as a result.

According to the Supreme Court, under the Fourth Amendment, an operation is considered a search, and therefore requires a warrant if a person has a reasonable expectation of privacy and the expectation is one that society would consider reasonable.[10]

Agencies are strongly advised to consult with their legal departments on legal and constitutional issues surrounding the use of unmanned aircraft systems before launching their program. While the legal issues surrounding UAS use are rapidly evolving as the courts consider them, significant guidance can be found in existing constitutional law addressing other technologies.

Any UAS policy should always take those privacy concerns into consideration and include a comprehensive framework for separating data and mission guidelines that do and do not require a warrant. [11]

6. UAS Operational Types and Capabilities

An important step in establishing an UAS program is determining which vehicle best fits the needs or your agency. The capabilities and usage of the different types of UAS platforms vary widely in their mission, applications, and cost. But, the basic functions and purpose of drones in public safety remain essentially the

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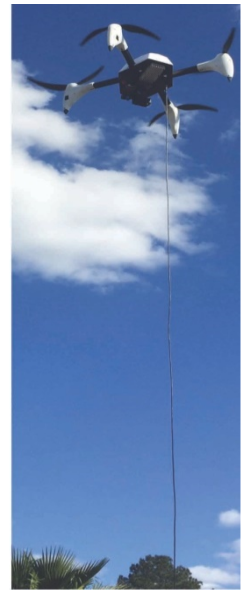
[9]https://obamawhitehouse.archives.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua

[10] Legal Information Institute: Fourth Amendment. https://www.law.cornell.edu/wex/fourth_amendment

[11] https://www.policefoundation.org/wp-content/uploads/2016/11/UAS-Report.pdf

same, namely to gather information and data from an aerial vantage that can be used by operators on the ground.

6.1 UAV Types and Sizes



Although UAV have extremely varying capabilities in flight, the UAS that are generally being sought for domestic use by public safety fall on the low end of the spectrum for all categories. This is partially because of FAA regulations regarding line of sight use for law enforcement, and partially because of cost considerations in choosing UAV for an UAS program.

The most common types of vehicles to be considered are:

- Fixed Wing. Unmanned airplanes (with wings) that require a runway to take off and land or that have hand or catapult launching capability. These generally have long endurance and can fly at high cruising speeds. These systems must keep moving to stay in the air and are unable hover over a location or object.

- Rotary Wing. Rotary wing UA, also called rotorcraft UAVs or vertical takeoff and landing (VTOL) UAVs, have the advantages of hovering capability and high maneuverability. A rotorcraft UAV may have different configurations, with main and tail rotors (conventional helicopter), coaxial rotors, tandem rotors, multi-rotors, etc. Multi-rotor UAVs have the same qualities as rotary wings, but they are even more stable and easier to control. That means they come in use in accurate and precise missions. Multi-rotors usually have a shorter flight time and ranges, so an operator might need additional flights to fully complete the operation.

- Tethered. Tethered UAV aircraft are those that come equipped to be tethered to the ground. The tether is used for several purposes. One is as a means to provide stability and ability to withstand higher wind speeds in those aerial operations where it is desired for the UAV to be in a single stationary fixed position at a particular altitude. Examples of these are tower-less radio communications such as LTE for providing a means for first responders to communicate with one another when there is no commercial network coverage or the network is not available due to an outage or severe network congestion. Here the tethered UAS is a very effective solution for search and rescue, remote forest fires, event monitoring, and other emergency response incidents like active shooter. The tether can also be used to send power to the drone itself, the communications payload, and/or other active sensor technologies resident as payload on the tethered UAS. Data can also be sent up and down the tether in a point-to-point fashion should that be desirable for the mission requirements. These types of UASs are limited to line of sight (LOS) operations at an altitude of typically 150 feet or less. Some advances are being made to extend the altitude to 400 feet. Higher altitudes naturally require longer tethers and more weight, imposing a greater strain on the UAS. Balloons are considered to be in the tethered drone category but do not fall under Part 107 and have a different set of regulations and safety concerns that need to be considered in their deployment. Information specific to balloons can be found on the FAA website[12] and under Part 101.[13]

6.2 Ground Control Station

In addition to the wide range of aircraft available, agencies will need to determine which of an every growing variety of ground control stations (GCS) to use. A ground control station is typically a software application, running on a ground-based computer that communicates with your UAV via wireless telemetry. It displays real-time data on the UAVs performance and position and can serve as a “virtual cockpit,” showing many of the same instruments that one would have if the operator were flying a real plane. A GCS can also be used to control a UAV in flight to cover predefined areas, uploading new mission commands and setting parameters and to monitor the live video stream from a UAV’s cameras.

The typical GCS is either a two-way data link (radio) for remote control or an on board computer (generally with GPS navigation) connected to the aircraft control system flight control and operating system which includes the control station(s), communication links, data terminal(s), launch and recovery systems, ground support equipment, and air traffic control interface. With the former, the pilot must apply every turn and make all elevation and maneuvering changes discretely and with the latter, a simple tracing of the finger or entering destination coordinates is all that is needed and the system works out the details.

When choosing a GCS for the UAS system, agencies should consider ease of use, functionality of the interface, capabilities, and the amount of training necessary in making the decision.

6.3 UAS Sensor Capabilities

As the use and application of UAS expands exponentially, the field of sensor capabilities is arguably the fastest growing area in the field of UAS technology. A very small list of examples include -

- Still and video cameras
- EO/IR cameras
- LIDAR Optical Detection14
- Chemical and bio hazard detectors
- Gas Sniffers
- Thermal imaging and Infrared Photography
- Sense and Avoid Technology
- Sound emitters

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[12] http://fsims.faa.gov/wdocs/8900.1/v03%20tech%20admin/chapter%2012/03_012_002.htm
[13] http://fsims.faa.gov/wdocs/8900.1/v03%20tech%20admin/chapter%2012/03_012_002.htm
[14]https://www.dronezon.com/learn-about-drones-quadcopters/best-lidar-sensors-for-drones-great-uses-for-lidar-sensors/

6.4 Communications Payload

The communications payload is a very important consideration when planning an UAS implementation and deployment scenario. The size, weight, and power of the communications payload can have significant impact on mission effectiveness especially on smaller line-of-site UAS aerial vehicles where size, weight, and power consumption are critical factors. The types of communication systems more readily deployed today vary from older, more traditional RF voice communications to more commonly used WiFi wireless technologies like those found on very small drones often used by hobbyists for sending images down from the small drone to your smart phone or tablet. Also, 4G-LTE technology is benefitting from miniaturization and may eventually be more suitable if integrated into the FirstNet framework.

7. UAS Airspace Integration

The introduction and evolution of UAS into the National Airspace System (NAS) is a dynamic process. Numerous airframes, missions, and flight characteristics create situations not common to manned flight. In the ever-expanding field of UAS operations with a vast array of supporters finding new technological opportunities for UASs, the challenge of integrating these aircraft into the NAS is huge. As the usage of UAS operations expands, the areas of operation will reach all classes of airspace and altitudes.

In less than a decade, the focus of UAS usage has changed from primarily military operations mixed in with a few hobbyists to an ever present option and viable solution for commercial, civil, and public safety concerns.

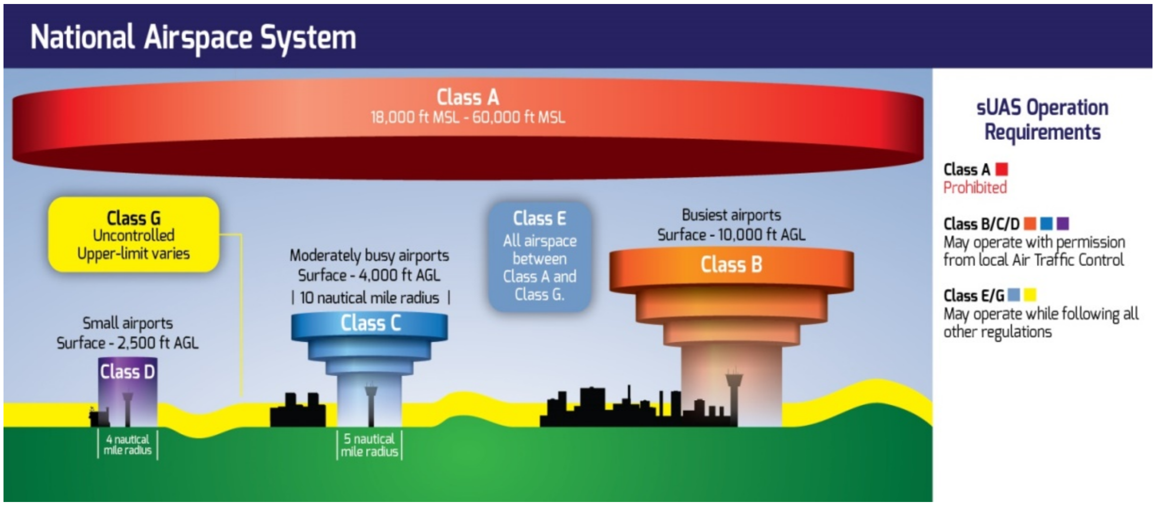
As the airspace becomes more congested, it follows that regulations surrounding the use of UASs are also being developed and refined to meet the changing landscape. It is vitally important for any agency contemplating establishing a UAS program, to not only confer with their local legal counsel, but to also check closely with current and pending legislation. There are a number of websites, both government and within the UAS community that provide updated information on a regular basis.

7.1 National Airspace System (NAS)

The National Airspace System is an intricate network of systems that involve the definitions of airspace both above and below you as well as all information having to do with that airspace such as airports, air charts, navigation, instruments, weather, rules, and regulations, policy, personnel and equipment. The NAS also changes by location and certification type and it is imperative each agency checks the requirements for their area early in the UAS Program planning process. Since UAS is defined as an aircraft, it falls within and is regulated by the NAS. Every Remote Pilot must understand the NAS to ensure safe and legal flight.

As shown in the picture below, the National Airspace System when talking about the actual airspace is broken down into 6 categories designated with a letter from “A” – “G” excluding “F” and is further divided up into two more categories, being controlled and uncontrolled. However, the lengthy list of variables within the designated categories makes it vitally important that any agency contemplating a UAS program, including those choosing to self-certify and fly under their agency COA, either engage a certified pilot or designate one or more personnel to go through the Part 107 Certification process.

Refer to the FAA website for more comprehensive information on NAS.



UASs would generally be flown from the surface to 400 feet in non-airport related (not B, C or D) airspace.

7.2 FAA UAS Policy

The FAA rules surrounding UAS flights fall into distinct categories, whether you are flying for fun, work, or as a public safety entity. This is an important distinction and precludes an agency's ability to use volunteers or agency personnel with hobbyist UAS experience from flying agency specific missions outside of an established UAS program.

The rules regarding the use of UAS for work or business are covered under the FAA Small UAS Rule Part 107.[15] Federal/State/Local government entities may also qualify for extended permissions in support of a certain mission (e.g., search and rescue) by applying for and receiving a public Certificate of Waiver or Authorization (COA).[16] Part 107 does not apply to UAS flown strictly for fun (hobby or recreational purposes) as long as these unmanned aircraft are flown in accordance with the Special Rule for Model Aircraft[17] (Section 336 of P.L. 112-95). The small UAS rule codifies the provisions of section 336 in part 101 of the FAA's regulations, which will prohibit operating a UAS in manner that endangers the safety of the National Airspace System.

7.3 FCC and Spectrum Information

Reliable and sufficient radio spectrum is a critical tool to help enable the operation of UAS and robotics. Appropriate spectrum is required for multiple aspects of UAS and robotics operations. These operations need spectrum for both control and for payload. Control spectrum likely can be more narrowband in nature as the signals for control should not be very bandwidth intensive. In contrast, spectrum to support the payload for

[15] https://www.faa.gov/uas/media/Part_107_Summary.pdf
[16] https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/aaim/organizations/uas/coa
[17] https://www.faa.gov/uas/resources/uas_regulations_policy/#rules

UAS would likely need to be broader in bandwidth. A primary public safety use for UAS is to serve as a "camera in the sky" to send back images and/or video of a scene, including a large fire, traffic accident, hostage incident, explosion, or an area undergoing a natural disaster.

For most visual line-of-sight flights, unlicensed spectrum can be utilized for command and control of the UAS. For longer range operations, there are various options as well. Internationally allocated aeronautical bands – the 960-1164 MHz band (L-Band) and the 5030-5091 MHz band (C-Band) – can be utilized for unmanned aircraft command non-payload control. Cellular spectrum can also be utilized. Finally,

NPSTC previously developed a National Plan Recommendation for the 4.9 GHz band that envisioned the need for spectrum to support both air-to-ground and robotics operations. The FCC is in the process of developing a Further Notice of Proposed Rulemaking regarding potential changes to the rules for 4.9 GHz band, including consideration of the NPSTC 4.9 GHz National Plan Recommendation.[18]

8. Additional References

- Aeryon Labs white paper "Considerations in Selecting a Small UAV for Police Operations[19]" - concerns to be factored into a selection decision.
- https://www.faa.gov/uas/
- http://amablog.modelaircraft.org/amagov/drone-legislation/
- https://www.faa.gov/uas/getting_started/fly_for_work_business/
- https://obamawhitehouse.archives.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua
- UAS App – QuadcopterFX

9. Contributors

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Michael Britt, Working Group Chair, State of Arizona
Richard Brenner, Clark County Fire Department
Kim Madsen Coleman, State of Colorado, Governor's Office of Information Technology
Bruce Cox, NextNav
Tewfik Doumi, Nokia
Joseph J. Farnam, III, Good Will Fire Company of New Castle Delaware
Heidi Fisher, Ontario Ministry of Transportation
Ed Freeborn, Unmanned Experts
Anna Gomez, Wiley Rein, LLP
Regina Harrison, NTIA

[18] http://www.npstc.org/download.jsp?tableId=37&column=217&id=3222&file=4_9_GHz_National_Plan_Report_131024.pdf
[19] https://www.aeryon.com/whitepaper/whitepaperpolice

William Janky, 10-18 Communications Consulting
James Johnson, State of Tennessee, Retired
Gary Monetti, Monetti and Associates, LLC
Peter Musgrove, AT&T
Ralph Newcomb, Ralph Newcomb Consulting
Paul Petronelli, PALM Associates, Inc.
Mark Raczynski, General Dynamics Mission Systems
Mel Samples, CADSTAR, INC.
Ben Schreib, AECOM
Michael Schwab, P3 Communications, Inc.
DeWayne Sennett, AT&T
Dean Skidmore, IoT+LTE Consulting Group
Helen Troyanovich, State of Iowa
Jared Vanderheuvel, Texas Department of Public Safety
Andrew Weinert, MIT Lincoln Laboratory
Michael Wendling, DHS
Charles Werner, VDEM
Everett Wittig, City of Bisbee Communications, Arizona
Bill Worger, General Dynamics Mission Systems