



**Department of the Interior**  
**Master UAS Requirements for the DOI**

Office of Aviation Services  
Version: 1.3

**NOTICE:**

REQUIREMENTS OUTLINED IN THE ATTACHED ARE USED TO INFORM CURRENT AND FUTURE DOI UAS PROCUREMENTS. ACTUAL PROCUREMENTS ARE DRIVEN BY CURRENT DEPARTMENT/BUREAU PRIORITIES, AVAILABLE FUNDING, AND STAFFING NECESSARY TO SUPPORT THE MANAGEMENT AND EMPLOYMENT OF ACQUIRED AIRCRAFT.

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<https://www.doi.gov/aviation/uas/news>

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**Office of Aviation Services**

Master UAS Requirements for the DOI

**A. BACKGROUND & PURPOSE**

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**BACKGROUND:** Solid, mission-based requirements are core to the success of any professionally managed aviation program. DOI began its UAS requirements determination process when the current program was initiated in 2006. Later, leveraging hundreds of excess DOD small UAS, OAS and Interior bureaus conducted hundreds of operational test and evaluation flights that were used to inform the initial development of a set of master UAS requirements. In 2014, over 300 bureau and OAS subject matter experts came together to draft the initial requirements document. The requirements document guides Interior’s market research and subsequent acquisitions for UAS and/or contracted services. Updates to UAS requirements are identified and proposed through formal feedback from field users channeled through appropriate DOI aviation management (e.g. bureau national aviation managers) and established advisory groups. Revisions are issued when the Master UAS Requirements are updated.

**PURPOSE:** To provide for dissemination and version control of DOI UAS Master Requirements for the DOI.

**B. APPLICABILITY**

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This process is applicable to Master UAS Requirements for the DOI.

**C. IMPACTED LINE ITEMS**

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This process has no impact on Department of the Interior Financial Statements prepared by the IBC.

**D. DOCUMENT APPROVING AUTHORITY AND CUSTODIAN**

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Document Number:	Master UAS Requirements	Approved by:	B. Koeckeritz
Document Revision:	1.3	Title:	OAS UAS DC
Next Review Due:	3/15/2019	Date Approved:	3/15/19
Document Custodian:	OAS UAS	Effective Date:	3/15/19

**E. DOCUMENT REVIEW AND REVISION HISTORY**

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Date	Document Revision	Document Revision Description	Document Author
	Revision 1	Initial Publication	Ramaekers
04/11/2018	1.1	Add VTOL	Stroud
10/08/18	1.2	Add CWN ISR	Stroud
03/15/19	1.3	Add #9 Training Multi Rotor / Remove “Up to 2 hrs #1 CWN”	Stroud

**F. RELATED METHODOLOGIES AND REFERENCES**

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OAS Quality Manual  
All core processes

## G. INPUTS AND OUTPUTS

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The principle input(s) into this process are:

1. Changes, edits or additions to the Master UAS Requirements

The principle output(s) from this process are:

1. Updated Master UAS Requirements document

## H. PROCESS NARRATIVE

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1. New and updated UAS requirements are identified and proposed through formal feedback from field users channeled through appropriate DOI aviation management (e.g. bureau national aviation managers) and established advisory groups.
2. OAS UAS determines whether the proposed requirement is one already covered by current requirements and equipment. OAS also conducts an assessment of whether the requirement can be met within the current legal, regulatory, and policy framework for safely and responsibly operating UAS.
3. If the proposed new/updated requirement is determined to be redundant or outside the bounds of the current legal, regulatory, and policy framework for safely and responsibly operating UAS, the Master UAS Requirements is unchanged. If the proposed new/updated requirement is determined to be valid, the Master UAS Requirements is edited.
4. Process ends.



# U.S. Department of the Interior Master UAS Requirements

V1.3 - March 15, 2019

## #1 CALL WHEN NEEDED (CWN) ISR

Flight Performance		
Item	Minimum Specification	Target Specification
Aircraft Type	Fixed wing, hand launch/assisted launch or VTOL, runway independent, 55 pounds or less.	
Airworthiness	DOI Aircraft and Flight Crew Authorization (carded AC and crew) Vendor may be required to complete DOI/NASA airworthiness review process at their expense	
Takeoff/Recovery Area	Maximum area of 300'x300'	Maximum area of 200'x200'
Service Ceiling	5000' AGL @ 3000' MSL @ 32° C	5000' AGL @ 8000' MSL @ 30° C
Flight Duration	2 hours (with fuel/batteries on site to fly for 12 hours)	Up to 14 hours
Wind Limit	Takeoff/landing: 20 knots.	Takeoff/landing: 30 knots
Wind Limit	Operate in sustained winds of 25 knots	Operate in sustained winds of 35 knots
Operational window	Day and night capable	
Temperature	Operational temperature of 32-100 degrees Fahrenheit	Operational temperature of 0-115 degrees Fahrenheit

Command and Control		
Item	Minimum Specification	Target Specification
Range	C2 range of >5nm	C2 range of >15nm
Uplink Frequency	Secure digital data link with FIPS compliant encryption	
Downlink Frequency	Secure digital data link with FIPS compliant encryption	
Lost Link	Loss of Link (LOL) capability: return to launch or land now.	Selectable LOL: Return to launch, land now, route retrace, programmable point.
Flight Planning	Ability to program restricted areas of operations (geo-fence)	Ability to program a flight plan based on a GIS produced polygon (shape file)
Flight profile	Ability to loiter at an assigned altitude with <200' deviation	

## #1 CWN ISR

Transponder	Mode C programmable	Mode C/S programmable
TCAS		TCAS unit at ground station
Altimeter	Programmable based on altimeter setting (inHG)	
UAS Location Display	Location displayed on GCS in latitude and longitude in degrees, decimal minutes (DDD MM.MM) format	
UAS Altitude Display	Altitude displayed on GCS in feet above mean sea level (MSL)	
Radios	Programmable VHF AM and FM at ground station (FCC compliant)	Programmable VHF AM and FM mounted in the UAS
Operations	Compliant with DOI, DOA, FAA policy (COA, ECOA, MOA, etc.)	

<b>Payload</b>		
<b>Item</b>	<b>Minimum Specification</b>	<b>Target Specification</b>
Gimbal - General	Gyro stabilized dual sensor (EO/IR)	Customizable multi-sensor gimbal (radiometric, gas, smoke, etc.)
Gimbal – EO video	Real-time HD (720p) video	Real-time HD (1080p) video
Gimbal – IR video	Real-time (mid-long wave) IR video (1.5-10 um)	Real-time mid-wave (1.5-5.6um) IR video (TASE 400 LRS or similar)
Gimbal EO and IR Images	Capture still images in EO and IR	High resolution EO/IR zoom (30-50x)
Gimbal - Mapping	Map a fire perimeter with the target cursor or other means	Transmit data to Federal Data Specialist laptop to process with ERSI Full Motion Video (FMV)
Object Tracking	Ability to lock gimbal on stationary POI	Ability to lock gimbal on moving POI
Mapping - Other		DSLR payload for ortho-image mapping

<b>Data Standards</b>		
<b>Item</b>	<b>Minimum Specification</b>	<b>Target Specification</b>
Telemetry	Provide flight telemetry data upon request.	
Video	Provide extractable GIS metadata (MSBI compliant) for both EO and IR	Capture/transmit ESRI compliant video to be viewed/edited with the ERSI Full Motion Video (FMV) extension
Fire Perimeter Data	Capture incremental GPS points around a fire perimeter and export them as a KML or SHP file. Tolerance for GPS points is 30'.	Map and share fire perimeter in real-time
Points of Interest	Capture geotagged still images/videos as directed. Geotagging format is DDD MM.MM. GPS tolerance is 30'	Share geotagged images in real-time
Data storage	Vendor will deliver/destroy data in compliance with federal standards.	

<b>Ground Terminal</b>		
<b>Item</b>	<b>Minimum Specification</b>	<b>Target Specification</b>
Live Video Feed	50" monitor displaying live EO/IR gimbal feed at ground station. Display will be split screen with contextual map (fire perimeter) and camera view	Transmit video feed to a remote terminal at the incident command post (ICP) or designated location using wave/mesh/ad-hoc/MIMO networking or other technology

<b>Time Requirements</b>		
<b>Item</b>	<b>Minimum Specification</b>	<b>Target Specification</b>
Mobilization	Vendor will be on site and operational within 72 hours, or mutually agreed upon time of dispatch	Vendor will be on site and operational within 24 hours of dispatch
Data Delivery	Telemetry data will be provided within 4 hours of request	GIS (point, line, polygon) data will be delivered to incident personal within 1 hour of request Compliant GIS and video data will be delivered to incident personal within 1 hour of request

Launch (once on site and available)	One hour after request	15 minutes after request
Gimbal Tasking	Gimbal will be tasked within 30 minutes of request	Gimbal will be tasked within 5 minutes of request

Miscellaneous		
Item	Minimum Specification	Target Specification
Invoicing	Vendor will utilize existing federal invoicing systems	
Procedural Training	Vendor crews will attend one week of BLM fire procedures training. <b>This training will include flight exercises with vendor UAS and sensors.</b>	
Fireline Training	Vendor crews will attend basic wildland firefighter and fire shelter training (S-130/190)	
Fireline Equipment	Vendor crews will have required fireline personnel protective equipment (PPE) on site. Required PPE is listed in the <i>Interagency Standards for Fire and Fire Aviation Operations</i>	
Camping/Logistics Equipment	Crews will be prepared to operate in remote areas and be self-sufficient for three days.	



## #2 Fixed VTOL

Flight Performance	
Minimum UAS Requirement	Target UAS Requirement
Platform weight under 25 lbs.	Platform weight under 10 lbs.
Flight duration of 30 minutes with max payload, standard day.	Flight duration of 90 minutes with maximum payload, standard day.
Service ceiling 10,500 feet density altitude.	Service ceiling 17,999 feet density altitude.
Maximum sustained wind speed capability of 15 knots.	Maximum sustained wind speed capability of 35 knots.
Minimum launch area requirement of 50 feet by 50 feet.	Minimum launch area requirement of 20 feet by 20 feet.
Minimum recovery area requirement of 50 feet by 50 feet.	Minimum recovery area requirement of 20 feet by 20 feet.
Vertical Take Off and Vertical Landing	N/A
Vertical Take Off and Vertical Landing from a boat	N/A
Operating temperature range of 10–110 degrees Fahrenheit.	Operating temperature range of negative 40–130 degrees Fahrenheit.
Environmental criteria of day/night time aircraft lighting (FAR part 91 section 209)	N/A
N/A	Environmental criteria of being water proof.

Command and Control	
Minimum UAS Requirement	Target UAS Requirement
Communication range (RX/TX) C2 of 2 Nautical Miles.	Communication range (RX/TX) C2 of 3 Nautical Miles.
N/A	Real Time Kinematic (RTK) GPS
Transmit video up to 2 Nautical Miles	Transmit video up to 3 Nautical Miles
Electric	N/A
Uplink control frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/FIPS compliant WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Downlink frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/FIPS compliant WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Programmable Loss of Link (LOL) capability: return to launch and land now.	Loss of Link (LOL): route retrace, land at a specified location.
Ground Control Station (GCS) provided and capable of importing shapefiles.	N/A
Aircraft has the ability to navigate by waypoints.	Aircraft can navigate by waypoints while making altitude changes allowing terrain following.

Payload	
Minimum UAS Requirement	Target UAS Requirement
Configurable payload weight of 1.5 lbs.	Configurable payload weight of 5 lbs.
N/A	Real time video EO forward looking (independent of payload) to provide UAS pilot with situational awareness during daytime, nighttime and low light missions with ability to record video stream.
Aircraft is equipped with modular payload design with plug and play swappable COTS cameras or sensors.	N/A
Gimbal EO/IR payload.	Gimbal EO/IR payload with on-board storage.
Gimbal IR payload.	Gimbal IR payload with on-board recording.
DSLR camera fixed Nadir mount.	DSLR camera mounted to gimbal stabilized mount (option to be fixed at the nadir position).
Provide technical specifications for payload interface.	N/A

#2 Fixed VTOL

Aircraft autopilot system has the ability to GPS trigger the payload based on GPS location or GPS/IMU distance for appropriate stereo coverage and image overlap at the desired stock payload configuration for photogrammetric stereo imaging.	N/A
N/A	Capable to integrate DGPS/RTK into imagery metadata for high precision mapping missions.
N/A	Provide MISB (motion imagery standards board) MUXE Video for HD quality or better. The Aircraft IMU telemetry should be embedded into the video metadata.

Miscellaneous Specifications	
Minimum UAS Requirement	Target UAS Requirement
A service manual provided.	N/A
Mission planning software must be able to program multiple GPS waypoints with the ability to modify flight plans while in flight.	N/A
Aircraft, GCS and battery charging system are included with protective shipping/carrying hard cases. Cases must be allowed as checked baggage on commercial airlines and deliverable by shipping services.	Aircraft, GCS and battery charging system are included with protective shipping/carrying/back-packable cases. Cases must be allowed as checked baggage and on commercial airlines and deliverable by shipping services.
Ability to decline and lock out any device information sharing including telemetry through aircraft, software or applications preventing any automated uploads or downloads.	N/A
Optional Customer Support	Customer Support
VTOL FW Fixed Wing VTOL without RTK	Fixed Wing Vertical Take-off and Landing (VTOL) with RTK and Base Station
Payloads: Sony a6000 Sony a7R SLANTRANGE 3p MicaSense RedEdge Gimbale FLIR Vue Pro R 640 (19mm,30Hz) Colibri EO/IR Gimbal Richo GR II Ground Control Station Computer: Dell (Rugged with i7 processor and 64 GB Ram)	

## #3 Medium Fixed

Flight Performance	
Minimum UAS Requirement	Target UAS Requirements (In addition to minimum requirements)
Platform weight under 25 lbs.	Platform weight under 10 lbs.
Flight duration of 60 minutes with max payload, standard day.	Flight duration of 90 minutes with maximum payload, standard day.
Service ceiling 12,500 feet density altitude.	Service ceiling 15,999 feet density altitude.
Maximum sustained wind speed capability of 25 knots.	Maximum sustained wind speed capability of 35 knots.
Minimum launch area requirement of 300 feet by 300 feet.	Minimum launch area requirement of 100 feet by 100 feet.
Minimum recovery area requirement of 300 feet by 300 feet.	Minimum recovery area requirement of 100 feet by 100 feet.
Assisted launch or hand launched	Assisted launch method.
Recovery by belly landing or parachute or deep stall or net.	Water recovery.
Noise level of 50 dB at 300 feet (AGL) at full power.	Noise level of 50 dB at 100 feet (AGL) at full power.
Operating temperature range of 10–110 degrees Fahrenheit.	Operating temperature range of negative 40–110 degrees Fahrenheit.
Environmental criteria of day/night time aircraft lighting (FAR part 91 section 209), water resistant (light rain, snow, mist).	Environmental criteria of being water proof.

Command and Control	
Minimum UAS Requirement	Target UAS Requirements (In addition to minimum requirements)
Communication range (RX/TX) C2 of 2 Nautical Miles.	Communication range (RX/TX) C2 of 5 Nautical Miles.
Transmit video up to 2 Nautical Miles.	Transmit video up to 5 Nautical Miles.
Electric, gas, turbine power supply, Fuel cell	Power supply non-aviation fuel.
Uplink control frequency that is a secure digital data link at 900 MHz ISM Band, w/ 256 bit encryption.	N/A
Downlink frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/ 256 bit encryption.	N/A
Programmable Loss of Link (LOL) capability: return to launch and land now.	Loss of Link (LOL): route retrace, land at a specified location.
N/A	Aircraft is designed to be interoperable with a medium fixed wing/rotor aircraft, includes; common battery, common GCS and common payloads.
Ground Control Station (GCS) provided and capable of controlling the aircraft offered.	N/A
GCS ability to be customized to operate numerous fixed wing and rotor wing platforms with aircraft direct control authority.	GCS is open source with the ability to be customized to operate numerous fixed wing and rotor wing platforms with aircraft direct control authority.
Direct pilot control authority, semi-autonomous flight modes.	Flight Operations are geofence restricting operations to G airspace with self-limiting capabilities.
Flight crew required a maximum of 2, not including observer.	Flight crew required a maximum of 1, not including observer.
Flight planning software must be able to program multiple GPS waypoints with in flight line modifiable options.	Aircraft has the ability to navigate by waypoints at a fixed elevation above the ground based on the terrain.
Ability to record sensor data on-board the aircraft.	N/A

### Payload

Minimum UAS Requirement	Target UAS Requirements (In addition to minimum requirements)
Configurable payload weight of 1.5 lbs.	Configurable payload weight of 5 lbs.

## #3 Medium Fixed

Real time video EO forward looking (independent of payload) to provide UAS pilot with situational awareness during daytime, nighttime and low light missions with ability to record video stream (IR night vision capability (NVG)).	Real time video HD EO/IR gimbal payload.
Aircraft is equipped with modular payload design with easily swappable COTS cameras or sensors.	Interface with aircraft IMU/GPS and autopilot (Digital interface solution).
HD EO/Thermal IR payload with fixed or gimbal mount for mirrorless interchangeable lens camera.	DSLR, RTK capability.
N/A	Gimbal HD EO and Thermal IR video.
N/A	DSLR camera mounted to gimbal stabilized mount (option to be fixed at the nadir position).
Provide technical specifications for payload interface.	Payload interface must provide 5 VDC; 12-14.5 VDC, Serial, USB, and Ethernet connections.
Aircraft autopilot system has the ability to GPS trigger the payload based on GPS location or GPS/IMU distance for appropriate stereo coverage and image overlap at the desired stock payload configuration for photogrammetric stereo imaging.	N/A
N/A	Capable to integrate DGPS/RTK into imagery metadata for high precision mapping missions.
N/A	Provide MISB (motion imagery standards board) MUXE Video for HD quality or better. The Aircraft IMU telemetry should be embedded into the video metadata.

## #4 Micro Fixed

Flight Performance	
Minimum UAS Requirement	Target UAS Requirements
Platform weight under 10 lbs.	Platform weight under 8 lbs.
Flight duration of 2 hours with max payload, standard day.	Flight duration of 4 hours with maximum payload, standard day.
Service ceiling 10,500 feet density altitude.	Service ceiling 15,999 feet density altitude.
Maximum sustained wind speed capability of 25 knots.	Maximum sustained wind speed capability of 35 knots.
Minimum launch area requirement of 300 feet by 300 feet.	Minimum launch area requirement of 100 feet by 100 feet.
Minimum recovery area requirement of 300 feet by 300 feet.	Minimum recovery area requirement of 300 feet by 300 feet.
Assisted launch or hand launched or VTOL.	Assisted launch method.
Recovery by belly landing.	Water recovery.
Noise level of 60 dB at 100 feet (AGL) at full power.	Noise level of 50 dB at 100 feet (AGL) at full power.
Operating temperature range of 10–110 degrees Fahrenheit.	Operating temperature range of negative 40–110 degrees Fahrenheit.
Environmental criteria of day/night time aircraft lighting (FAR part 91 section 209), water resistant (light rain, snow, mist).	Environmental criteria of being water proof.
Surge Flight Speed 45 knots.	Surge Flight Speed 50 knots.

Command and Control	
Minimum UAS Requirement	Target UAS Requirements
Communication range (RX/TX) C2 of 2 Nautical Miles.	Communication range (RX/TX) C2 of 5 Nautical Miles.
Transmit video up to 2 Nautical Miles.	Transmit video up to 5 Nautical Miles.
Electric power supply.	N/A
Uplink control frequency that is a secure digital data link at 900 MHz ISM Band, w/ 256 bit encryption.	N/A
Downlink frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/ 256 bit encryption	N/A
Programmable Loss of Link (LOL) capability: return to launch and land now.	Loss of Link (LOL): route retrace, land at a specified location.
N/A	Aircraft is designed to be interoperable with a medium fixed wing/rotor aircraft, includes; common battery, common GCS and common payloads.
Ground Control Station (GCS) provided and capable of controlling the aircraft offered.	N/A
GCS ability to be customized to operate numerous fixed wing and rotor wing platforms with aircraft direct control authority.	GCS is open source with the ability to be customized to operate numerous fixed wing and rotor wing platforms with aircraft direct control authority.
Direct pilot control authority, semi-autonomous flight modes.	Flight Operations are geofence restricting operations to G airspace with self-limiting capabilities.
Flight crew required a maximum of 1.	N/A
Flight planning software must be able to program multiple GPS waypoints with in flight line modifiable options.	Aircraft has the ability to navigate by waypoints at a fixed elevation above the ground based on the terrain.
Ability to record sensor data on-board the aircraft.	N/A

Payload	
Minimum UAS Requirement	Target UAS Requirements
Configurable payload weight of 1 lb.	N/A

#4 Micro Fixed

Real time video EO payload (day/night) and or IR night vision capability (NVG) for nighttime and low light missions with ability to record video stream.	Real time video EO payload (day/night) and IR night vision capability (NVG) for nighttime and low light missions with ability to record video stream.
Aircraft is equipped with modular payload design with easily swappable COTS cameras or sensors.	Interface with aircraft IMU/GPS and autopilot (Digital interface solution).
HD EO/Thermal IR payload with fixed or gimbal mount for mirrorless interchangeable lens camera or RTK capable payload.	Gimbal HD EO and Thermal IR video.
N/A	DSLR, RTK camera mounted to gimbal stabilized mount (option to be fixed at the nadir position).
Aircraft autopilot system has the ability to GPS trigger the payload based on GPS location or GPS/IMU distance for appropriate stereo coverage and image overlap at the desired stock payload configuration for photogrammetric stereo imaging.	N/A
N/A	Capable to integrate DGPS/RTK into imagery metadata for high precision mapping missions.
N/A	Provide MISB (motion imagery standards board) MUXE Video for HD quality or better. The Aircraft IMU telemetry should be embedded into the video metadata.

## #5 T1 Rotor

<b>Flight Performance</b>	
<b>Minimum UAS Requirement</b>	<b>Target UAS Requirements</b>
Platform maximum weight under 100 lbs.	Platform maximum weight under 35 lbs.
Flight duration of 20 minutes with 8lb payload, standard day.	Flight duration of 45 minutes with 10lb payload, standard day.
N/A	Service ceiling 12,000 feet density altitude.
Maximum sustained wind speed capability of 20 knots.	Maximum sustained wind speed capability of 35 knots.
Minimum launch area requirement of 30 feet by 30 feet.	Minimum launch area requirement of 10 feet by 10 feet.
Minimum recovery area requirement of 30 feet by 30 feet.	Minimum recovery area requirement of 10 feet by 10 feet.
Vertical take-off and landing (VTOL).	N/A
N/A	Noise level of 60 dB at 100 feet (AGL) at hover with maximum payload.
Operating temperature range of 10–110 degrees Fahrenheit.	Operating temperature range of negative 40–110 degrees Fahrenheit.
N/A	Water proof capable.
<b>Command and Control</b>	
<b>Minimum UAS Requirement</b>	<b>Target UAS Requirements</b>
Communication range (RX/TX) C2 of 1 Miles.	Communication range (RX/TX) C2 of 4 to 6 Miles.
Transmit video up to 1 Miles.	Transmit video range of 4 to 6 Miles.
Electric, Gas, or Turbine power supply.	Power supply of electric, or non-aviation fuel.
N/A	Sense and avoid capable
Uplink control frequency that is a secure digital data frequency hopping link at 2.4 GHz or 5.8 GHz or 900 MHz ISM Band, WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Downlink frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/FIPS compliant WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Loss of Link (LOL) capability: return to launch or land now.	Loss of Link (LOL): land at a specified location
GPS capable of USA satellite constellations.	GPS capable of using all three satellite constellations at the same time: USA (GPS), Russian (GLONASS), and European (Galileo) or superior
N/A	Selectable LOL: Return to launch, land now, programmable point.
Basic manual control along with a GCS (laptop, tablet).	Aircraft has the ability to navigate by waypoints at a fixed elevation above the ground based on the terrain.
N/A	GCS is open source with the ability to be customized. Flight transects are custom generated when user gives a specific area of interest (AOI). The software calculates the optimum flight lines based on sensor height, focal length, width, speed to cover the AOI with specific forward and side lap image %.
N/A	Ability to geo-fence operations.
Flight crew required a maximum of 2.	Flight crew required a maximum of 1, not including observer.
N/A	Aircraft has the ability to navigate by waypoints at a fixed elevation above the ground based on the terrain.

## #5 T1 Rotor

Ability to terminate flight instantaneously.	N/A
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Payload Specifications	
Minimum UAS Requirement	Target UAS Requirements

Configurable payload weight of 1.5 lbs.	Configurable payload weight of 25 lbs.
Real time HD EO/IR gimbal payload with video stream that is continuously downloaded and recorded with FPV capability. The ability to mount dual payloads including Gimbaled DSLR HD EO, Thermal IR, or fixed nadir LIDAR	N/A
Aircraft is equipped with modular payload design with easily swappable COTS cameras and camera mounting location.	Interface with aircraft IMU/GPS and autopilot (Digital interface solution)
N/A	Provide technical specifications for payload interface.
N/A	Payload interface must provide 5 VDC or 12-14.5 VDC, Serial or USB or Ethernet connections or Micro USB
Payload / log file provides the ability to geotag images	Payload produces geotagged images directly on the SD card.
N/A	Capable to integrate DGPS/RTK into imagery metadata for high precision mapping missions.

Aircraft Requirements	
Minimum UAS Requirement	Target UAS Requirements

A service manual provided.	N/A
N/A	A list of spare parts that would be included in a field service kit and update the list throughout the life of the contract as required.
Includes software updates, and updates to latest firmware.	N/A
Customer Support	N/A

  

Data Product and Vendor Specifications	
Minimum UAS Requirement	Target UAS Requirements
Flight planning software must be able to program multiple GPS waypoints with the ability to modify flight plans while in flight.	N/A
Aircraft secured in a hard case capable for transport in a standard SUV and FedEx style shipping.	N/A
Ability to decline and lock out any device information sharing including telemetry through aircraft, software or applications preventing any automated uploads or downloads	N/A
Vendor has demonstrated flight experience, list of current customers with references	Vendor currently operating under a COA/Military AWR/FAA Cert/NASA Cert.
Provide a list of spare parts that would be included in a field service kit.	
Provide an itemized list of available spare parts and the purchase prices.	



## #6 T2 Rotor

<b>Flight Performance Specifications</b>	
<b>Minimum UAS Requirement</b>	<b>Target UAS Requirements</b>
Platform maximum weight under 20 lbs.	Platform maximum weight under 10 lbs.
Flight duration of 30 minutes with max payload, standard day.	Flight duration of 60 minutes with maximum payload, standard day.
N/A	Service ceiling 10,000 feet density altitude.
Maximum sustained wind speed capability of 20 knots.	Maximum sustained wind speed capability of 35 knots.
Minimum launch area requirement of 20 feet by 20 feet.	Minimum launch area requirement of 10 feet by 10 feet.
Minimum recovery area requirement of 20 feet by 20 feet.	Minimum recovery area requirement of 10 feet by 10 feet.
Vertical take-off and landing (VTOL).	N/A
N/A	Noise level of 50 dB at 100 feet (AGL) at hover with maximum payload.
Operating temperature range of 10–110 degrees Fahrenheit.	Operating temperature range of negative 40–110 degrees Fahrenheit.
N/A	Water proof capable.
<b>Command and Control Specifications</b>	
<b>Minimum UAS Requirement</b>	<b>Target UAS Requirements</b>
Communication range (RX/TX) C2 of 0.6 Miles.	Communication range (RX/TX) C2 of 4 to 6 Miles.
Transmit video up to 0.6 Miles.	Transmit video range of 4 to 6 Miles.
Electric power supply.	N/A
N/A	Sense and avoid capable
Uplink control frequency that is a secure digital data frequency hopping link at 2.4 GHz or 5.8 GHz or 900 MHz ISM Band, WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Downlink frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/FIPS compliant WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Loss of Link (LOL) capability: return to launch or land now.	N/A
GPS capable of using USA satellite constellations.	GPS capable of using all three satellite constellations at the same time: USA (GPS), Russian (GLONASS), and European (Galileo) or superior
N/A	Selectable LOL: Return to launch, land now, route retrace, programmable point.
Basic manual control	Basic manual control along with a GCS (laptop, tablet).
N/A	GCS is open source with the ability to be customized.
N/A	Ability to geo-fence operations.
Flight crew required a maximum of 1.	Flight crew required a maximum of 1, not including observer.
N/A	Aircraft has the ability to navigate by waypoints at a fixed elevation above the ground based on the terrain.
Ability to terminate flight instantaneously.	

#6 T2 Rotor

<b>Payload Specifications</b>	
<b>Minimum UAS Requirement</b>	<b>Target UAS Requirements</b>
Configurable payload weight of 1.5 lbs.	Configurable payload weight of 15 lbs.
Real time EO video to provide UAS pilot with situational awareness with ability to record on board.	Real time HD EO/IR gimbal payload with video stream that is continuously downloaded and recorded with FPV capability.
Aircraft is equipped with modular payload design with easily swappable COTS cameras and camera mounting location.	N/A
N/A	Provide technical specifications for payload interface.
N/A	Payload interface must provide 5 VDC or 12-14.5 VDC, Serial or USB or Ethernet connections or Micro USB
Payload / log file provides the ability to geotag images	Payload produces geotagged images directly on the SD card.
<b>Aircraft Requirements</b>	
<b>Minimum UAS Requirement</b>	<b>Target UAS Requirements</b>
A service manual provided.	N/A
N/A	A list of spare parts that would be included in a field service kit and update the list throughout the life of the contract as required.
Includes software updates, and updates to latest firmware.	N/A
Optional Customer Support	Customer Support
<b>Data Product and Vendor Specifications</b>	
<b>Minimum UAS Requirement</b>	<b>Target UAS Requirements</b>
Flight planning software must be able to program multiple GPS waypoints with the ability to modify flight plans while in flight.	N/A
System secured in backpack sized case capable for commercial carry-on luggage	N/A
Ability to decline and lock out any device information sharing including telemetry through aircraft, software or applications preventing any automated uploads or downloads	N/A
System includes a total of 4 Aircraft Batteries	System includes a total of 8 Aircraft Batteries

## #7 T3 Rotor

<b>Flight Performance Specifications</b>	
<b>Minimum Requirements</b>	<b>Target</b>
Platform maximum weight under 5 lbs.	Platform maximum weight under 3 lbs.
Flight duration of 20 minutes with max payload, standard day.	Flight duration of 40 minutes with maximum payload, standard day.
Service ceiling 10,000 feet density altitude.	Service ceiling 14,500 feet density altitude.
Maximum sustained wind speed capability of 10 knots.	Maximum sustained wind speed capability of 30 knots.
Minimum launch area requirement of 20 feet by 20 feet.	Minimum launch area requirement of 10 feet by 10 feet.
Minimum recovery area requirement of 20 feet by 20 feet.	Minimum recovery area requirement of 10 feet by 10 feet.
Vertical take-off and landing (VTOL).	N/A
N/A	Noise level of 50 dB at 100 feet (AGL) at hover with maximum payload.
Operating temperature range of 10–100 degrees Fahrenheit.	Operating temperature range of negative 40–110 degrees Fahrenheit.
N/A	Waterproof capable.
<b>Command and Control Specifications</b>	
<b>Minimum Requirements</b>	<b>Target</b>
Communication range (RX/TX) C2 of 1 Mile.	Communication range (RX/TX) C2 of 3 Miles.
Transmit video range of 1 Mile.	Transmit video range of 3 Mile.
Electric power supply.	N/A
N/A	Obstacle avoidance capable
Uplink control frequency that is a secure digital data frequency hopping link at 2.4 GHz or 5.8 GHz or 900 MHz ISM Band, WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Downlink frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/FIPS compliant WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Loss of Link (LOL) capability: return to launch or land now.	Selectable LOL: Return to launch, land now, programmable point.
GPS capable of using USA satellite constellations.	GPS capable of using all three satellite constellations at the same time: USA (GPS), Russian (GLONASS), and European (Galileo) or superior
Flight controller allows for manual control of the aircraft	N/A
N/A	Ability to geo-fence operations.
Flight crew required a maximum of 1.	Flight crew required a maximum of 1, not including observer.
N/A	Aircraft has the ability to navigate by waypoints at a fixed elevation above the ground based on the terrain.
Ability to terminate flight instantaneously.	N/A

## #7 T3 Rotor

Payload Specifications	
Minimum Requirements	Target
N/A	FPV camera, HD video link to provide UAS pilot with situational awareness with ability to record 4K video
HD EO stabilized gimbal with ability to record 2K video and 12MP stills onboard.	HD EO stabilized gimbal with ability to record 4K video and 20MP stills onboard and configure camera settings via app
N/A	Gimbal stabilized zoom camera with up to 30x optical and 6x digital zoom with ability to record video and stills onboard and ability to configure camera settings via app
FLIR Vue Pro R stabilized gimbal.	FLIR Vue Pro R stabilized gimbal with ability to configure camera settings via app
Sony RX1R II mapping payload	N/A
Ricoh GR II mapping payload	N/A
Micasense rededge M-Multispectral	N/A
Aircraft is equipped with modular payload design with easily swappable COTS cameras and custom payloads.	
N/A	Provide technical specifications for payload interface.
N/A	Payload interface must provide 5 VDC or 12-14.5 VDC, Serial or USB or Ethernet connections or Micro USB
N/A	Payload produces geotagged images directly on the SD card.
Miscellaneous Specifications	
Minimum Requirements	Target
Autopilot logs are downloadable for georeferencing imagery and troubleshooting	Autopilot logs are downloadable and images are automatically geotagged
A service manual provided.	N/A
N/A	A list of spare parts that would be included in a field service kit and update the list throughout the life of the contract as required.
Includes software updates, and updates to latest firmware.	N/A
Optional Customer Support	Customer Support
Flight planning software with free license (available on tablet and laptop	N/A
Flight planning software for repeatable flights and must display UAS latitude/longitude position and telemetry data	N/A
System secured in backpack case for field work and commercial carry-on luggage	System includes backpack and hard case.
Ability to decline and lock out any device information sharing including telemetry through aircraft, software or applications preventing any automated uploads or downloads	N/A
System includes a total of 4 aircraft batteries equal to or less than 100Wh	System includes a total of 8 aircraft batteries equal to or less than 100Wh

## #8 Micro Rotor

<b>Flight Performance Specifications</b>	
<b>Minimum Requirements</b>	<b>Target</b>
Platform maximum weight under 2 lbs.	Platform maximum weight under 1.7 lbs.
Flight duration of 25 minutes with max payload, standard day.	Flight duration of 40 minutes with maximum payload, standard day.
Service ceiling 10,000 feet density altitude.	Service ceiling 15,500 feet density altitude.
Maximum sustained wind speed capability of 25 knots.	Maximum sustained wind speed capability of 35 knots.
Minimum launch area requirement of 10 feet by 10 feet.	Minimum launch area requirement of 5 feet by 5 feet.
Minimum recovery area requirement of 10 feet by 10 feet.	Minimum recovery area requirement of 5 feet by 5 feet.
Vertical take-off and landing (VTOL).	N/A
N/A	Noise level of 50 dB at 100 feet (AGL) at hover with maximum payload.
Operating temperature range of 10–100 degrees Fahrenheit.	Operating temperature range of negative 40–110 degrees Fahrenheit.
N/A	Waterproof capable.
<b>Command and Control Specifications</b>	
<b>Minimum Requirements</b>	<b>Target</b>
Communication range (RX/TX) C2 of 3 Mile.	Communication range (RX/TX) C2 of 8 Miles.
Transmit video range of 3 Mile.	Transmit video range of 8 Mile.
Electric power supply.	N/A
N/A	Obstacle avoidance capable
Uplink control frequency that is a secure digital data frequency hopping link at 2.4 GHz or 5.8 GHz or 900 MHz ISM Band, WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Downlink frequency that is a secure digital data link at 2.4 GHz and or 5.8 GHz ISM Bands and or 900mhz, w/FIPS compliant WPA2 or 128, 192, or 256 bit AES encryption (FIPS compliant).	N/A
Loss of Link (LOL) capability: return to launch or land now.	Selectable LOL: Return to launch, land now, programmable point.
GPS capable of using USA satellite constellations.	GPS capable of using all three satellite constellations at the same time: USA (GPS), Russian (GLONASS), and European (Galileo) or superior
Flight controller allows for manual control of the aircraft	N/A
Optical stabilization mode	N/A
Flight crew required a maximum of 1.	Flight crew required a maximum of 1, not including observer.
Aircraft has the ability to navigate by waypoints at a fixed elevation above the ground based on the terrain.	N/A
Ability to terminate flight instantaneously.	N/A

## #8 Micro Rotor

Payload Specifications	
Minimum Requirements	Target
Ability to live stream HD video for capture 720p minimum	FPV camera, HD video link to provide UAS pilot with situational awareness with ability to record 4K video
HD EO stabilized gimbal with ability to record 2K video and 12MP stills onboard.	HD EO stabilized gimbal with ability to record 4K video and 20MP stills onboard and configure camera settings via app
N/A	Gimbal stabilized zoom camera with up to 30x optical and 6x digital zoom with ability to record video and stills onboard and ability to configure camera settings via app
N/A	FLIR stabilized gimbal with ability to configure camera settings via app
N/A	Ability to do mapping missions from waypoint navigation
N/A	Provide technical specifications for payload interface.
N/A	Payload interface must provide 5 VDC or 12-14.5 VDC, Serial or USB or Ethernet connections or Micro USB
N/A	Payload produces geotagged images directly on the SD card.
Miscellaneous Specifications	
Minimum Requirements	Target
N/A	Autopilot logs are downloadable and images are automatically geotagged
A service manual provided.	N/A
N/A	A list of spare parts that would be included in a field service kit and update the list throughout the life of the contract as required.
Includes software updates, and updates to latest firmware.	N/A
Optional Customer Support	Customer Support
Flight planning software with free license (available on tablet and laptop)	N/A
Flight planning software for repeatable flights and must display UAS latitude/longitude position and telemetry data	N/A
System secured in case for field work and commercial carry-on luggage	System includes backpack and hard case.
Ability to decline and lock out any device information sharing including telemetry through aircraft, software or applications preventing any automated uploads or downloads	N/A
System includes a total of 6 aircraft batteries equal to or less than 100Wh	System includes a total of 8 aircraft batteries equal to or less than 100Wh

## #9 Training Micro Rotor

<b>Flight Performance Specifications</b>	
<b>Minimum Requirements</b>	<b>Target</b>
Platform maximum weight 320 grams.	N/A
Flight duration of 25 minutes with payload, standard day.	Flight duration of 40 minutes with maximum payload, standard day.
Service ceiling 10,000 feet density altitude.	Service ceiling 15,500 feet density altitude.
Maximum sustained wind speed capability of 25 knots.	Maximum sustained wind speed capability of 35 knots.
Vertical take-off and landing (VTOL).	N/A
Operating temperature range of 14 –104 degrees Fahrenheit.	Operating temperature range of negative 40–110 degrees Fahrenheit.
N/A	Waterproof capable.
<b>Command and Control Specifications</b>	
<b>Minimum Requirements</b>	<b>Target</b>
Communication range (RX/TX) C2 of 2.5 Mile.	Communication range (RX/TX) C2 of 4 Miles.
Transmit video range of 2.5 Mile.	Transmit video range of 8 Mile.
Uplink control frequency that is secure digital data link with FIPS compliant encryption	N/A
Downlink control frequency that is secure digital data link with FIPS compliant encryption	N/A
Loss of Link (LOL) capability: return to launch or land now.	Selectable LOL: Return to launch, land now, programmable point.
GPS capable of using USA (GPS) satellite constellations as well as Russian (GOLNASS).	GPS capable of using all three satellite constellations at the same time: USA (GPS), Russian (GLONASS), and European (Galileo) or superior
Flight controller allows for manual control of the aircraft	N/A
Flight crew required a maximum of 1.	Flight crew required a maximum of 1, not including observer.
Ability to terminate flight instantaneously.	N/A
<b>Payload Specifications</b>	
<b>Minimum Requirements</b>	<b>Target</b>
Ability to live stream HD video for capture 720p minimum	FPV camera, HD video link to provide UAS pilot with situational awareness with ability to record 4K video
HD 3 axis stabilized gimbal with ability to record 4K video and capture 21 MP Photos	N/A
N/A	Gimbal stabilized zoom camera with up to 30x optical and 6x digital zoom with ability to record video and stills onboard and ability to configure camera settings via app
N/A	FLIR stabilized gimbal with ability to configure camera settings via app
	N/A Ability to do mapping missions from waypoint navigation

**#9 Training Micro Rotor**

Miscellaneous Specifications	
Minimum Requirements	Target
N/A	Autopilot logs are downloadable and images are automatically geotagged
A service manual provided.	N/A
N/A	A list of spare parts that would be included in a field service kit and update the list throughout the life of the contract as required.
Includes software updates, and updates to latest firmware.	N/A
Optional Customer Support	Customer Support
Flight planning software with free license (available on tablet and laptop)	N/A
System secured in case for field work and commercial carry-on luggage	System includes backpack and hard case.
Ability to decline and lock out any device information sharing including telemetry through aircraft, software or applications preventing any automated uploads or downloads	N/A
System includes a smart battery equal to or less than 100Wh	System includes a total of 6-8 aircraft batteries equal to or less than 100Wh