ARMY, MARINE CORPS, NAVY, AIR FORCE

UAS

MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR THE TACTICAL EMPLOYMENT OF UNMANNED AIRCRAFT SYSTEMS

ATP 3-04.64
MCRP 3-42.1A
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22 January 2015

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MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES

FOREWORD

This multi-Service tactics, techniques, and procedures (MTTP) publication is a project of the Air Land Sea Application (ALSA) Center in accordance with the memorandum of agreement between the Headquarters of the Army, Marine Corps, Navy, and Air Force doctrine commanders directing ALSA to develop MTTP publications to meet the immediate needs of the warfighter.

This MTTP publication has been prepared by ALSA under our direction for implementation by our respective commands and for use by other commands as appropriate.

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PREFACE

1. Purpose

This multi-Service tactics, techniques, and procedures (MTTP) publication for unmanned aircraft systems (UASs) provides commanders, operational staffs, requestors, and unmanned aircraft (UA) operators with descriptive procedures for effective planning, tasking, integration, and utilization of UASs.

Note: For the Army, the term “command and control” was replaced with “mission command.” Mission command now encompasses the Army’s philosophy of command (still known as mission command) as well as the exercise of authority and direction to accomplish missions (formerly known as command and control).

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2. Scope

This UAS MTTP publication supports planners and warfighters by establishing tactics, techniques, and procedures (TTP) for tactical planning, requesting UASs, and using UAS capabilities. It addresses tactical and operational considerations regarding mission planning, command and control (C2) of operations, system capabilities, and limitations.

3. Applicability

This MTTP publication applies to all commanders and their staffs that participate in operations involving UASs. This publication is unclassified with restricted Distribution Statement C, in accordance with Department of Defense Directive 5230.24, *Distribution Statements on Technical Documents*.

4. Implementation Plan

Participating Service command offices of primary responsibility will review this publication; validate the information; and, where appropriate, reference and incorporate it in Service manuals, regulations, and curricula as follows:

Army. Upon approval and authentication, this publication incorporates the TTP contained herein into the United States (US) Army Doctrine and Training Literature Program as directed by the Commander, US Army Training and Doctrine Command (TRADOC). Distribution is in accordance with applicable directives listed on the authentication page.

Marine Corps.[1] The Marine Corps will incorporate the procedures in this publication in US Marine Corps doctrine publications as directed by the Deputy Commandant, Combat Development and Integration (DC, CD&I). Distribution is in accordance with the Marine Corps Publication Distribution System.

Navy. The Navy will incorporate these procedures in US Navy training and doctrine publications as directed by the Commander, Navy Warfare Development Command (NWDC) [N5]. Distribution is in accordance with *MILSTRIP/MILSTRAP Desk Guide,* Naval Supply Systems Command Publication 409.

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Air Force. The Air Force will incorporate the procedures in this publication in accordance with applicable governing directives. Distribution is in accordance with Air Force Instruction 33-360, *Publications and Forms Management*.

5. User Information

a. US Army Combined Arms Center; HQMC, DC, CD&I; NWDC; Curtis E. LeMay Center for Doctrine Development and Education (LeMay Center); and Air Land Sea Application (ALSA) Center developed this publication with the joint participation of the approving Service commands. ALSA will review and update this publication as necessary.

b. This publication reflects current joint and Service doctrine, C2 organizations, facilities, personnel, responsibilities, and procedures. Changes in Service protocol, appropriately reflected in joint and Service publications, will be incorporated in revisions to this document.

c. We encourage recommended changes for improving this publication. Key your comments to the specific page and paragraph and provide a rationale for each recommendation. Send comments and recommendations directly to:

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SUMMARY OF CHANGES

ATP 3-04.64/MCRP 3-42.1A/NTTP 3-55.14/AFTTP 3-2.64, *Multi-Service Tactics, Techniques, and Procedures for the Tactical Employment of Unmanned Aerial Systems*

This revision:

Updates:

- Chapter I to reflect current unmanned aircraft system (UAS) aircraft, missions, and unit structures.
- Chapter II with specific payload data and current employment considerations.
- Chapter III with current tactics, techniques, and procedures for executing UAS missions.
- Appendix A with current systems information relating to spectrum management.
- Appendix B with tables that detail specific platform information for all current UASs.

Deletes appendices C (Brevity Codes and Chat Abbreviations) and D (Standard Formats), and incorporates standard format information (or references to joint publications) throughout the remainder of the text.

Adds:

- Sections in chapter II describing operations-intelligence integration techniques, command and control, and tasking structures.
- A section in chapter III containing considerations for information exchange between supported and supporting units during all phases of UAS missions.

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***ATP 3-04.64 [ATTP 3-04.15]**
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ATP 3-04.64 [ATTP 3-04.15]	**US Army Training and Doctrine Command** **Joint Base Langley-Eustis, Virginia** **US Army Combined Arms Center** **Fort Leavenworth, Kansas**
MCRP 3-42.1A	**Headquarters, USMC, Deputy Commandant, CD&I** **Quantico, Virginia**
NTTP 3-55.14	**Navy Warfare Development Command** **Norfolk, Virginia**
AFTTP 3-2.64	**Curtis E. LeMay Center for Doctrine** **Development and Education** **Maxwell Air Force Base, Alabama**

22 January 2015

UAS

MULTI-SERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR THE TACTICAL EMPLOYMENT OF UNMANNED AIRCRAFT SYSTEMS

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EXECUTIVE SUMMARY

UAS

Multi-Service Tactics, Techniques, and Procedures (MTTP) for the Tactical Employment of Unmanned Aircraft Systems establishes tactics, techniques, and procedures (TTP) for tactically employing unmanned aircraft systems (UASs) and addresses operational considerations, system capabilities, payloads, mission planning, and multi-Service employment.

Historically, warfighters have used UASs as platforms to collect surveillance and reconnaissance data to produce intelligence. Recently, however, mission capabilities and tactical employment have expanded dramatically. All four Services employ UASs for a variety of tasks including reconnaissance, surveillance, target acquisition, weapons guidance, and battle damage assessment. This MTTP publication establishes a framework for employing UASs in a multi-Service environment.

Chapter I Introduction

Chapter I describes the UAS group system, general components, missions, and organizations.

Chapter II Planning

Chapter II provides planning considerations for UAS employment and the various command, control, and tasking structures that exist for their execution.

Chapter III Execution

Chapter III defines the UAS mission phases and describes general execution considerations and TTP related to UAS missions and information exchange between supporting and supported units.

Appendix A Spectrum Management

Appendix A describes UAS electromagnetic spectrum usage and information on the one system remote video transceiver and remotely operated video enhanced receiver systems.

Appendix B Platform Specifics

Appendix B provides tables containing specific platform and payload information for current UASs.

PROGRAM PARTICIPANTS

The following commands and agencies participated in creating this publication:

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Chapter I
INTRODUCTION

1. Introduction

a. Unmanned aircraft systems (UASs) provide a critical capability to warfighters at all levels of joint and multinational forces. The unique characteristics of these platforms distinguish them from their manned counterparts (e.g., fighters, bombers, and helicopters). However, UAS development in recent years has lessened this distinction in many areas. Today's UASs offer capabilities complementing those of manned assets. These systems now support many missions that were exclusive to their manned counterparts only a few years ago. Therefore, mission planning and execution for UASs follow the same processes established in doctrine for manned aircraft.

b. Warfighters at the tactical level should expect the same level of support from UASs as they do from manned aircraft and should hold them to the same standards. Warfighters should develop a thorough understanding of the capabilities unique to unmanned and manned systems and maximize their effects through seamless integration and informed application.

2. UAS Components

All UASs have several common components; the unmanned aircraft (UA), payload, control element, communications, and the support element. (See figure 1.)

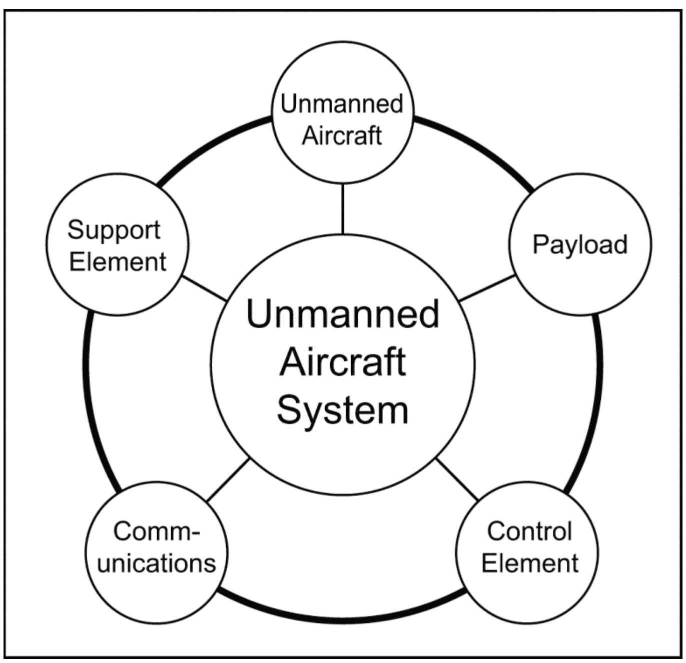

Figure 1. UAS Components

a. UA. UA are rotary- or fixed-wing aircraft or lighter-than-air vehicles capable of flight without an onboard crew. The UA includes the aircraft and integrated equipment (i.e., propulsion, avionics, fuel, navigation, and on-board communication systems).

Note: The United States (US) Air Force (USAF) refers to its Group 4 and 5 UA as remotely piloted aircraft (RPA) to emphasize that their operators are trained to the same standards as manned-aircraft pilots.

b. Payload. Payloads may include sensors, communications relay, and weapons. The numbers and types of payloads present will affect the performance characteristics of most UASs. Refer to appendices A and B for platform specific payloads.

(1) Sensors. The majority of today's payloads are imaging sensors, such as electro-optical (EO), infrared (IR), synthetic aperture radar (SAR), inverse synthetic aperture radar (ISAR), and maritime search radar. In addition, there are ground, surface, and maritime moving target indicators; light detection and ranging (LIDAR); chemical, biological, radiological, and nuclear (CBRN) detection; Automatic Identification System (AIS), geospatial intelligence; and signals intelligence (SIGINT) sensors. Sensor packages may also include a laser range finder (LRF) and coded LRF/detector (LRF/D) capability. The use of multiple sensors (e.g., full motion video [FMV] and SAR) requires a large amount of dedicated bandwidth that may impact the ability to process and disseminate data.

(2) Communications Relay. Communications relay payloads provide the capability to extend voice and data transmissions via the UA.

(3) Weapons. Payloads include lethal (e.g., missiles and bombs) and nonlethal (laser designator) weapons. (For specific weapons carried by individual aircraft, see appendix B.)

c. Control Element. The control element (whether ground-based, sea-based, or airborne), may handle multiple mission aspects, such as mission planning and execution, payload control, and communications. The UA operator is physically located at the primary UAS control element referred to as the ground control station (GCS). The GCS can be a laptop computer, large control van, shipboard module, or fixed facility. It can be located onboard airborne platforms to enable control from manned aircraft. Some GCSs can allow one pilot or operator to control multiple UAs. For some larger UASs, the GCS may be geographically separated from the UA launch and recovery site (LRS) and may be located outside the area of operations. Additionally, sensor operators (SOs) control wide-area airborne surveillance and most SIGINT sensors at a location geographically separated from the primary UAS control element.

d. Communications. All communications among the UA, UAS control element, and supported unit occur via voice and data link. The UA may use line of sight (LOS) or beyond line of sight (BLOS) communications. UA data links can directly supply the warfighter with imagery and associated metadata via direct LOS downlink to a remote video terminal (RVT). Systems such as the distributed common ground/surface system (DCGS), Global Broadcast Service (GBS), or the UA directly (e.g., RVT) transmit the data products to the network. (See appendix A for platform specific RVT capabilities.)

e. Support Element. Like manned aircraft, UASs require logistic support. This support element includes the equipment to deploy, transport, maintain, launch and recover the UA, and enable its communications.

3. UA Groups

a. The UA group system establishes the foundation for joint UAS terminology. It provides a common reference to compare UA.

b. UA are grouped based on the physical and performance characteristics of weight, operating altitude, and airspeed. UA groups are determined without regard for payload, mission, command relationship, or Service. A UA possessing one attribute of the next higher group is placed in that group. All UA fall into one of five groups as outlined in table 1.

Table 1. UA Group Categories

<table>
<tr><th>UA Category</th><th>Maximum Gross Takeoff Weight (lbs)</th><th>Normal Operating Altitude (ft)</th><th>Airspeed (KIAS)</th><th>Representative UA</th></tr>
<tr><td>Group 1</td><td>0–20</td><td><1,200 AGL</td><td><100</td><td>Raven
Wasp
Puma</td></tr>
<tr><td>Group 2</td><td>21–55</td><td><3,500 AGL</td><td rowspan="2"><250</td><td>Scan Eagle</td></tr>
<tr><td>Group 3</td><td>56 < 1,320</td><td rowspan="2"><18,000 MSL</td><td>Shadow</td></tr>
<tr><td>Group 4</td><td rowspan="2">>1,320</td><td rowspan="2">Any airspeed</td><td>Hunter
Predator
Gray Eagle
Fire Scout</td></tr>
<tr><td>Group 5</td><td>>18,000 MSL</td><td>Global Hawk
Reaper
Triton</td></tr>
</table>

Legend:
AGL—above ground level
ft—feet
KIAS—knots indicated airspeed
kts—knots
lbs—pounds
MSL—mean sea level
UA—unmanned aircraft

Note: Groups 1, 2, and 3 are sometimes referred to as low, slow, or small UASs

(1) Group 1 UA are generally hand-launched and self-contained aircraft. Tactical units (e.g., battalions, companies, and squadrons) typically employ Group 1 UA. They operate within LOS of the GCS at low altitudes and generally have limited endurance. Group 1 UA are typically man or vehicle portable and Group 1 UAS crews may operate from moving vehicles. Therefore, they can be hand launched in one area and recovered later in the route with little delay to normal ground maneuvers.

(2) Group 2 UA are generally medium-sized, catapult-launched aircraft. These systems have a small logistics footprint. They typically operate within LOS of the

GCS and have short to medium endurance. Some Group 2 UA can operate from aboard ship or unimproved areas.

(3) Group 3 UA are generally medium sized and normally operate at medium altitudes. Range and endurance can vary significantly among platforms. Although they require a larger logistics footprint than Groups 1 and 2 UA, many Group 3 UA can operate from expeditionary or unimproved areas.

(4) Group 4 UA are relatively large aircraft, operate at medium to high altitudes, and have an extended range and endurance. Fixed-wing UA in this group generally require a runway for launch and recovery (LR); however, several UA can operate from unimproved locations (e.g., the Hunter can takeoff from unimproved roads). The logistics footprint for these aircraft may be similar to that of manned aircraft.

(5) Group 5 UA are the largest aircraft, operate at medium to high altitudes, and typically have the greatest range, endurance, and airspeed. Group 5 UA require runways and improved areas for LR. The logistics footprint may be similar to that of manned aircraft of similar size. (For detailed descriptions of UA capabilities, see appendices A and B.)

4. UAS Missions

a. UASs perform a number of missions including: intelligence, surveillance, and reconnaissance (ISR); close air support (CAS); strike coordination and reconnaissance (SCAR); communications or data relay; electronic attack; close combat attack (CCA); and convoy escort.

b. UASs perform specific missions in accordance with (IAW) the same joint and Service doctrine as their manned counterparts. For example, UASs accomplish CAS IAW Joint Publication (JP) 3-09.3, *Close Air Support,* and personnel recovery IAW JP 3-50, *Personnel Recovery*. However, planners should consider the unique circumstances for employing UASs across the range of military operations.

5. UAS Units

a. USAF Organization.

(1) Groups 1, 2, and 3 UASs.

(a) The USAF defines small UASs (SUASs) as Groups 1-3. Air Force Instruction (AFI) 11-502 Volumes 1 through 3, *Small Unmanned Aircraft Systems,* 26 April 2012 establish Service guidance for operations, training and standards, and evaluation programs for all USAF SUASs. Air Force Special Operations Command (AFSOC) is the lead major command for SUAS operations. All USAF SUAS operators are required to attend AFSOC approved training courses to obtain initial qualifications.

(b) USAF SUASs are organic assets that enhance integrated defense, force protection, and ground based irregular warfare capabilities. They may conduct or support several missions: surveillance, reconnaissance, medical and casualty evacuation; CAS, combat search and rescue, fire (e.g., artillery and mortars); battle damage assessment, and convoy support.

(c) Deployed base defense squadrons normally have eight SUAS operators qualified to employ the RQ-11B Raven.

(d) Special tactics teams employ a wide array of SUAS assets. These may be Service-common or special operations forces (SOF)-specific.

(e) The typical USAF SUAS operator ranges from junior enlisted security forces members to highly trained SOF operators. USAF SUAS operators receive training on two crew positions: vehicle operators (VOs) and mission operators (MOs). SUAS operator manuals normally require both a VO and an MO to operate the SUAS. Using an untrained assistant (unqualified member) may severely degrade SUAS mission effectiveness. USAF SUAS operators are trained to operate in Class D airspace.

(2) Groups 4 and 5 RPA.

(a) Groups 4 and 5 USAF RPA are typically employed through an operational squadron. Qualified pilots operate tactical and operational Groups 4 and 5 RPA. They can interact with joint forces via communication methods, which may include ultrahigh frequency (UHF) and very high (VHF) radio, tactical chat, secure telephone networks, and Link 16 tactical data link. A qualified targeting pod operator, or in certain situations a geographically separated intelligence analyst or specialized system operator, operates the aircraft sensors.

(b) USAF Squadron Operation Centers (SOCs) are the dynamic battle centers for UAS operations for MQ-1 and MQ-9. These centers are called Global Hawk Operations Centers (GHOC) for the RQ-4B. SOC functions include mission planning, mission execution support, tasking and targeting updates, airspace coordination support, dynamic targeting support, threat warning support, weather updates, and administrative support. The SOC receives, processes, and reformats real-time information to produce mission data in a form suitable and usable to aircrew in the UAS cockpits. The on duty RPA pilot commands the SOC and GHOC and exercises control over all RPA missions assigned to the squadron. (See figure 2.)

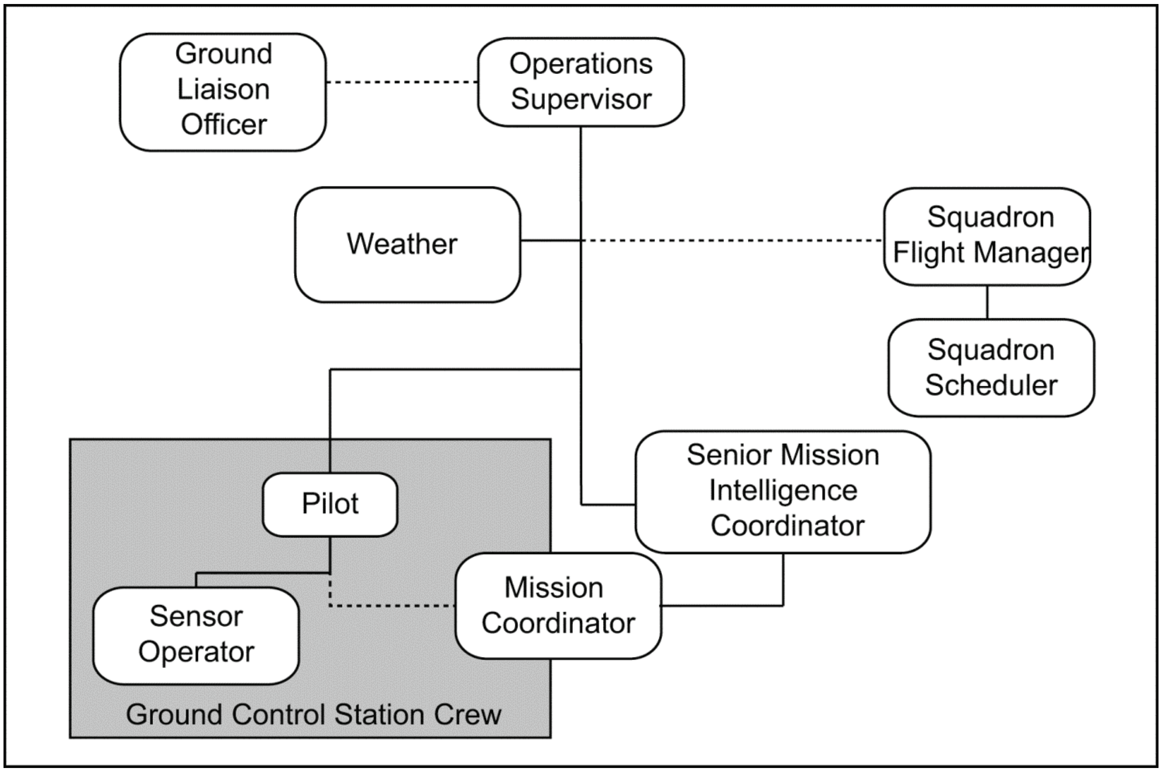

Figure 2. SOC Organizational Relationship

b. United States Marine Corps (USMC) Organization.

(1) Group 1 UASs. The Group 1 family of systems supports the Marine Corps' SUAS concept of operations (CONOPS). The supported maneuver unit (e.g., infantry battalion) organically owns and operates these systems. The Marine Corps' current Group 1 systems inventory includes the RQ-11B Raven digital data link (DDL), RQ-12A Wasp AE (all environment), and RQ-20A Puma DDL. A single operator can employ these systems with the exception of the RQ-12A; a crew of two is optimal.

(2) Group 3 UASs. The Marine unmanned aerial vehicle squadron (VMU) is the tactical unit employing the RQ-7B and RQ-21A. Each Marine Aircraft Wing possesses one VMU. Each VMU has three RQ-7B systems and up to nine RQ-21A systems. VMUs share the same organizational structure as other Marine Corps aviation squadrons. A Marine Corps Group 3 UAS is crewed by two or three Naval Air Training and Operating Procedures Standardization (NATOPS) qualified crewmembers. A fourth non-standard crewmember, an Intelligence or imagery analyst, may augment the crew when there is a requirement to produce intelligence from collection operations. During certain complex missions, the VMU may employ an unmanned mission commander (UMC).

(a) UMC. The UMC is responsible for all phases of the assigned mission except those aspects of safety of flight related to UA control and within the prerogative of the unmanned aircraft commander (UAC). The UMC may exercise command of multiple UASs. The UMC is qualified and designated, but need not be a winged aviator or a commissioned officer. UAS type/model/series NATOPS manuals define the specific UMC qualification requirements for each platform. The UMC directs a coordinated plan of action and is responsible for the effectiveness of the mission.

(b) UAC. The UAC is responsible for the overall conduct of the mission. The UAC leads, supervises, and approves mission planning to comply with the air tasking order (ATO), flight schedule, and supported unit requirements.

(c) Air Vehicle Operator (AVO). The AVO is responsible for the safe control and operation of assigned aircraft, as directed by the UAC. The AVO is involved in mission planning and ensures all preflight, pre-launch, mission, and recovery checklists are completed. The AVO also assists in evaluating and disseminating in-flight data.

(d) Mission Payload Operator (MPO). The MPO is responsible for the efficient and effective use of the payload. The operator manipulates the sensor; processes and sends the data to command, control, communications, computers, and intelligence users; and recommends approaches and tactics to employ sensors. The MPO is the primary crewmember to manipulate the communications relay payload. The RQ-21A UAS combines the AVO and MPO functions into a single station, reducing the crew requirement from the RQ-7B.

(e) Intelligence or Imagery Analyst. The intelligence or imagery analyst processes and analyzes FMV collected by the aircraft. Each is responsible for collecting, recording, analyzing, processing, and disseminating information and intelligence. Intelligence personnel provide aircrew with estimates and updates concerning enemy courses of action.

(f) Figure 3 shows the flow of information for aircrew coordination.

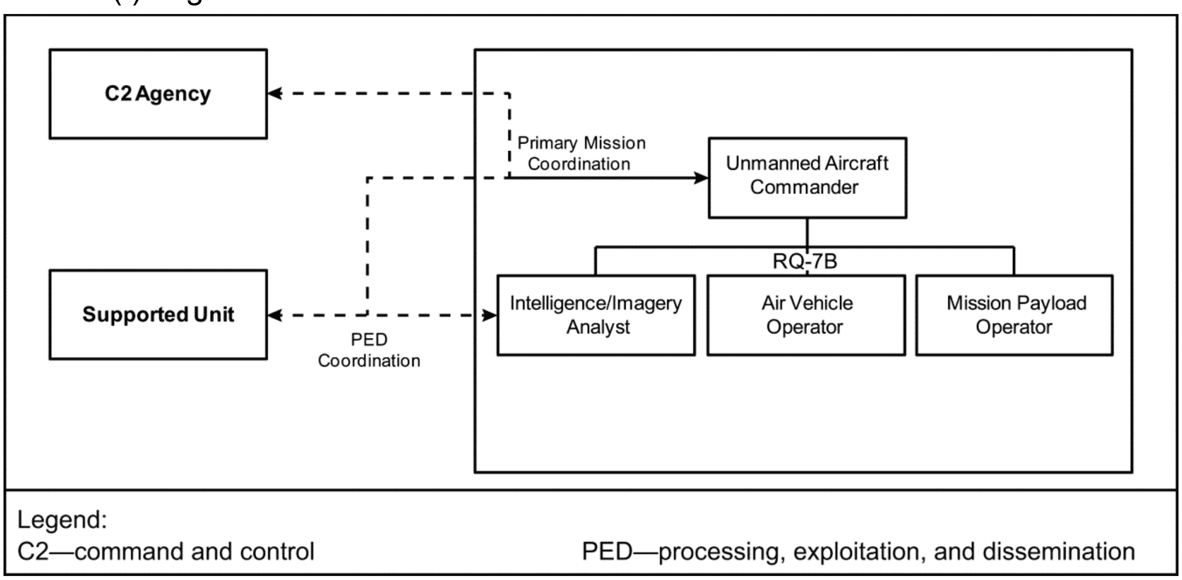

Figure 3. USMC RQ-7B Aircrew Coordination

c. United States Army (USA) Organization.

(1) Group 1 UASs. Maneuver units down to the battalion level operate organic Group 1 UASs. They are crewed by single operators and incorporated into all mission sets.

(2) Groups 3 and 4 UASs. The basic tactical unit for these UASs is the company. UAS companies are organic to maneuver units at all echelons. These units may be resident in the division, brigade combat team (BCT), expeditionary military intelligence brigade, fires brigade (FIB), or combat aviation brigade (CAB). The UAS company deploys a GCS organic to the maneuver brigade or CAB for mission planning and execution. Based on division requirements, the BCT or CAB will control the UA for reconnaissance, surveillance, and target acquisition (RSTA). US Army Intelligence and Security Command assets (Hunter and Warrior A) perform reconnaissance and surveillance collection operations. The CAB or BCT will launch its aircraft in support of the ground maneuver units. The BCT may occasionally send a GCS forward to another site (within either their area of operations or that of another unit) for mission execution. The GCS supporting the expeditionary military intelligence brigade or FIB will locate where it can best control the aircraft and allow for dissemination of collected information.

(a) Division. The division commander establishes the overall scheme of maneuver, tempo, and focus by fusing employment of all available joint and organic aviation assets. The Assistant Chief of Staff for Intelligence (G-2) coordinates collection requirements with the Assistant Chief of Staff, Operations (G-3) to ensure balanced UAS employment among division intelligence, maneuver, and command and control (C2) requirements. The division commander also may place UASs in direct support of a BCT, CAB, FIB, or intelligence brigade.

(b) BCT. UASs provide the commander with an organic aerial reconnaissance, surveillance, security, and communications relay capability. Organic Group 3 assets are employed with externally tasked UASs in support of the BCT mission.

(c) CAB. The CAB commander is the division commander’s senior advisor for employing aviation assets. The CAB commander and staff are the primary integrators of manned and unmanned aviation operations. They provide expertise, technical knowledge, and aviation experience to the division. The CAB plans and executes UAS operations with the division staff, FIB, expeditionary military intelligence brigade, and BCT.

(d) Brigade Aviation Element (BAE). The BAE conducts aviation planning and coordination and is organic to the BCT, expeditionary military intelligence brigade, and FIBs. It synchronizes aviation operations into the scheme of maneuver. The BAE provides employment advice and initial planning for aviation missions; and airspace planning, coordination, and synchronization. The BAE does not replace aviation task force (TF) planning. It assists the brigade-level planners and provides the CAB or supporting aviation TF with BCT mission information. A BAE member participates in the targeting, ISR, and airspace command and control (AC2) working groups to develop missions for UASs. The BAE implements and disseminates the airspace control order (ACO).

(e) GCS. The GCS provides the technical means to receive UA sensor data. The UA operator, payload operator, and mission coordinator assigned to the GCS provide tactical and technical expertise to facilitate UAS operations. The CAB commander advises the division commander on placement of this critical UAS component. The CAB, expeditionary military intelligence brigade, FIB, and BCT conduct disparate missions simultaneously across the division area of operation, with different tactics, techniques, and procedures (TTP); focus; and skill sets required. This requires integrating overall aviation operations at the division level to avoid redundancy of effort. GCS positioning is critical to successfully employing UASs.

- Single-site Operations. The entire UAS unit is collocated during single-site operations. Single-site operations facilitate unit command, control, communication, and logistics. However, separation from the supported unit may result in reduced communications, making coordination difficult. In addition, single-site operations require increased radio frequency (RF) emissions and a large physical footprint.

- Split-Site Operations. UAS units operate from two distinct sites during split-site operations: the mission planning and control site (MPCS) and the LRS. The MPCS is normally located with the supported unit's main or tactical command post (CP). It consists of the GCS, operators, and supporting equipment. The MPCS receives the tasking, plans the mission, takes control of the UA for mission execution, and reports information. The LRS is positioned to best support operations, usually in a secure area. It consists of the UA, LR systems, GCS, maintenance equipment, ground support equipment, and supporting personnel. It receives the mission from the MPCS, then prepares and launches the UA. After the UA has reached a predetermined altitude, the GCS at the MPCS assumes control of the UA. This process is reversed for UA recovery.

d. United States Navy (USN) Organization.

(1) Rotary-Wing UASs. The MQ-8B belongs to a shipboard aviation detachment. The detachment may consist solely of MQ-8B aircraft or it may be a composite detachment including manned and unmanned helicopters. Just as on other USN air-capable ships, the aviation detachment will be under the operational control of the ship's commanding officer but remains under the administrative control of its parent squadron.

(a) The MQ-8B Crew Organization. USN UAS crew positions are similar to manned aircrew positions. USN UAS detachments typically employ a crew of two: an AVO and MPO. These crewmembers may fulfill multiple crew positions simultaneously or have other crewmembers join them to fill the other positions. Chief of Naval Operations instruction (OPNAVINST) 3710.7 series, *NATOPS General Flight and Operating Instructions,* contains a detailed discussion of the UAS crew positions, which include the following.

- AVO. The AVO is the individual flying the UA. Most USN UASs are not flown in the traditional sense, but use a mouse and keyboard to issue commands to the UA, which then determines how best to fly itself to the specified point in the air. The AVO is typically an officer who is a rated aviator.
- MPO. The MPO is the individual controlling payloads and sensors on the UA. The MPO will typically be an enlisted aircrew member.
- UAC. The UAC is the individual responsible for the safe conduct of the UAS flight. The UAC must be qualified to operate the UAS.
- UMC. The UMC is the individual responsible for the safe conduct of the UAS mission. The UMC will be an officer.
- An imagery analyst also may support the crew. The UMC and imagery analyst positions are always military, but the AVO and MPO positions may be contractor personnel.
- When a supported unit is communicating with a ship-based UAS over the radio, it is likely they are speaking with either the AVO or MPO. When communicating via chat, they may be communicating with the AVO, MPO or other dedicated operator position. If communications cannot be established through normal channels, communicating through relays within the ship can be accomplished.

(2) Group 5 UASs. USN currently operates the RQ-4A Broad Area Maritime Surveillance Demonstrator for combat support and experimentation.

Chapter II
PLANNING

1. Payloads

a. UAS Sensors.

(1) EO.

(a) EO sensors capture images and video in the visible light spectrum, similar to the naked eye and video cameras. Relying on ambient light, EO sensors are not effective at night. They can deliver images and video in color or black-and-white. EO sensors are typically gimbaled (i.e., the sensor can be pointed independent of the aircraft). Gimbaling can provide some image and video stabilization to the sensor. Fixed sensors can be difficult to employ because the aircraft must be steered to point the sensor, and often the target is only in the field-of-view for a short period. Standard camouflage, concealment, and deception (CCD) techniques may limit EO sensor effectiveness.

(b) Larger UA typically carry combined EO and IR sensors or other integrated sensor packages. Improvements to sensor and gimbal technology have allowed some small UAs to carry gimbaled EO and IR sensors along with IR illuminators.

(2) IR. IR imaging sensors are normally passive receivers. They measure temperature differentials between targets and backgrounds. They can produce still or motion imagery. IR sensors may be designed for sensitivity in the long-wave infrared (LWIR), medium-wave infrared (MWIR), and short-wave infrared (SWIR). The operating wavelength will affect the sensor capabilities and limitations (e.g., different bands of IR will have varying difficulty seeing through visible moisture).

(a) Thermal crossover—occurring when the background temperature becomes close to that of the target—can affect IR sensor capabilities. Thermal crossover typically occurs just after sunrise (when background temperatures normally rise) and sunset (when background temperatures normally decrease); however, changing weather conditions may cause the same effect. During thermal crossover, an IR sensor may be unable to distinguish the target from the background.

(b) Certain CCD techniques also can affect IR sensors. Some larger sensors include low–light level television (LLLTV) to help compensate for this phenomenon. With image fusion, the LLLTV is fused with the IR or EO to create a more realistic and useful image.

(3) Radar. Radar is an active transmitter that emits RF energy, recovers the reflected RF energy, and processes it into useful information. Moisture affects radar less than EO and IR sensors. However, CCD techniques may hide or mask targets of interest using foliage and certain types of camouflage netting. Radars can typically work in one mode at a time (i.e., the system capabilities and limitations may change during a mission). Sophisticated radars can quickly switch modes with minimal interruption to human operators. Radars are useful for

quickly finding objects of interest over large areas, compared to EO and IR sensors.

(a) SAR. The SAR radar mode is useful for making map-like images of stationary features (wide-area view) or a single target (spot mode). SAR images taken from different angles or altitudes of the same area may not correlate well. When possible, planners should ensure aircraft fly similar profiles if change detection is the purpose of imagery collection using SAR.

(b) Moving Target Indicator (MTI). The MTI radar mode is useful for detecting and locating surface or airborne moving objects. Typically, this mode is programmed to reject returns below or above certain speeds to reduce clutter. This can have the adverse effect of eliminating true but slow returns, such as personnel.

(4) SIGINT. SIGINT payloads are useful for detecting, locating (e.g., direction finding), and exploiting RF signals. If the targets emit RF energy, this method is more useful than FMV when searching for targets over a wide area. Visible moisture does not significantly affect these sensors. However, the sensors typically require LOS and collections ranges vary based on the transmit power of the emitter.

(5) Hyperspectral Imagery (HSI). HSI sensors often can distinguish between different kinds of surfaces, which may aid in classification and identification. HSI sensors often generate large amounts of raw information, requiring significant onboard storage and processing before moving information off the platform. Thus, smaller UASs may not carry HSI payloads. Due to the high bandwidth required, manned platforms more frequently carry these payloads since they can support both an intelligence analyst and the sensor.

(6) CBRN. Coherent LIDAR and HSI sensors effectively detect chemical and biological agents. The environment generally affects the detection of these particles or phenomena and also may affect the performance of sensors and drive UA flight profiles.

(7) AISs. To perform the surface surveillance and control mission, USN UA often will carry an AIS interrogator. AISs, which include a broadcast of identification, position, and intention information, can be particularly effective in filtering non-threat maritime traffic.

(8) Table 2 lists advantages and disadvantages of current geospatial intelligence UAS sensors.

Table 2. Geospatial Intelligence Sensor Considerations		
	Advantages	**Disadvantages**
Electro-optical (EO)	• Provide a familiar view of a scene. • Offer system resolution unachievable using other optical systems or in thermal images and radars. • Is preferred for detailed analysis and measurement. • Has passive sensors.	• Deceived by camouflage and concealment techniques. • Restricted by weather conditions; visible light cannot penetrate clouds or fog. • Restricted by terrain and vegetation. • Has limited low-light capabilities. Certain sensors can provide daylight color motion video; others may provide only black and white still images.
Infrared (IR)	• Has passive sensors. • Provides good resolution. • Provides images in low-light environments.	• Effected by thermal crossover conditions (1 to 1.5 hours after sunrise or sunset). • Quality is degraded in rainfall and high humidity.
Synthetic aperture radar (SAR)	• Supports near continuous coverage even in adverse weather. • Provides detailed images of large areas. • Captures photograph-like images. • Detects changes in the environment.	• Lacks full motion video capability. Is not supported by remote video transceivers. • Requires extensive processing and distribution bandwidth. • Has high image latency based on resolution.
Inverse SAR (a maritime mode)	• Supports near continuous situational awareness, even in adverse weather. • Provides limited detail imaging of vessel-size targets using ship motion. • Provides individual frames that can be post-processed to form a pseudo-motion “flip book” image for analysis, such as target aspect changes that provide gross shape and significant structural features. • Retains image metadata that provides a geo-position.	• Has low resolution. • Has a limited area (“spot” image cell). • Requires extensive processing and post processing.
Moving target indicator	• Provides near continuous coverage, even in adverse weather. • Tracks and classifies moving vehicles and vessels. • Cues narrow-field-of-view EO and IR sensors.	• Additional processing may be required. • Unable to provide positive identification of moving vehicles, vessels, etc. (Requires sensor cross-cuing).

b. General Sensor Considerations.

(1) Wide Area versus Local Search. Some sensors are more appropriate for the initial search and others for a more targeted search. Wide area motion imagery, wide area surveillance, radar, SIGINT, and AIS sensors are generally better for the initial search of a large area. These sensors can quickly scan large areas. EO and IR sensors are optimal for targeted searches once the area sensors have detected and located potential targets.

(2) Cross-Cueing.

(a) Cross-cueing refers to the technique of cueing multiple sensors (from one or more platforms) to a target or area. This technique produces synergistic detection effects. It can significantly increase the effectiveness of a search or tracking problem. In some difficult tracking situations (e.g., tracking a vehicle in an urban environment), two or more UA may maintain contact with a target when a single UA would not be able to maintain a track.

(b) Proactive cross-cueing with other collection platforms or onboard sensors offer important TTP for operators of all collection assets. The low density of assets in a target area, combined with the high demand throughout the battlespace, make cross-cueing essential for efficient collection operations. A UAS providing unplanned support (e.g., a Predator or Reaper conducting another mission in the area) can provide essential elements of information (EEIs) that may not be available from assigned assets to the ground commander. Furthermore, viewing the target area through a narrow focus is very limiting, even for proficient UAS SOs. UAS operators should proactively seek cross-cueing with other collection platforms in the immediate vicinity of the target area.

(c) Using multiple sensors can effectively increase overall sensing performance. For example, fused information from SAR and HSI can identify a target that appears ambiguous using those sensors individually.

(3) Sensors on Small versus Large Aircraft.

(a) The sensors on large aircraft are not necessarily better than the sensors typically found on small aircraft. For example, the same EO and IR sensor coverage area can be obtained with a small sensor flying on a small UA closer to the target as a large sensor flying on a large UA further away.

(b) In addition, given the rapid pace of sensor improvements, small UA can now carry sensors previously restricted to large UA.

(4) Future Sensors for Consideration.

(a) Foliage Penetration (FOPEN). Typical radars cannot see through foliage. FOPEN radars assist in detecting targets under foliage and are typically associated with large UA.

(b) LIDAR. LIDAR uses pulses of laser energy similar to radar. LIDAR can build high resolution, map-like images of an area as well as three-dimensional models. Additionally, LIDAR can penetrate foliage (e.g., through gaps in leaves). However, visible moisture, dust, and atmospheric turbulence limit LIDAR.

c. UAS Weapons.

(1) Weapon payloads include missiles, bombs, and lasers.

(2) The only missile in general use on UA is the AGM-114 Hellfire, which includes several variants with differing capabilities. USAF MQ-1 and MQ-9 and the USA MQ-1C carry the AGM-114.

(3) The only bomb in general use is the laser-guided GBU-12, and is only carried by the MQ-9. The general trend in weapons for UA is to produce accurate, lower-yield weapons to reduce cost, collateral damage, and increase magazine size. Testing is ongoing for other guided munitions. Consult platform specific publications for current weapon payloads.

(4) UA employ laser target designators, laser target markers (LTMs), rangefinders, and spot trackers. Laser payloads increase target area situational awareness (SA), facilitate target handovers, and decrease weapon employment timelines using laser illumination. LTM settings on many UASs permit differentiation among users.

d. Communications Relays. Some UA carry communications relay payloads, extending voice and data for external users to overcome range and LOS limitations. Gray Eagle, Shadow, and EQ-4 Global Hawk Block 20 employ communications relay payloads with differing capabilities.

2. UAS Characteristics and Capabilities

a. USAF Platforms.

(1) Wasp AE, RQ-11B DDL Raven, and RQ-20 DDL Puma. The Wasp, Raven, and Puma systems are hand-launched reconnaissance and surveillance platforms. These systems transmit live, airborne video images; compass headings; and location information to a GCS, laptop, and RVT. A single payload may include dual-color EO cameras, a side-look IR camera with laser illuminator, gimbaled and gyro-stabilized EO camera, an LWIR camera, and an IR illuminator.

(2) MQ-1B Predator. The Predator is a medium-altitude, long endurance, multimission platform. An aircraft sensor payload consists of the AN/AAS-52 multi-spectral targeting system (MTS) housing EO, IR, and LLLTV cameras along with a laser range detector (LRD), IR marker, and high beam (a spotlight capability). The Predator UA is restricted from operating in icing conditions. Employment altitudes typically range from 10,000–20,000 feet mean sea level (MSL) depending on mission requirements and sensor payload. The Predator has slow rates of climb, making fixed operating altitudes favorable. FMV fidelity is most effective at 3–7 nautical miles standoff from the point of interest. The Predator armament includes up to two HELLFIRE missiles (HF-IIP, HF-IIP+, and HF-R variants). Some variants of the HELLFIRE missile enable target engagements +/- 180-degrees off the nose of the aircraft (AGM-114P-4, AGM-114N-4, and AGM-114R-2).

(3) MQ-9 Reaper. The Reaper is a medium- to high-altitude, long endurance, multimission platform. An aircraft sensor payload consists of the AN/DAS-1 MTS,

housing EO, IR, and LLLTV cameras along with an LRD and IR marker. It also has a SAR and ground MTI capability. The Reaper UA is restricted from operating in icing conditions. Employment altitudes are typically 15,000–25,000 feet MSL depending on mission requirements and sensor payload. The Reaper can climb quicker than the MQ-1B Predator, allowing it to respond to altitude changes more effectively. FMV quality allows increased stand-off (over the MQ-1B) while maintaining the same, or better, fidelity. Standoff distances depend on the tactical situation, but the Reaper typically uses 5–8 nautical miles. The Reaper employs laser-guided munitions. Common weapon payloads are either four HELLFIRE missiles (HF-IIP, HF-IIP+, and HF-R variants) and two GBU-12s, or four GBU-12s. Some variants of the HELLFIRE missile enable target engagements +/- 180-degrees off the nose of the aircraft (AGM-114P-4, AGM-114N-4, and AGM-114R-2).

(4) RQ-4 Global Hawk. The RQ-4 is a large, high-altitude, long-endurance, collection platform UAS consisting of an aircraft, enhanced integrated sensor suite, ground C2 elements, and redundant LOS and BLOS C2 links. Global Hawk's mission is to provide a broad spectrum of collection capabilities to support joint combatant forces in worldwide peacetime, contingency, and wartime operations. The Global Hawk provides persistent near-real-time coverage using imagery intelligence and SIGINT sensors. The RQ-4B has three variants (Blocks 20, 30, and 40). Their primary differences are the type of sensor packages and associated support.

b. USMC Platforms.

(1) Wasp AE, RQ-11B DDL Raven, and RQ-20 DDL Puma. In addition to the characteristics and capabilities listed in paragraph 2.a., the USMC's variants of these systems employ electronic warfare payloads, communications relay capabilities, coded laser pointer, and hostile force tagging, tracking, and locating systems.

(2) RQ-7B Shadow. The Shadow is a medium-altitude, medium endurance, multimission platform. Aircraft sensor payload consists of the EO, IR, and LRF/D packaged in a single sensor pod. Each VMU has three RQ-7B systems and employs them in support of the Marine Corps Tactical UAS CONOPS.

(3) RQ-21 Blackjack. The Blackjack is a medium altitude, medium endurance, multimission platform employed by the USMC and USN. Aircraft sensor payload consists of EO, IR, LRF, SIGINT, AIS, and LTM. The Blackjack crew consists of a UAC and an AVO. Although not an aircrew member, an imagery analyst or specialist is part of the team for the RQ-21A to provide first-pass intelligence analysis of the raw data feed. Additionally, the RQ-21A is the only USMC UAS that is shipboard capable to support all Marine expeditionary units.

c. USA Platforms.

(1) RQ-7Bv1 and RQ-7Bv2 Shadow. The Shadow is a medium altitude, medium-endurance platform. It provides brigade-level RSTA and is generally located in the BCTs and the full spectrum CABs. An aircraft sensor payload consists of the EO, IR, and LRF/D packaged in a POP300 or POP300D. Only the POP300D includes an LRF/D. The RQ-7B platoon is equipped with two POP300 payloads

and two POP300D LRF/D payloads. The full spectrum CAB troop comes equipped with eight POP300D LRF/D payloads.

(2) MQ-5 Hunter. The Hunter is a medium-altitude, medium-endurance platform. It provides corps and division-level RSTA and SIGINT. An aircraft payload consists of EO and IR sensors and LRF/D.

(3) MQ-1C Gray Eagle. The Gray Eagle is a medium-altitude, long-endurance, multimission platform. An aircraft sensor payload consists of the high definition Common Sensor Payload MTS, which houses EO, IR, fused LLLTV, laser spot tracker cameras along with a LRF/D and LTM. The weapon payload is four HELLFIRE missiles (HF-IIP+ variant).

d. USN Platforms.

(1) Scan Eagle. The ScanEagle is a low- to medium-altitude, long endurance, expeditionary, multimission platform for conducting persistent day and night surveillance and reconnaissance. Payload options include high resolution EO, picture in picture, MWIR, dual EO and IR imaging and LTM. An automated catapult launches the aircraft and a runway-independent retrieval system recovers it. This system catches the aircraft by its wing tip with a rope that hangs from a 50-foot-high boom, making it suitable for operations from ships and in forward deployed areas.

(2) MQ-8B Fire Scout. The Fire Scout is a medium-altitude, medium endurance, multimission, rotary-wing platform supporting maritime and ground forces across the spectrum of operations. It can perform day and night surveillance and reconnaissance, target acquisition and tracking, laser designation, target damage assessment, and communication relay missions. The Fire Scout is a second-generation, single-engine helicopter UAS. It operates from littoral combat ships and other ships capable of supporting aviation operations (e.g., guided missile frigates and destroyers) as well as land-based sites for expeditionary operations and providing support to SOF.

(3) RQ-4A Broad Area Maritime Surveillance-Demonstrator (BAMS-D). The BAMS-D is a forward deployed, land based, high altitude, long endurance platform developed from the USAF RQ-4A Global Hawk for maritime operations. It provides persistent maritime surveillance and reconnaissance to the fleet and combatant commanders to enhance SA with payloads including radar, EO, IR, electronic support measures, and AIS sensor packages. The system consists of the RQ-4A aircraft, mission control element, tactical auxiliary ground station, launch and recovery element, on-board sensors, communications links, support elements, and trained personnel.

e. The tables in appendix B contain specific information for the systems mentioned in this section.

3. General Employment Considerations

a. Communications. UASs require equipment and interface capabilities to meet varied communication requirements. Some missions and platforms require radio communication, while others require the use of internet relay chat (IRC), 2-way radio, satellite link (e.g., Ku-band), or voice over internet protocol (VoIP) capability.

These requirements should be determined during mission planning by referencing specific UAS capabilities.

(1) The MQ-1 Predator, MQ-9 Reaper, and MQ-1 Gray Eagle provide examples of these varied communication capabilities.

(a) The Predator and Reaper have a single ARC-210 aircraft radio used for airborne C2, airspace deconfliction, and tactical execution. The crew has alternate means of communication, such as secure and non-secure IRC and VoIP available at the control station.

(b) The Gray Eagle utilizes one ARC-231 and two ARC-201 radios for airborne C2, airspace deconfliction, and tactical execution. The crew has alternate means of communication, such as secure and non-secure IRC and VOIP, available at the control station.

(2) Planners, aircrew, and operators should develop detailed procedures using all available communications means to mitigate safety of flight and weapons employment issues.

(3) Planners should consider the supported unit and the information requirements to use RVT during operations. Information requirements include video frequency, tail number, aircraft type, and encryption key. UAS crews also should have access to selected supported unit radio networks and encryption keys. This access will improve coordination and timeliness of response.

b. Environmental Considerations. Successful UAS employment requires adequate planning for environmental factors. Depending on the platform and mission, planners and operators may have to consider the environmental factors in four separate locations (i.e., LRS, transit route(s), satellite relay site, and anticipated target location(s)).

(1) Winds. UA have crosswind and total wind limitations that may affect LR operations. The availability of alternate runways, at an LRS, to accommodate crosswinds may aid launching and recovering aircraft. Winds at altitude may have significant effects on UA range, transit time, and time on station. High surface winds at UAS communications and relay sites may force antenna stowage and delaying or curtailing missions.

(2) Precipitation. Rainfall may limit or preclude UAS flight operations due to its effects on aircraft and sensor performance. Additionally, precipitation may cause structural damage to the aircraft, sensors, and payloads.

(3) Obscurants to Visibility. Obscurants include visible moisture (e.g., clouds, fog, or haze), blowing smoke, sand, or dust. Visibility restrictions at the LRS may limit or prevent LR operations. Visibility restrictions in the target area may inhibit target acquisition and weapons employment by obscuring the target with debris, smoke, or dust from operations. Visible moisture in the target area may severely degrade some sensors (e.g., EO and IR systems cannot sense through clouds). Planners should attempt to mitigate the impact weather in the target area.

(4) Turbulence. Turbulence may affect the operator's ability to control UA during all phases of flight, to include the UA's ability to maintain a data link. It may affect sensor stability and potentially prevent weapons employment. If turbulence

exceeds the structural capability of the UA, the UA may experience structural failure.

Note: USA aircraft will not be intentionally flown into known or forecast extreme turbulence or into known severe turbulence. (See Army Regulation 95-23, *Unmanned Aircraft System Flight Regulations.*)

(5) Icing. Most UA do not have anti-icing capabilities and cannot fly in freezing precipitation or icing conditions. This includes climbing and descending through precipitation above the freezing level. Similar to manned aircraft, a UA flying into icing conditions can accumulate ice on its skin causing changes to the shape of its flight surfaces or weight. These changes could adversely affect its flight performance.

(6) Space and Solar Weather. Solar activity may cause significant changes to the Earth's ionosphere. These changes may adversely influence communications over high frequency (HF), UHF, and satellite communications links.

(7) Hot Weather Operations. Extreme heat conditions during ground operations may severely limit UA LR operations. Planners should consider specific aircraft limitations when operating in this environment.

c. Spectrum Management.

(1) Spectrum access often limits UAS employment. Planning for spectrum access includes conducting early spectrum surveys, database searches, and other methods of examining the electromagnetic environment. UAS units should coordinate using the electromagnetic spectrum through the appropriate agencies.

(2) Supported unit planners must consider other systems and emitters in the local areas of the GCS and UA to avoid electromagnetic interference. The planners must coordinate with other systems and emitters in the local area.

(3) Appendix A contains detailed information for spectrum management.

d. Airspace Management.

(1) Background.

(a) The joint force commander (JFC) will designate an airspace control authority (ACA). The ACA will coordinate airspace use within the operating environment. JP 3-52, *Joint Airspace Control*, describes combat airspace.

(b) Combat Airspace. Three products govern US and coalition combat airspace:

- Airspace Control Plan (ACP). The JFC issues specific planning guidance and procedures for airspace control in the operational area using the ACP. The special instructions (SPINS) document may supplement the ACP.

- ATO. The JFC issues the ATO to task aviation assets and disseminate relevant mission data. It serves as a daily flight schedule for the area of responsibility. The SPINS document may supplement the ATO.

- ACO. The ACO implements the ACP by providing the details of the approved requests for airspace coordinating measures. It is published either as part of the ATO or as a separate document.

(2) SA.

(a) UAS crews will have varying levels of SA depending on the system and payload capabilities. It is important for air controllers, supported units, and airspace planners to understand the specific capabilities of each UAS and their contributions to building the UA crew's SA. Controllers should be prepared to assist UA crews in building and maintaining SA.

(b) Additionally, not all UAS operators are "rated aircrew." A Group 5 UA operator will be a qualified pilot. However, the operators of smaller UA may have varying degrees of aviation training and experience. Controllers should be aware of these differences and be prepared to tailor the level of SA they provide to the UA crews, accordingly.

(c) Chapter III and appendix B contain UAS-specific capabilities and limitations regarding battlespace SA.

(3) Combat Airspace Planning Considerations.

(a) All UA operating above the coordinating altitude (CA) should appear in the ATO. The ACP will describe the procedures for all UA operating below the CA. Planners should consult with the ACP for theater-specific requirements early in the planning phase.

(b) In order to separate UA from manned aircraft and to prevent engagement by friendly air defense systems, planners should coordinate their airspace requirements with the ACA and include appropriate UAS coordination measures in the ACO. The ACP delineates the operating procedures for UAS missions operating below the CA. The ACA may establish specific flight routes and altitudes and publish them in the ACO.

(c) Several airspace coordinating measures (ACMs) are particularly well suited to UAS employment. Consult the appropriate joint and multi-Service publications for specific information concerning ACMs.

- CA. The CA uses altitude to separate users and as the transition between different airspace coordinating entities.
- Restricted Operations Zone (ROZ). A ROZ is airspace reserved for specific activities in which the operation of one or more airspace users is restricted. For example, the ACA may establish a UAS ROZ around areas in which UASs are conducting LR operations.
- Ship Control Zone. A ship control zone is an area activated around a ship operating aircraft into which friendly aircraft may not enter without permission. Similar to a ROZ in many ways, controllers may establish a ship control zone during maritime UAS LR operations.

(d) The ACA may establish additional ACMs for UAS operations. It is crucial for all UAS planners and operators to understand the ACP and ACO prior to planning and executing UAS operations.

(4) International Airspace.

(a) The international community created the International Civil Aviation Organization (ICAO) to increase interoperability of national domestic airspace systems. It is a United Nations specialized agency consisting of about 190 member contracting states, including the US. ICAO is an organization of the civil aviation authorities of these contracting states. To enable safe operations worldwide, the ICAO has established a consistent set of standards for pilot qualifications, airworthiness, and airspace classification and control services. However, each nation applies these standards differently. The ICAO rules provide common terminology and serve as a foundation for understanding the particular rules in each country. The ICAO divided international airspace over the oceans into flight information regions and assigned them to national civil aviation authorities to provide air traffic services.

(b) For US personnel, international airspace is any airspace not over land or water claimed by recognized nations, or in areas defined as combat airspace. The Federal Aviation Administration (FAA) represents the US in the ICAO.

(5) Domestic Airspace.

(a) Normal peacetime policies and regulations govern domestic airspace. Domestic airspace is one of the most challenging environments for conducting military UAS flight operations.

(b) The term national airspace system (NAS) is the common network of US airspace and includes air navigation facilities, equipment and services, and airports or landing areas. The NAS includes special use airspace such as warning and restricted areas. Title 10 of the United States Code (U.S.C.) provides the authority for the military departments to set military aviation standards, certify military aircraft (including UASs), and direct military aviation operations. Title 49 U.S.C. Sections 106, *Federal Aviation Administration*; 40103(b), *Sovereignty and Use of Airspace*; and 44701(a)(5), *General Requirements*, provide the authority of the FAA to set aviation safety standards and regulate aviation operations in the NAS. The FAA defers control of warning and restricted areas to a Department of Defense (DOD) airspace control agency in each area. The FAA holds the authority to grant a Certificate of Authorization or Waiver for DOD UAS activities outside warning and restricted areas. Through this process, the FAA may place conditions or limitations on UASs. Local commanders follow applicable Service and FAA guidance prior to approving domestic UAS training operations and demonstrations.

(c) Obtaining airspace for UAS operations is a very detailed and, often, a time consuming process. Successful integration requires early coordination with FAA military liaisons.

(d) Information on FAA policies and procedures for UAS flights in the NAS can be found on the FAA website listed in the Reference section of this publication. Refer to Service guidance for all Certificate of Authorization or Waiver applications.

(e) In accordance with Memorandum of Agreement Concerning the Operation of Department of Defense Unmanned Aircraft Systems in the National Airspace System, dated 16 September 2013, airspace users may submit new Certificates of Authorization or Waiver via the FAA Obstruction Evaluation, Airport Airspace Analysis website listed in the References. The FAA will process new Certificate of Authorization or Waiver requests within 60 business days of receipt. If this timeline will not be met, the FAA will notify the requester of the nature of the anticipated delay, any additional information required, and the expected Certificate of Authorization or Waiver completion date.

(f) Priority Certificate of Authorization or Waiver Requests. If a Certificate of Authorization or Waiver application or renewal is urgent, the DOD Policy Board on Federal Aviation representative will notify the FAA of the Certificate of Authorization or Waiver request for high priority action. The representative will give the reason for higher priority action and the requested approval date. The FAA will move the requested Certificate of Authorization or Waiver to the front of the DOD queue and process it as quickly as possible. During disaster relief missions, the FAA may issue emergency Certificates of Authorization or Waiver within as little as a few days once a formal request for support reaches the Secretary of Defense.

e. UAS Hand Overs. UAS hand overs, used to extend operational range, occur between two geographically separated crews. UASs that are more complex can operate BLOS by using this procedure. This procedure must be carefully coordinated between the two crews. The losing crew must pass control frequencies, airspace clearances, and any nonstandard settings prior to releasing control to the gaining crew. UAS crews should advise the supported unit that a new crew is now controlling the same aircraft and maintaining the current call sign.

f. Lost Link.

(1) A significant limitation associated with UASs involves the requirement to maintain a data link. Although most UA can fly preprogrammed missions, they still require some form of data link for aircraft systems and mission monitoring and remote manual flight control. A lost link occurs when the pilot or operator relinquishes positive control of the UA intentionally, or loses it due to an unplanned loss or interruption of the necessary control or monitoring data link(s). Unplanned lost link is generally the more serious event.

Note: An unintentional and extended link loss is an emergency, but may not require crash-rescue services.

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(2) Losing the link between the GCS and the UA may pose an increased risk to other aircraft. Operators should program lost link mission data to ensure standard, predictable, and safe lost link routing to minimize risk and facilitate aircraft recovery.

(3) In the event that a UA loses its link, the pilot or operator should immediately notify air traffic control (ATC) and provide the following information.

(a) The time of the lost link.

(b) The last known position.

(c) The altitude.

(d) The direction of flight and preprogrammed routing.

(e) Confirmation of lost link procedure execution.

(f) Confirmation that the pilot, operator, or observer has visual contact with the UA (conditions permitting).

(g) An estimated remaining time of flight.

(h) The airspeed.

(4) Upon receiving this information, ATC will clear airspace, as required, to ensure the UA can safely reach its lost-link contingency hold point and issue advisories and ATC instructions, as appropriate, to ensure safe operation of all aircraft.

Note: UAS units should carefully select lost link or contingency hold points and update them periodically during missions to ensure people and structures are not harmed in the event that link cannot be reestablished.

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4. Operations and Intelligence Integration

a. Comprehensive coordination between the operations and intelligence staffs ensures critical collection requirements are forecast and resourced. Despite deliberate planning, more immediate and critical requirements may emerge. The efficient collaboration between the operations and intelligence staffs enables the rapid re-tasking of airborne collection assets.

b. Planning for airborne collection assets requires consideration of the ATO cycle. Intelligence staffs will use different planning horizons than those used for ground-based assets. They should consider the ATO and the associated timelines at the various echelons for a typical 72-hour airborne collection cycle. Table 3 describes the tasks associated with a 72-hour ATO cycle.

Table 3. Tasks Associated with an Airborne Collection Request (FOUO)

Up to 72 hours before collection mission start	
1.	Supported units develop their collection requirements and build their target decks, forwarding them to higher headquarters (HQ) for refinement and inclusion in the requests for collection.
2.	The primary deconfliction function during this time is verifying requests against stated information collection priorities.
3.	The unit order or plan normally publishes information collection priorities, which drive the overall information collection effort.
4.	After receiving the initial plan, the operations staff forwards it to higher HQ to begin parallel planning.
5.	The operations staff posts the proposed schedule.

Table 3. Tasks Associated with an Airborne Collection Request (FOUO) (cont'd)
48 to 72 hours before collection mission start
6. Planners resolve any issues concerning the proposed collection asset schedule and changes in the collection priorities. 7. The operations staff approves the information collections plan and distributes it to higher HQ and subordinate commands.
24 to 48 hours before collection mission start
8. The operations staff approves the proposed information collection plan and sends it to higher HQ for action. 9. The operations staff resolves requests for changes in the approved schedule, including immediate requests or priority changes. 10. Once the operations staff approves all changes, the staff begins the mission planning cycle. 11. Higher HQ validates requirements and tasks aerial assets to conduct reconnaissance and surveillance missions. 12. Simultaneously, the air and space operations center coordinates airspace. 13. Command groups, at the aviation unit, receive the tasking and initiate the mission planning process. 14. The staff, at the aviation unit, develops the schedule and coordinates mission and flight operations. 15. Mission operations sections collaborate with all supported units to ensure target decks are logical and asset-to-collection requirement pairs are appropriate.
6 to 12 hours before collection mission start
16. Units refine the approved plan, dictated by the tactical situation, with operations staff approval. 17. Intelligence staffs, along with aviation mission planners, make final adjustments to target decks.

c. Preplanned collection requests occur during the normal ATO cycle. They support the requesting commander's information collection requirements to facilitate unit planning, preparation, and execution. The commander also may require standing requests to provide indications and warning or force protection. For the USA, the air support operations center (ASOC) and battlefield coordination detachment monitor and analyze threat activity and support targeting while providing feedback to the commander to aid decision making for shaping operations. Preplanned collection enables the seamless transition from preplanned missions to dynamically tasking and cueing assets. Preplanned requirements typically focus on:

(1) Observing indications and warnings of activity.

(2) Supporting the targeting process.

(3) Identifying and verifying targets.

(4) Supporting combat assessment.

(5) Building SA.

(6) Supporting force protection.

(7) Fulfilling strategic collection requirements.

(8) Developing the common operational picture (COP).

d. An immediate collection request supports collection requirements developed inside the normal ATO cycle. These collection requirements are often time-sensitive. Coordination between intelligence staffs and collections managers, at all echelons, is especially important for gaining support for immediate collection requests. This coordination ensures proper prioritization of immediate collection requests with existing requirements and tasks. Situations warranting dynamic re-tasking of an airborne asset may include:

(1) Engagement of time-sensitive targets.

(2) Time-sensitive physical and functional assessments.

(3) Weather and maintenance issues.

(4) Ad hoc or emergent collection requirements.

(5) Personnel recovery (PR) or downed aircraft.

(6) Dissemination system failures.

5. Command, Control, and Tasking

a. Group 1 UASs. Units employ Group 1 UASs as direct support assets. These assets may not appear in the ATO, depending on the theater ACP and SPINS. However, airspace used by Group 1 UASs will appear in the ACO.

b. Groups 2–5 UASs. The joint force air component commander (JFACC) tasks Groups 2–5 UASs made available to the JFC via the ATO as part of the same deliberate planning process as manned aircraft. JP 3-30, *Command and Control for Joint Air Operations*, specifies this process. Groups 2–5 UASs under mission control of specific units should appear in the ATO for the purposes of airspace coordination and deconfliction, as prescribed in the ACP. Multiple means of communication to a control station can enable a qualified UAS crew to support multiple units. Depending on aircraft payloads and geometry relative to the target(s), this support may be sequential or simultaneous.

c. USAF.

(1) C2. USAF Groups 4 and 5 RPA are multirole platforms. Centralized control ensures maximum theater-wide utilization of limited resources. Decentralized execution ensures the greatest level of effectiveness for joint participants. Therefore, the air operations center (AOC) retains C2 authority over USAF Groups 4 and 5 RPA, and delegates execution authority to the ASOCs for direct support missions.

(2) Tasking. The JFACC tasks USAF Groups 4 and 5 RPA through the standard ATO process. The JFACC tasks USAF RPA for direct support missions or integrates them into the master air attack plan (MAAP).

(a) Direct Support Missions. Direct support missions, such as armed overwatch, CAS, surveillance, or reconnaissance are requested and tasked through the theater air control system or Army air-ground system. Supported units request direct support missions IAW JP 3-30 and theater specific procedures.

(b) MAAP process. RPA integrate into the full range of USAF missions. USAF Groups 4 and 5 RPA have been employed to conduct air interdiction, SCAR, CAS, strategic attack, PR, suppression of enemy air defenses, destruction of enemy air defenses, and airborne operations in maritime surface warfare. Through the deliberate planning process, the AOC tasks Groups 4 and 5 RPA to these missions IAW JP 3-30.

d. USMC.

(1) C2.

(a) The Marine air command and control system (MACCS) exercises control over all aircraft operating in assigned Marine air-ground task force (MAGTF) airspace, including UASs. In addition to providing air control, the direct air support center (DASC) issues immediate tasking to aviation assets. Marine Corps warfighting publication (MCWP) 3-25, *Control of Aircraft and Missiles,* contains more information concerning the MACCS.

(b) Supported MAGTF commanders typically exercise operational control over UASs in direct support of their units through organic air officers and joint terminal attack controllers (JTACs). Navy tactics, techniques, and procedures (NTTP) 3-22 series, *Navy Aviation Tactics, Techniques and Procedures*, and the Marine Aviation Weapons and Tactics Squadron One (MAWTS-1) *Tactical Air Control Party Tactical Standard Operating Procedures* manual contain specific C2 TTP for UASs.

(2) Tasking. The USMC integrates UASs into MAGTF operations as aviation combat element (ACE) assets. The ACE typically employs UASs in direct support of the MAGTF, except in circumstances defined by JP 1, *Doctrine for the Armed Forces of the United States* (e.g., when excess sorties are made available to the JFACC).

(a) Preplanned Missions. Supported units request preplanned UAS sorties via the operations chain regardless of the supported units' or mission's type (intelligence or operations). The supported units' operations staff requests UAS sorties (except Group 1) by submitting a DD Form 1972, Joint Tactical Air Strike Request, to the tactical air command center (TACC). The TACC publishes UAS sorties in support of the MAGTF in the direct support ATO and provides sorties to the JFACC as available. The VMU Operations Department coordinates operations with the supported unit based on support requirements specified in the DD Form 1972. MCWP 3-2, *Aviation Operations*, contains more information in the USMC ATO process. Figure 4 outlines the USMC'S preplanned request process.

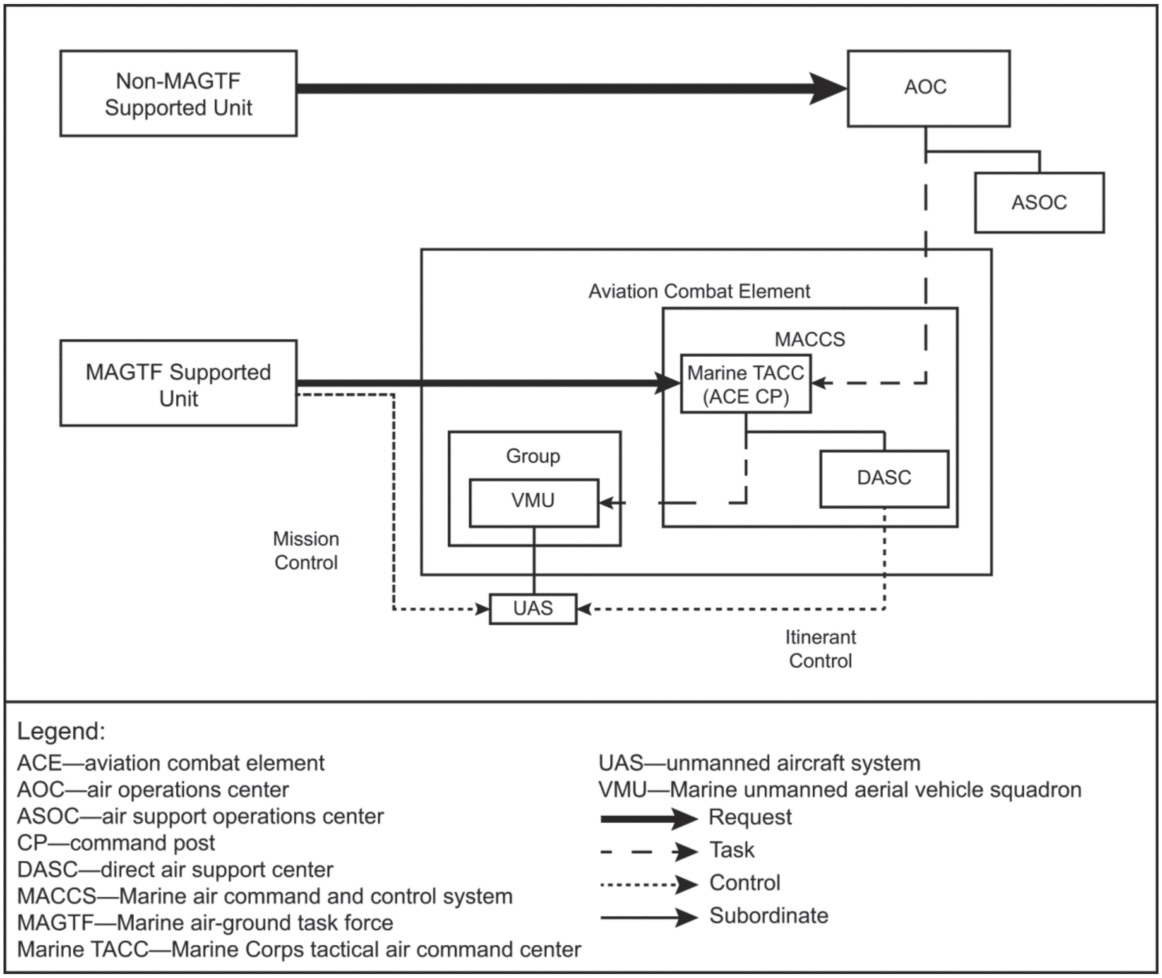

Figure 4. USMC Preplanned Request Process

(b) Immediate Missions. Immediate missions require support inside the ATO cycle. A supported unit with an immediate requirement should submit a DD Form 1972 to the DASC. The DASC will re-task and route the UA appropriately.

e. USA.

(1) C2. UAS units inherit the C2 structure of their higher headquarters (HQ). The BAE is the principle staff element coordinating AC2 requirements and integrating Army aviation into the BCT scheme of maneuver. BAE duties and responsibilities include:

(a) Coordinating and synchronizing operational and tactical aviation support, to include UAS, attack, air assault, air movement of troops, equipment and key personnel, C2 aircraft, and Army air medical evacuation.

(b) Receiving, distributing, and providing Army aviation input to the ATO.

(c) Requesting immediate ACMs to support UAS dynamic re-tasking.

(d) Writing the BCT commander’s AC2 annex and maintaining the AC2 running estimate.

(e) Advising the commander and staff on all aviation related issues.

(2) Tasking.

(a) Preplanned Requests. Supported units submit preplanned requests as part of the normal ATO process. They request UAS support in the same manner as manned aviation. Groups 3 and 4 UAS support appears in the ATO and ACO, while only the Group 1 UAS airspace typically appears in the ACO. Unfilled UAS requests are forwarded to the next echelon for consideration and tasking. Airspace planning and coordination parallels the request process. Figure 5 shows the Army aviation support request and tasking process.

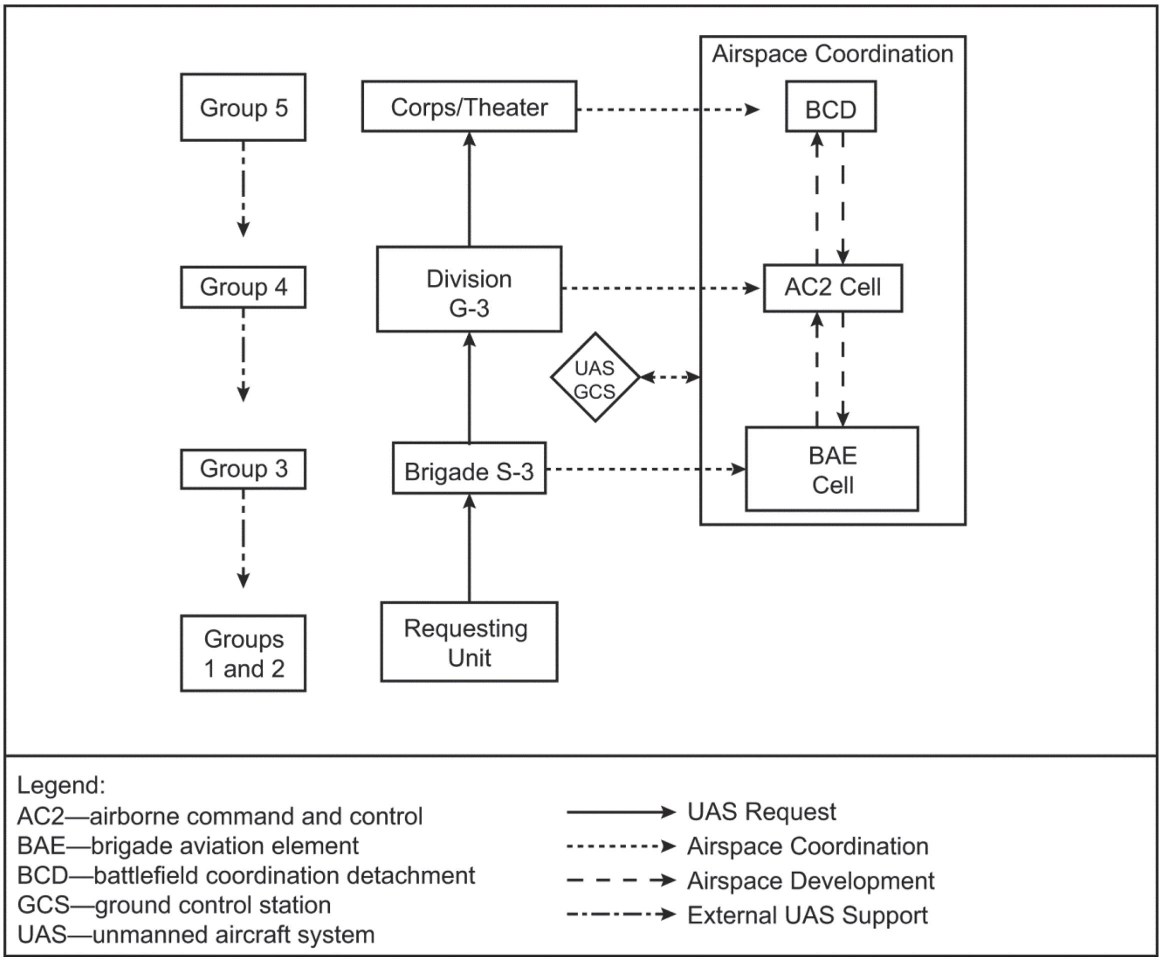

Figure 5. USA Preplanned Task Flow for UASs

(b) Immediate Requests. Immediate requests support requirements arising inside the normal ATO timeline. Supported units may use email, tactical chat, telephone, and radio to help expedite immediate requests. The G-3 forwards unfilled requests if organic assets are not available. The following situations may require immediate requests.

- Changes in the area of operations or mission.
- Changes to commander's scheme of maneuver or timeline.
- LRS or mission area weather.
- Airspace conflicts.

(c) Dynamic Re-tasking. Dynamic re-tasking diverts a UA from an existing mission to a new task. Dynamic re-tasking requires a rapid decision based on previously published criteria. Clearly defined priorities facilitate effective coordination of an emerging tactical situation. Figure 6 depicts an example of the information flow when a battalion requests dynamic re-tasking. Upon completion of dynamic re-tasking, the UA may resume the preplanned mission if circumstances permit. The minimum information required to begin dynamic re-task planning includes:

- Mission priority.
- Call sign.
- Routing.
- ACMs.
- Required altitude.
- Weapons considerations.

(d) In the absence of re-tasking from higher HQ, a mission change during flight requires the UAS mission coordinator to validate the request and requirement based on:

- Asset availability and capability (e.g., remaining station time and on-board munitions).
- Time sensitivity and criticality.
- Impact on current mission and mission priority.
- Airspace coordination and deconfliction.
- C2 support available.

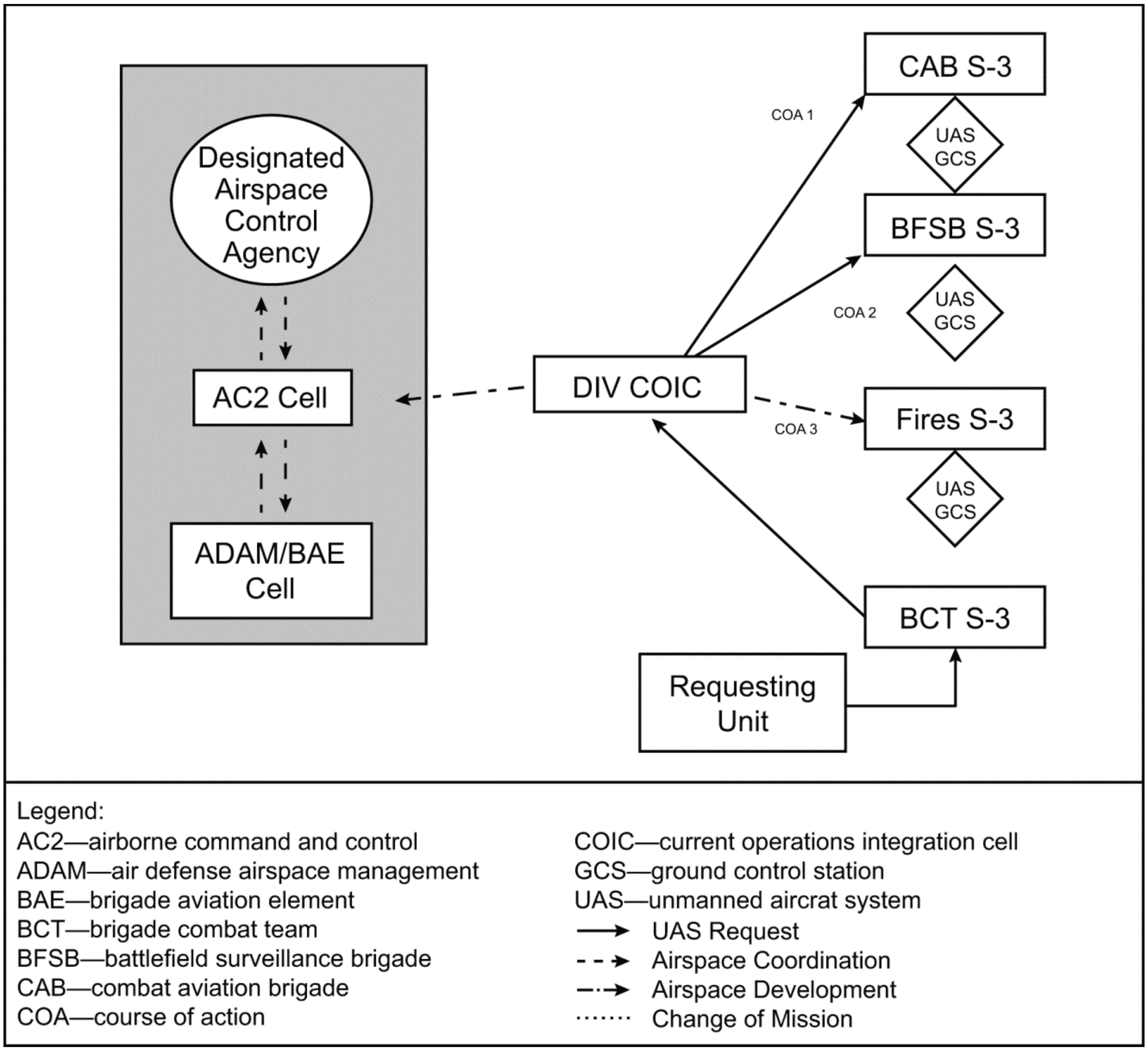

Figure 6. USA Dynamic Re-task Flow Example

f. USN.

(1) C2.

(a) Ship-based C2. The designated ACA controls USN UASs. A UAS operating from a ship in support of missions ashore coordinates movement in the airspace with the antisubmarine/antisurface tactical air controller (ASTAC). UASs provide mission support and receive specific tasking from the parent TF or supported unit. The ship retains control of the UAS during independent operations.

(b) Shore-based C2. The joint force maritime component commander (JFMCC) collaborates with subordinate commands and higher headquarters to determine collection requirements. The JFMCC also will ensure the chosen platform's capabilities will satisfy mission requirements. The JFMCC maritime operations center develops the maritime task plan based on validated maritime collection requirements. This plan provides tasking for supporting units (e.g., strike groups) to perform mission planning. The JFMCC or supporting unit generates a specific tasking message to UAS units.

(2) Tasking. The parent TF or Carrier Strike Group tasks USN UASs via the air plan IAW the theater ATO in the same manner as their manned counterparts. The operating ship coordinates UAS operations when operating outside the vicinity of the strike group. USN UASs receive tasking via the theater ATO process when conducting shore-based operations. UAS units receive tasking from the tactical action officer or the ASTAC for ship-based operations. For more information concerning USN UAS detailed integration, refer to NTTP 3-03.4, *Naval Strike and Air Warfare,* NAVAIR 00-80T-122, *Helicopter Operating Procedures for Air-Capable Ships NATOPS Manual*, and Commander, Third Fleet Tactical Memorandum 2-01.1-13, *Ship-Based Unmanned Aircraft Systems (UAS) Employment Tactics.*

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Chapter III
EXECUTION

1. Mission Phases

a. Pre-mission Phase. The pre-mission phase begins when the supporting unit receives a task to support the supported unit's operation. This phase continues until mission communications are established and the UAS crew can receive and react to further direction or updated information.

b. Mission Execution Phase. The mission execution phase begins when the UAS crew establishes mission communication (i.e., the UA is on station with the supported unit). The UAS can receive and react to further supported unit direction or updated information during this phase. This phase continues until the UAS completes the mission, the supported unit releases the UAS, or the UAS receives alternate tasking. Unlike manned aircraft, UA may be airborne for extended periods before or after the mission execution phase. For this reason, supported units should consider the UAS mission timeline in planning.

c. Post-mission Phase. The post-mission phase commences when the UAS crew terminates mission communication (i.e., the UAS is off station). The UAS may conduct another mission or return to base during this phase.

2. General Considerations

a. SA. UAS crews have varying levels of SA of the operating area of the UA. Their SA depends on the capabilities (e.g., onboard sensors and other systems) of that UA. Groups 1–3 UAS crews typically have limited battlespace awareness since they rely on a single sensor and a ground controller. Groups 4 and 5 UAS crews typically have improved theater battlespace awareness provided by multiple onboard sensors, data links (e.g., Link 16), and the ability to interface directly with theater computer networks. These communication capabilities make these UASs unique force multipliers, as they may be the only airborne asset with the capability to communicate directly and simultaneously with ground forces, AC2, and leadership worldwide. These capabilities are enhanced by extended loiter times and Link 16 capabilities of Groups 4 and 5 UASs. Appendix B provides specific UAS platform capabilities.

b. UAS Link Considerations. Specific DOD doctrine publications or SPINS for UASs address lost link considerations for individual mission sets. Regardless of mission set or UAS category, crews should provide individual lost link considerations to their supported unit and C2 entities. Groups 4 and 5 UASs are typically robust, making them more capable for operations in such an environment. See appendix B for specific UAS platform capabilities when operating in contested or degraded operational environments.

3. Surveillance

Surveillance involves observing threats and local activity in a named area of interest (NAI) or target area of interest (TAI). Surveillance may be a standalone mission or part of a reconnaissance mission (particularly area reconnaissance). Elements conducting surveillance must maximize assets, maintain continuous surveillance on all NAIs and TAIs, and report all information rapidly and accurately. The following list provides important information for the UAS aircrew performing surveillance.

a. Target name. High-value or high-payoff target list item.

b. Physical description to aid in acquisition.

c. Location.

d. Required surveillance mission (point, area, or zone) and expected products (e.g., spot report, annotated photographs, video clips, and storyboards).

e. Operational graphics (e.g., gridded reference graphic, operations order, air mission brief).

f. Time sensitivity or urgency.

g. The ISR tasking and priority intelligence requirement associated with the tasking and the EEI associated with the priority intelligence requirement. This information should identify:

(1) Task. Including the time of desired coverage.

(2) Desired end-state.

(3) Desired effect (e.g., during a raid, report personnel on rooftops and any activity in the target area).

h. Reporting instructions (e.g., the supported unit's call sign, frequency, and other contact information).

4. Reconnaissance

a. Types. UASs conduct three forms of reconnaissance: route, zone, and area. They conduct reconnaissance operations to:

(1) Obtain information about the enemy and terrain.

(2) Assist in building and sharing the COP.

(3) Focus combat power at the decisive point and time.

b. Times and Places. UAS units perform reconnaissance before, during, and after combat operations and provide combat information to develop situational understanding. The ability to seize or retain the initiative and concentrate overwhelming combat power at the right time and place depends on current and relevant threat information. UASs can provide much of this information to the tactical commander, including:

(1) Size.

(2) Activity.

(3) Location.

(4) Composition.

(5) Direction and rate of movement.

c. Capabilities. UAS reconnaissance may occur forward of or near friendly forces. UAS units expand the area covered by ground and air reconnaissance assets. UASs can:

(1) Observe areas and objectives where terrain or a threat can hinder ground or manned air reconnaissance.

(2) Operate at extended distances or extended durations, or both.

(3) Maximize standoff distance to retain the element of surprise and increase force security.

(4) Effectively gather and disseminate mission payload data.

d. Crew Changes. The long endurance and range capabilities of most UASs often require using multiple crews over the course of a mission. The crews should brief all aspects of the mission prior to turnover. Supported units should understand the implications of this turnover. Refer to specific platform and mission-specific Service publications for the format and content for the information exchanged during these crew changes.

e. Positive Target Hand Off. A positive hand-off occurs when one asset builds target area SA for another prior to departing. The process should conclude with the oncoming asset gaining target contact prior to the off going asset departing. Direct coordination between the two crews is a highly effective technique for a positive target hand off.

f. Detection Concern. Supported units should specify their level of concern for the enemy gaining visual or auditory UAS detection. The UAS crew will determine how to best mitigate this concern for their individual platforms. UASs can use several techniques that maximize slant range and altitude from the target to reduce their visual and audio signatures.

(1) Low detection concern occurs when the supported unit is not concerned with alerting personnel at the target location to the presence of a UAS.

(2) Medium detection concern occurs when ground personnel may be alerted to the presence of a UAS (by sight or sound), but the UA should not appear to be prosecuting a specific target.

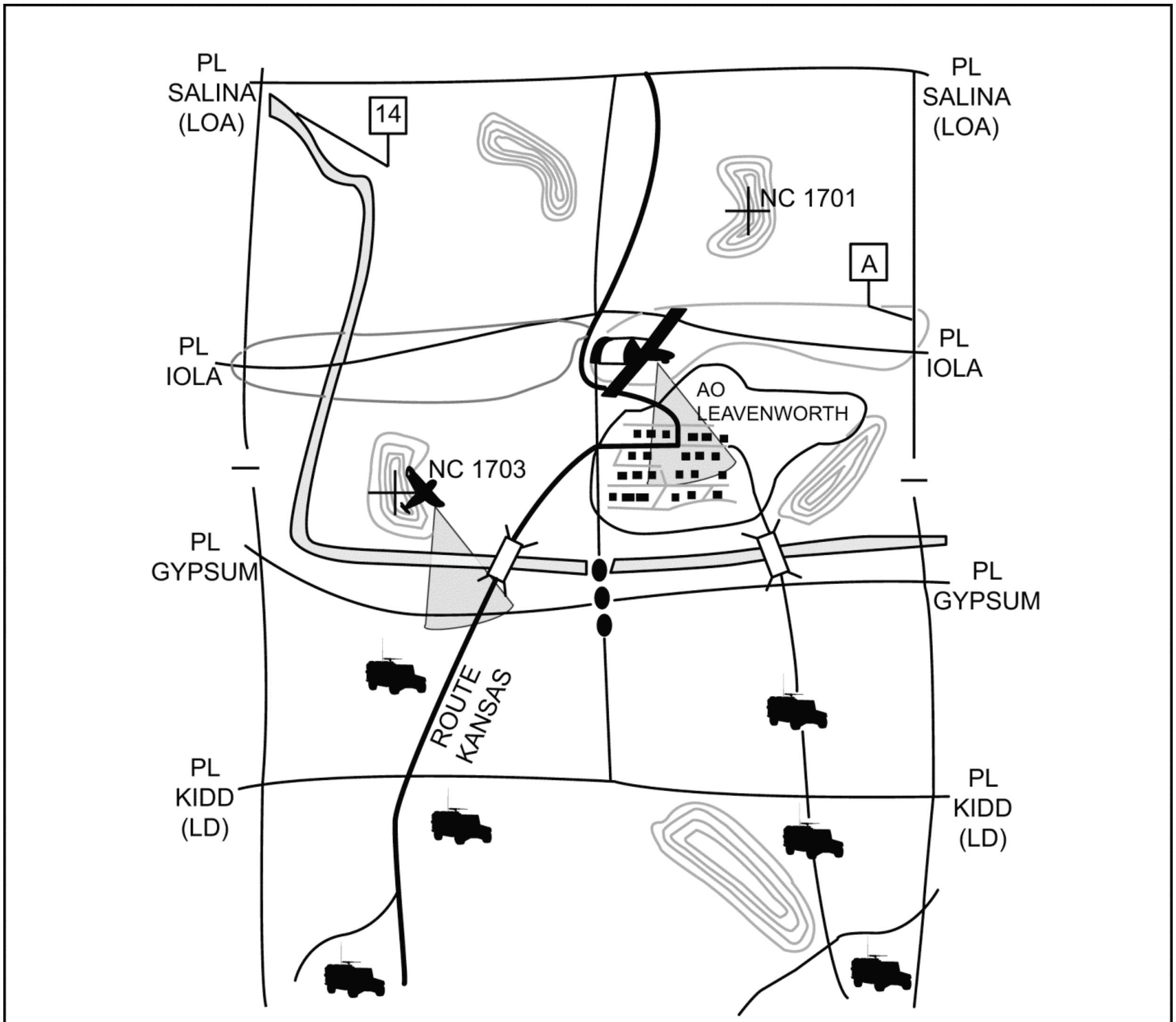
(3) High detection concern occurs when the supported unit does not desire the enemy to observe or detect the UAS from the target location.

g. Area Reconnaissance.

(1) Area reconnaissance gathers information or conducts surveillance of a specified area. Commanders designate areas to be reconnoitered by specifying boundary lines. These areas contain key terrain or other features critical to friendly operations.

(2) Area reconnaissance has permissive boundaries allowing UASs great freedom. The unit may move to and reconnoiter one large area or several small, dispersed areas. Figure 7 shows an example of an area in which a UAS conducts

reconnaissance of an NAI (i.e., the intersection of phase line Gypsum and route Kansas). The figure also shows a UAS conducting zone reconnaissance in the zone labeled “Area of Operations Leavenworth.”



Legend:
AO—area of operations
LD—line of departure
LOA—limit of advance
PL—phase line

Figure 7. Area and Zone Reconnaissance

h. Zone Reconnaissance.

(1) Zone reconnaissance involves a directed effort to obtain information concerning all routes, obstacles, terrain, and adversary forces within a zone defined by unit boundaries. The boundaries of a zone are restrictive, unlike those of an area reconnaissance. Zone reconnaissance is the most time consuming of the reconnaissance missions. UA frequently conduct this mission at long ranges from the LRS, which dictates special considerations for aircraft team employment (e.g., crew change).

(2) Reconnaissance assets normally conduct zone reconnaissance when the joint force has limited knowledge of the terrain, combat operations have altered the terrain, or the adversary situation is vague. Obstacles encountered during zone reconnaissance may be manmade or natural and include bridges, fords, and obstacles created by CBRN contamination. Supporting units should reconnoiter every route within the zone unless the supported unit directs otherwise. Lateral boundaries, a line of departure (LD), and an objective or limit of advance define the reconnaissance zone.

(3) Considerations for organizing zone reconnaissance support are the same as route reconnaissance support. However, multiple teams (i.e., manned and unmanned, airborne and ground forces) often operate simultaneously during zone reconnaissance (as depicted in figure 7). Generally, UASs operate forward of ground forces or over terrain not accessible to ground forces. In time sensitive situations, UASs perform reconnaissance alone with the understanding that the combat information obtained may be less detailed.

(4) The primary difference between zone and area reconnaissance is the nature (restrictive versus permissive) of the boundaries.

(a) Reconnaissance assets may only search within the zone during zone reconnaissance.

(b) Reconnaissance assets conducting an area reconnaissance use the area boundaries to guide their search; however, those boundaries do not limit them. This mission allows the UAS more flexibility.

i. Route Reconnaissance.

(1) Route reconnaissance is more restrictive than area or zone reconnaissance. It focuses on a specific route and adjacent terrain from which the threat may influence movement along the route. The object of the reconnaissance may be a road, axis, air route, specific line of communications, railway, cross-country mobility corridor, or general direction of advance or attack. It provides new or updated information on route conditions, such as obstacles, bridge classifications, threats, and civilian activity.

(2) The following is a list of critical tasks for route reconnaissance support.

(a) Reconnoiter all terrain that a threat can use to dominate movement along the route.

(b) Provide overwatch for ground elements, especially in built-up areas.

(c) Assess the ability to navigate the route.

(d) Locate sites for hasty obstacles that may impede movement.

(e) Reconnoiter all defilade along the route for possible ambush sites.

(f) Locate and report a bypass around built-up areas, mines, obstacles, barriers, and contaminated areas.

(g) Locate and report suitable landing sites or zones and hazards to flight (e.g., suspected adversary locations, mountainous areas, wires, large bodies of water, open terrain and other natural and manmade features).

(h) Detect and report all threats that can influence movement along the route.

(i) Detect and report suspicious items along the route.

(j) Identify existing or potential civilian use of the route.

(k) Identify the ability of a threat to deny the use of a route through civilian interference.

(l) Locate and report bridges, overpasses, underpasses, and culverts that might restrict movement.

(m) Locate and report ford and crossing sites in proximity to the route.

(n) Report route information, to include providing a sketch map, overlay, or video.

(3) Before conducting route reconnaissance support, the UAS operators must know certain information about the route. They should determine:

(a) Which reconnaissance tasks are applicable to the mission.

(b) The supported unit task organization and any reinforcements, especially engineers and supporting fires, and their relationship to the reconnaissance effort.

(c) The start point, release point, and designation of the route.

(d) Other mission support prior to and following the route reconnaissance.

(e) Mission start and end times.

(f) The critical points along the route identified as checkpoints.

(g) Intelligence preparation of the battlespace information on the route and current threat situation.

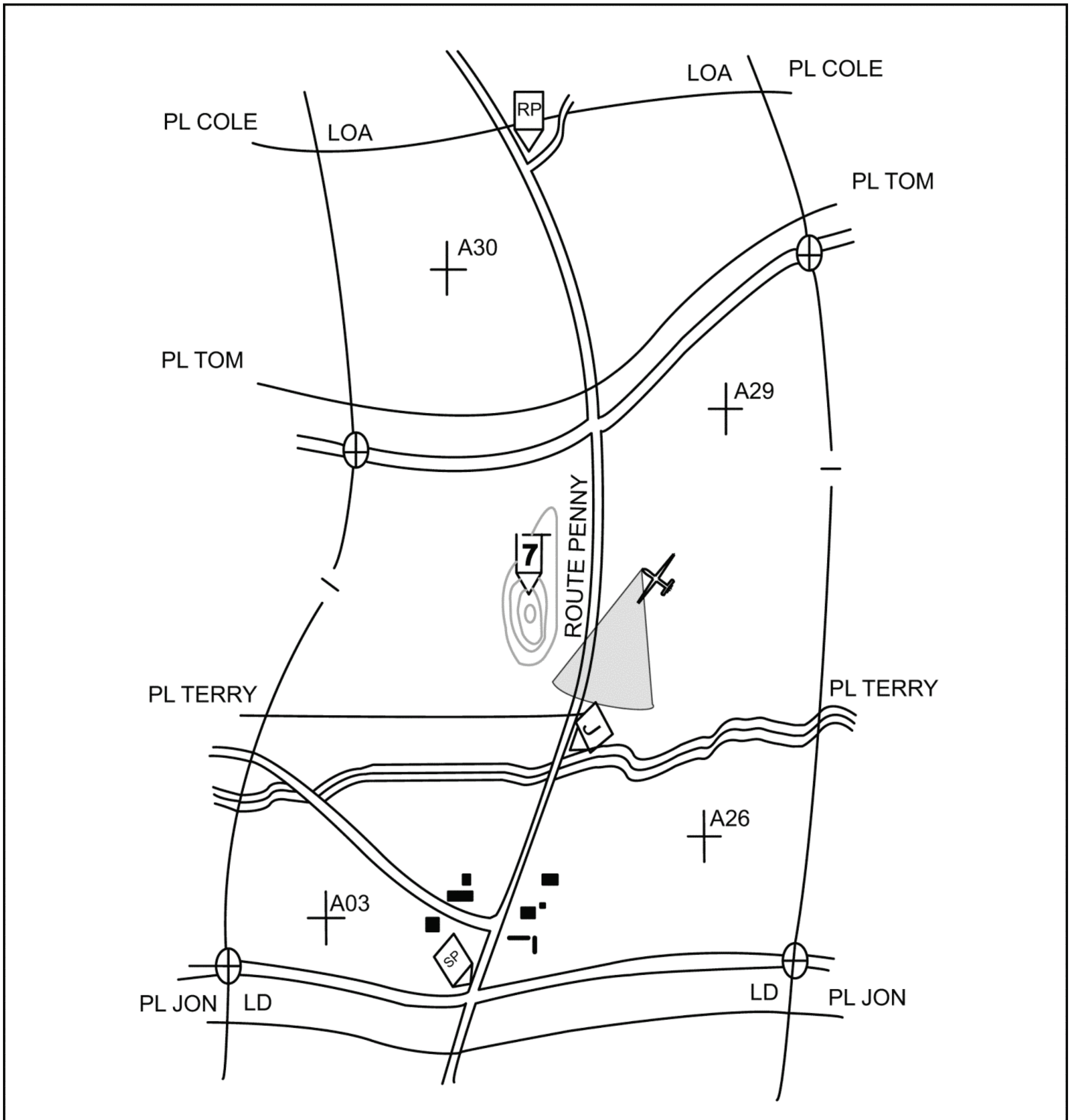
(h) Any constraints or restrictions.

(i) Expected weather conditions for the duration of the mission.

(j) The type of unit or vehicles expected to use the route, if applicable.

(k) The time of day or night the route is expected to be used, if applicable.

(4) Route reconnaissance is best accomplished by employing air and ground elements simultaneously. Ground elements gather information regarding the designated route and all adjacent terrain from which a threat may engage friendly forces with direct fires. The UASs (or manned aircraft) reconnoiter to the front, flanks, and rear providing early warning, ambush detection, and overwatch. The ground force, if available, commands the route reconnaissance. Figure 8 shows an example of a UAS conducting route reconnaissance forward of the LD.



Legend:
LD—line of departure
LOA—limit of advance
PL—phase line
RP— release point
SP—start point

Figure 8. Route Reconnaissance

5. Security Operations Support

a. Security operations provide reaction time, maneuver space, and protection to air-ground maneuver. Security operations orient on the protected assets (i.e., force, area, or facility).

b. Security operations support characteristics include:

(1) Conducting reconnaissance to reduce terrain and threat unknowns.

(2) Gaining and maintaining contact with the threat to ensure continuous information flow.

(3) Providing early and accurate information reporting to the protected force.

c. Security operations support includes supporting the conduct of a screen, guard, and cover; convoy security and aerial security (for air operations); and area security focusing on a specific geographic area. Security operations support actions include:

(1) Managing sensors to develop the situation.

(2) Maneuvering to positions of advantage.

(3) Developing and sharing the COP with members of the air-ground team.

(4) Maintaining communications with all members of the air-ground team.

(5) Applying principles of reconnaissance by gaining and maintaining contact.

(6) Conducting actions to fix, isolate, or destroy threat forces.

(7) Synchronizing fires, maneuver, and tactical assault.

d. Before conducting security support, the UAS operators must know certain information about the mission. This information includes:

(1) The time to establish security and duration.

(2) The operation schedule.

(3) The location of phase lines (if applicable).

(4) The location of ingress and egress routes (if applicable).

(5) The friendly position relative to convoy.

(6) The convoy schedule.

6. UAS Search Techniques

a. Area Targets.

(1) Rolling Box Search. UAS SOs can use rolling box patterns to search a small area surrounding a point target as depicted in figure 9. UAS sensors can scan the perimeter of a certain point of interest (POI) to locate nearby vehicles, people, and buildings. UAS crews can employ a rolling box search in the following way.

(a) Designate a significant point (such as a building, tree, or road intersection) as the center point of the area search.

(b) Slew the sensor to place the designated point at any corner of the screen.

(c) Slew the sensor slowly around the designation so that it will touch all four corners of the screen, making a box.

(2) SOs should take care to slew the sensor slowly. If the SO slews the sensor too fast, the image will not refresh fast enough, giving an unworkable picture. If the picture becomes unworkable, starting in a closer field of view (FOV), then zooming out, or switching cameras, and performing another box search may produce the desired effects.

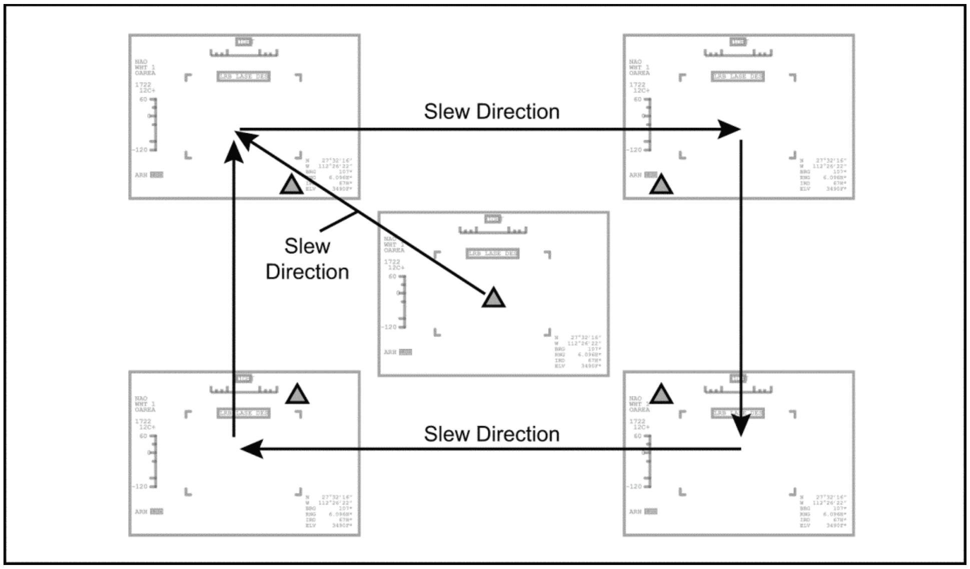


Figure 9.   Rolling Box Search

(3) Raster Scan. UAS SOs can use a raster scan to search large open areas, as depicted in figure 10. SOs most often use raster scans to determine personnel activity in an area. Some communities refer to this search pattern as a plowed field search. To perform a raster scan search:

(a) View the entire area of interest in a wide FOV.

(b) Note landmarks that will serve as lateral boundaries for the search and indicate when to stop slewing one direction and proceed in the opposite direction.

(c) Define the search area. Defining the search area as a box shape may make the search easier.

(d) Move the sensor to one corner of the area.

(e) Zoom in to a sufficient FOV.

(f) Slew the sensor in one direction until reaching the edge of the search area.

(g) Slew it up or down one full screen, depending on direction, and work back in the opposite direction. Include a slight "overlap" to ensure complete coverage of the area.

(h) Continue this motion until the area scan is complete.

(4) While performing the raster scan, search at a rate that facilitates the desired effect. Throughout the search, SOs should apply the big-to-small concept to maintain overall SA on the search progress.

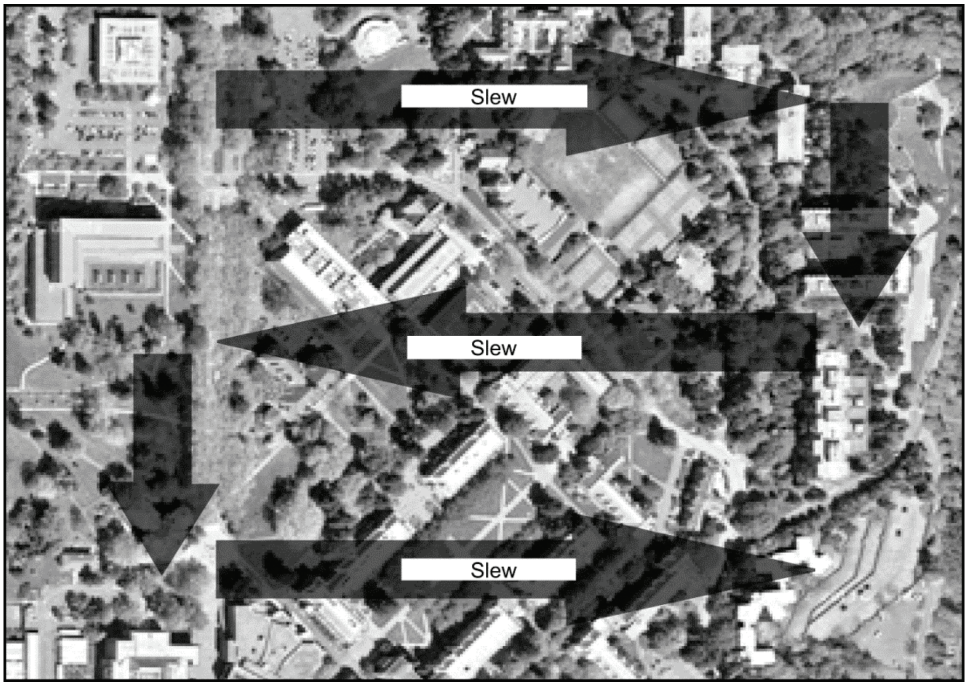


Figure 10. Raster Scan

(5) Sector Search. UAS crews use sector searches for detailed searches around a specific POI as depicted in figure 11. The main application of the search is to sanitize the area around the friendly position, out to a specific distance. The two main benefits of the sector search are that they force the SO to continuously return to the friendly location to verify status and they allow the search to focus only on the sectors that pose the most significant threat. For example, if friendlies are located east of a river but west of a populated town, the sector search can be focused to the east of the friendlies since that is the most probable direction from which a threat may come. To perform a sector search, the crew should:

(a) Determine the distance to scan from the POI (e.g., 500 or 1,000 meters).

(b) Select an appropriate FOV for the target.

(c) Scan in the direction towards the most probable threat.

(d) Continue to scan until reaching the preplanned distance.

(e) Shift one screen width or height in the appropriate direction, and begin working the sensor back to the POI.

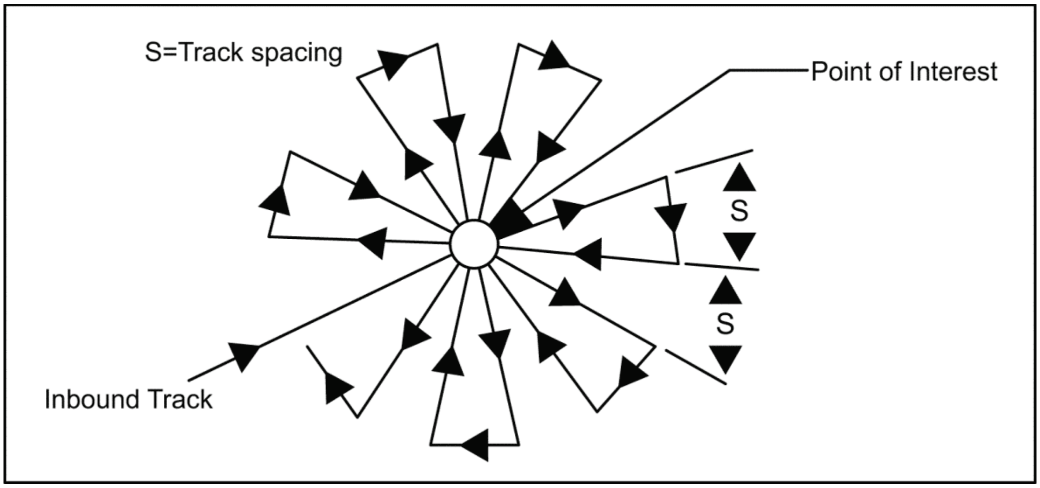


Figure 11. Sector Search

b. Point Targets. UA operators should consider using all cameras and at least one 360-degree scan of the target to meet the EEIs. High depression angles (i.e., closer to the target) may produce higher quality images but may not be appropriate to detect targets. Lower depression angles will allow vertical features to stand out (e.g., wall heights, entrances, or exits). Depending on winds, the UAS crew can fly a 360-degree pattern around the target or hold in a specific sector using a wheel, figure-8 pattern, or dogbone orbit.

(1) Wheel. A circular pattern oriented directly over the target area as depicted in figure 12. Wheel holding is optimal in low-threat environments and when SOs require or desire a 360-degree view of an area.

(a) Advantages. Wheel holding is easy to fly and the area of interest is always on the UAS's left or right. This pattern facilitates quick weapons employment for armed UAs. The wheel also allows for a 360-degree view of the target, building SA on the entire target area.

(b) Disadvantages. In wheel holding, the orientation of the target is always changing. Targets requiring a specific look angle may preclude the use of a wheel pattern. This pattern can be risky in a medium- to high-threat environment due to its predictability and tendency to be close to the target.

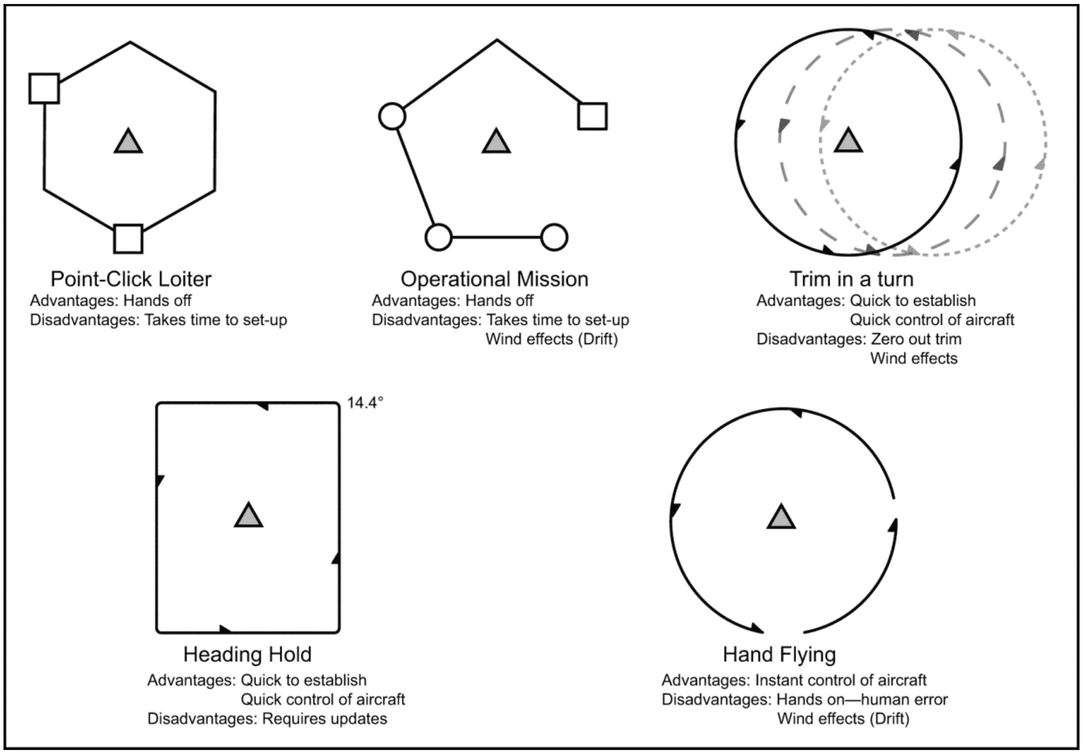


Figure 12. Wheel Holding Patterns

(2) Figure-8. UAS crews typically use figure-8 holding when the geographic borders or terrain are limiting or when they desire or require a specific look angle. The figure-8 pattern is optimal in a medium- to high-threat environment. The pattern consists of overflight of a point away from the target area with turns into it, as depicted in figure 13.

(a) Advantages. Figure-8 holding allows for a consistent look angle throughout maneuvering. It also minimizes exposure to a threat collocated with the target.

(b) Disadvantages. This pattern makes the UA predictable. Additionally, turning away from the target can increase the probability of detection.

(c) Sensor Masking. Sensor masking occurs when a portion of the UA body blocks the sensor LOS with the target. The figure-8 pattern typically minimizes sensor masking for most UASs. Although conducting turns toward the target minimizes the potential for the UA's tail to mask the sensor, the wings could mask it.

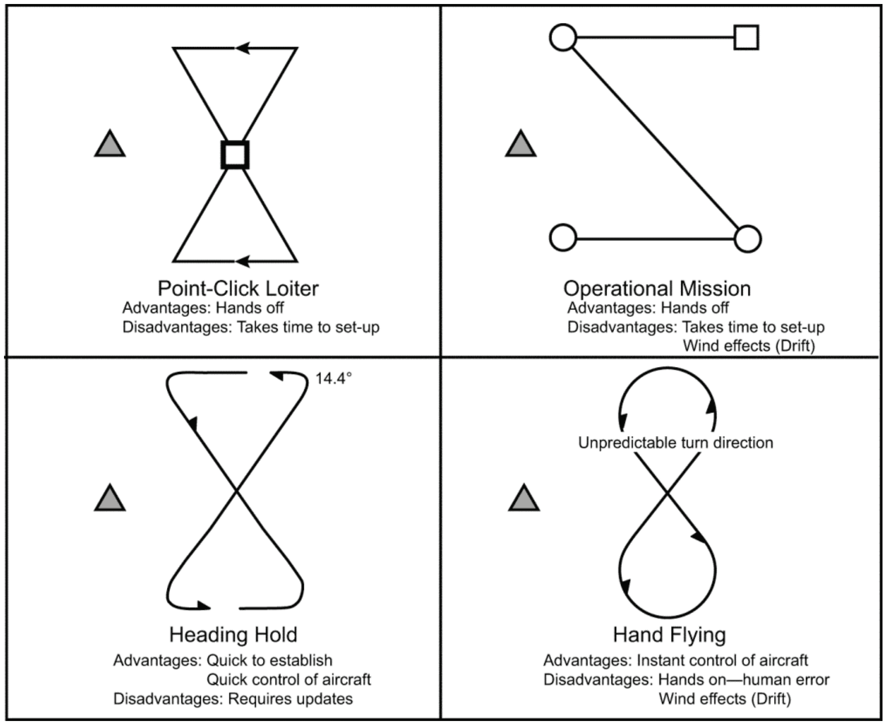


Figure 13. Figure-8 Holding Patterns

(3) Dogbone. UAS crews typically use dogbone patterns when geographic borders or terrain limits airspace or they desire to maintain quick weapons employment capability. They fly the dogbone pattern at a desired distance from the target area with turns into the target as shown in figure 14.

(a) Advantages. Dogbone holding allows for a consistent look angle throughout maneuvering as well as allows for extended periods of wings level flight. It also minimizes exposure to a threat co-located with the target.

(b) Disadvantages. This holding method is predictable.

(c) Sensor Masking. Sensor masking can be minimized in the dogbone pattern. While using turns into the target may minimize the potential for the UA's tail to mask the sensor, the wings could mask the sensor during the turns. In general, this pattern minimizes sensor masking for most UASs.

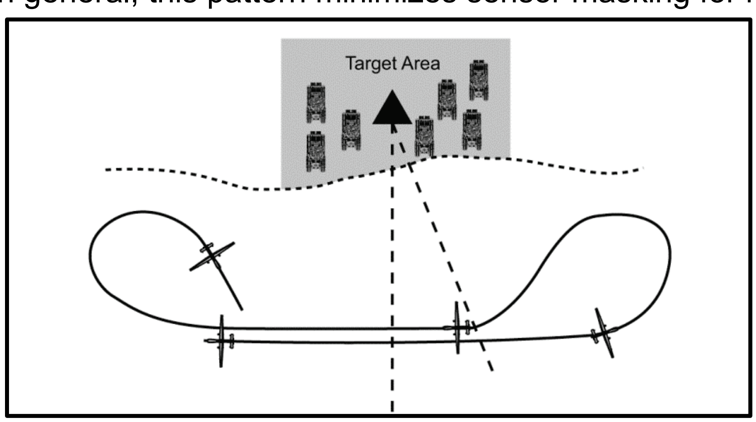


Figure 14. Dogbone Holding Pattern

c. Moving Targets. Group 1 UASs with fixed cameras are poorly suited for moving target tracking. Fixed camera assets, like the Raven B DDL, require a proficient operator to maintain continuous contact with a moving target through constant left hand turns and precise wind corrections. More capable Group 1 UASs, like Puma DDL and Raven DDL, may follow slow moving vehicles more successfully. A slow UAS may need to fly parallel to the moving target, where a faster UAS can circle around a moving target using a wheel or S-turn as shown in figures 15 and 16.

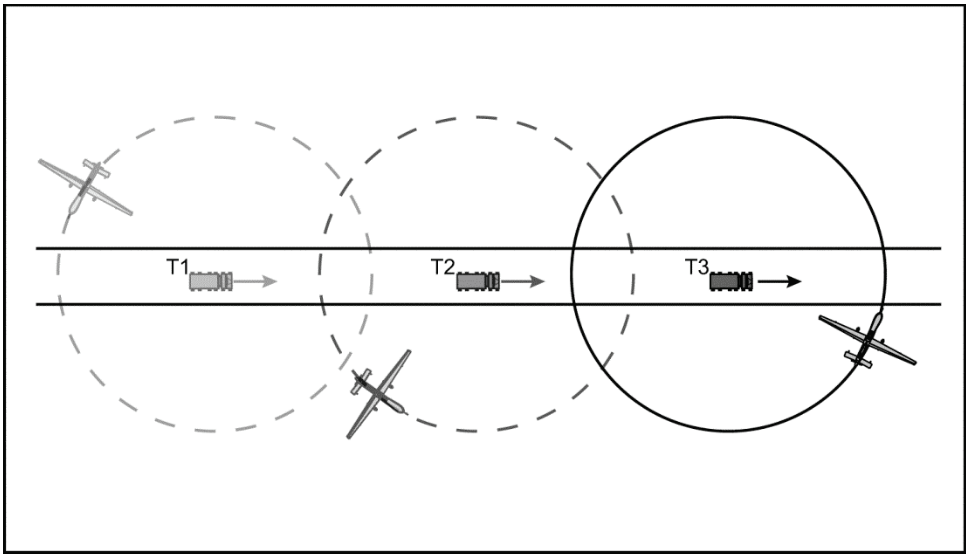


Figure 15. Moving Target Wheel Pattern

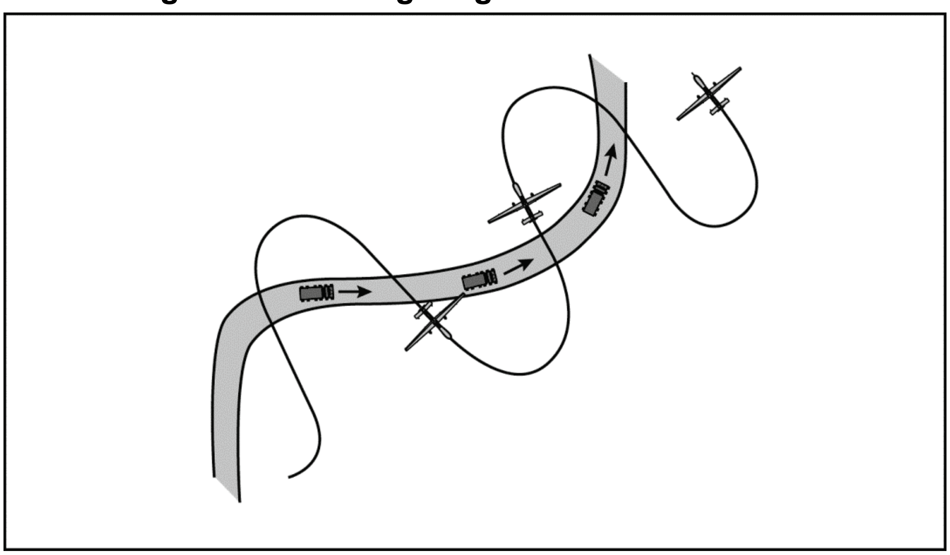


Figure 16. Moving Target S-turn Pattern

d. Whisper Pass (or Covert) Approaches. These tactical flight procedures enable a UAS crew to approach a target for increased video resolution without increasing the risk of detection in the vicinity of the target. This procedure can yield a higher detailed picture. The crew must consider the entry and egress altitudes, directions, and winds. An altitude block is required because the pilot or operator reduces power and glides in a straight line or spirals closely around the target without exceeding the limitations of the imagery payload. A spiral requires more altitude. The crew must egress the target area with adequate time to add power for the level off and not alert the target with engine or motor noise. Figures 17 and 18 depict straight line and spiral whisper passes.

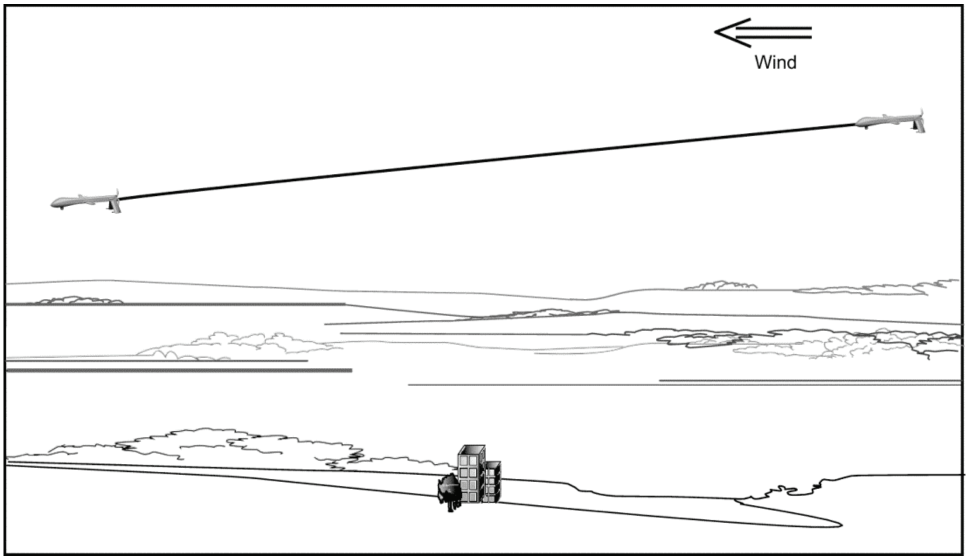


Figure 17. Straight Line Whisper Pass

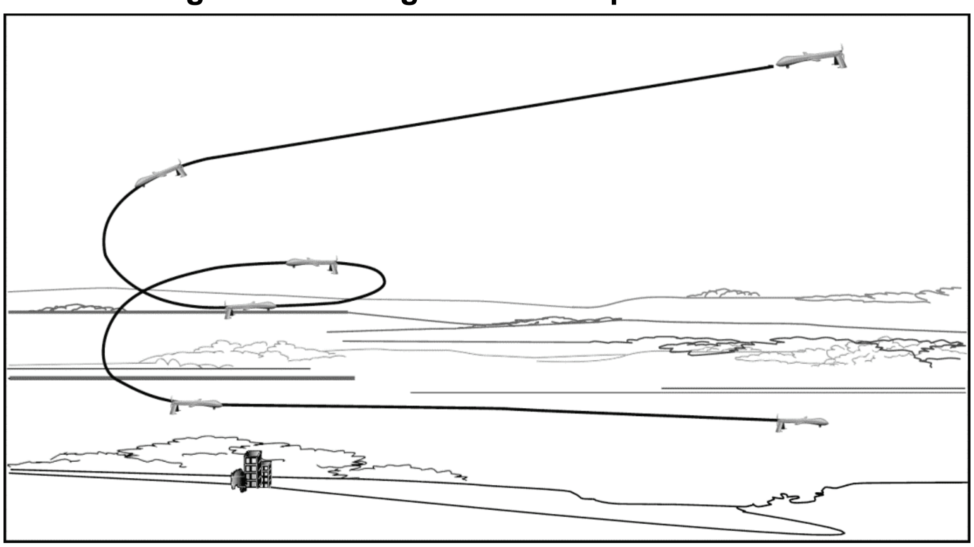


Figure 18. Spiral Whisper Pass

7. Information Exchange

a. Standard communications enable information exchange by establishing common formats and terms. All participants in UAS missions should use formats and terms set forth by joint publications, multi-Service manuals, and published standard operating procedures. Due to the significant connectivity available to UAS crews, tactical chat systems often play a significant role in information exchange during UAS operations. The following JPs, Army tactical publications (ATPs), Marine Corps reference publications (MCRPs), Navy tactic, techniques, and procedures (NTTPs), and Air Force tactics, techniques, and procedures (AFTTPs) are good resources for standard formats and terms relating to UAS missions.

(1) JP 1-02, *Department of Defense Dictionary or Military and Associated Terms*.

(2) ATP 1-02.1/MCRP 3-25B/NTTP6-02.1/AFTTP 3-2.5, *Multi-Service Brevity Codes.*

(3) ATP 6-02.73/MCRP 3-40.2B/NTTP 6-02.8/AFTTP 3-2.77, *Multi-Service Tactics, Techniques, and Procedures for Tactical Chat in Support of Operations.*

(4) JP 3-09.3, *Close Air Support*.

(5) JP 3-30, *Command and Control for Joint Air Operations*.

(6) JP 3-52, *Joint Airspace Control*.

b. Pre-mission Phase.

(1) Effective mission execution depends on the UAS crewmembers' understanding of the ground force commander's operation and their role in its execution. Specifically, UAS operators should understand the tactical situation and the commander's intent to effectively support the ground mission. The crew should achieve this understanding prior to the UA arriving on station. The supported unit requires a thorough understanding of specific UAS capabilities to make sound tactical decisions when integrating UAS support into their operations. Standardized coordination during the pre-mission phase facilitates and guides operators in providing the minimum information exchanges required to gain this understanding.

(2) For the supporting unit to be effective, the supported unit's pre-mission information exchange should adequately convey their task, purpose, and end state. It should include the supporting unit's assigned tasks and responsibilities. The following list contains the recommended pre-mission information elements that the supported unit should pass to the supporting unit.

(a) Commander's intent.

(b) Operations and objective.

(c) Supporting unit's tasks, purpose, and end state.

(d) Sensor start point.

(e) Start time.

(f) Detection concerns and required standoff.

(g) Mission plans and SPINs.

(h) Maneuver graphics.

(i) Target graphics.

(j) Unit designator and call sign.

(k) JTAC call sign and frequency.

(l) ISR tactical controller call sign and contact information.

(m) Video downlink method.

(n) Primary and secondary contact method.

(o) RF.

(p) Phone number.

(q) Email address.

(r) Tactical chat room and handle.

(s) Additional remarks and planning factors.

(3) The supported unit should know and understand the supporting unit's designation, contact method, ATO mission, and aircraft and payload capabilities. The following list contains the recommended information elements the supporting unit should pass to the supported unit.

(a) Aircraft callsign.

(b) Supporting unit's name.

(c) Primary and secondary contact method.

(d) RF.

(e) Phone number.

(f) Email address.

(g) Tactical chat room and handle.

(h) Post-mission report destination.

(i) Start time.

(j) Play time.

(k) Video downlink.

(l) Non-ordnance payload.

(m) FMV capability.

(n) EO capability.

(o) IR capability.

(p) Laser pointer capability.

(q) IR pointer capability.

(r) Laser range finder or laser target designator capability.

(s) Communications relay capability.

(t) SIGINT collection capability.

(u) Ordnance load.

(v) Other capabilities.

(w) Additional remarks and planning factors.

(4) The pre-mission coordination phase ends when the UAS arrives on station. Both participants should continue to exchange this data during the mission if mission changes require updates or clarification. Ultimately, conducting proper preparation and coordination prior to the UA arriving on station increases the effectiveness of the UAS during the execution phase.

c. Execution Phase.

(1) By following the techniques and procedures outlined in the previous section, the supporting unit should have a basic understanding of the supported unit's operation. The UAS crew also should understand their tasks, roles, and

responsibilities. Additionally, the supported unit should know the supporting UAS capabilities, including FMV downlink frequency or stream location, and how to contact the supporting unit. To leverage the UAS crew members' expertise in employing their platform's capabilities, they should be aware of all essential pre-mission information and request updates concerning operational conditions or parameters as they evolve during the operation.

(2) As the mission transitions to the execution phase, the focus shifts to all players gaining and maintaining SA to support rapid adaptation to changing operational conditions. The coordination procedures and techniques described in this section will allow the supported and supporting units to synchronize mission related information, optimize UAS placement and sensor management, and utilize the information available on their COP.

(3) The mission execution phase typically begins with the supporting unit checking in with the supported unit. The check-in updates the supported unit on UAS status and pre-mission coordination plan changes. Table 4 provides a common check-in brief format.

Table 4. UAS Check-in Brief
Call Sign "__________________"
Mission Number "__________________"
Number and Type of Aircraft "__________________"
Position and Altitude "__________________"
Ordnance "__________________"
Playtime or Time on Station "__________________"
Capabilities "__________________"
Abort Code "__________________"

(4) A situation update is the first opportunity for the supported unit to relate the pre-mission information exchanged to the current tactical situation. It is a critical portion of the information exchange. Effective UAS support depends on the supporting unit's ability to understand the dynamic environment, priorities, and tasks. The supported unit's situation update provides the basis for this understanding.

(5) For preplanned missions, the situation update provides the current area of interest, location information, and airspace coordination as the UA arrives on station. The situation update serves as a guide to provide critical information in a succinct and complete manner for changing mission conditions. Also, it is useful when a UAS receives dynamic tasking airborne, where the pre-mission phase is abbreviated or absent. The situation update amplifies information previously passed during the pre-mission phase. The supported unit will provide a situation update to the supporting unit at the beginning of the mission execution phase. The situation update should include the following elements:

(a) Enemy situation.

(b) Detection concerns.

(c) Friendly situation.

(d) Mission plans.

(e) Operational updates.

(f) Location.

(g) Tasks.

(h) Graphics.

(i) EEIs.

(j) Target names and identifiers.

(k) Additional target updates.

(l) Sensor deconfliction plan.

(m) Primary and secondary contact method.

(n) RF.

(o) Phone number.

(p) Email address.

(q) Tactical chat room and handle.

(r) Flight hazards.

(s) Additional remarks and mission details.

(t) Transition point for the post-mission phase.

(6) The mission execution phase ends when the UAS completes the mission or receives alternate tasking. Coordination during the mission execution phase is essential to maximizing mission success. Using standardized coordination techniques, including the checklists discussed, allows the supported and supporting units to gain and maintain SA throughout the mission.

d. Post-mission Phase.

(1) The mission is complete once all parties participate in the debrief. Commanders, planners, and analysts require post-mission data for current and future operations. Thorough debriefing is critical especially for joint UAS missions because they support future integration. Due to the potential for multiple crew swaps throughout a UAS mission, when able, debriefing should occur prior to any crew changes at the GCS or supported unit.

(2) By following the procedures and techniques discussed in this section, the supported and supporting units will collect mission results, identify significant issues that influenced mission execution, and receive and relay effective feedback. This section stresses the importance of accomplishing effective debriefs, completed IAW unit standard operating procedures.

(3) Post-mission Feedback.

(a) The core objective of the post-mission phase is to collect mission-focused feedback. However, opportunities for immediate feedback are available throughout all phases of the UAS mission. All participants share the responsibility to request feedback to address any questions or issues.

(b) Each participant in a UAS mission should record mission-specific information. Mission reports (MISREPs), intelligence summaries (INTSUMs), post-mission summaries, and after action reports (AARs) are tools used for post-mission communications. Although they take the form specified by unit, theater, and Service directives, they all provide similar essential feedback information to all participants.

(c) The supporting unit uses the MISREP to capture significant mission information, such as results and issues. The JFACC, or next higher HQ, typically define specific formatting instructions for this report.

(d) Post-mission debriefs should inform all INTSUMs or AARs. This information is valuable because it captures lessons learned for application in future operations.

(4) Archiving and Exchanging Post-mission Feedback.

(a) The supported and supporting units must synchronize the post-mission feedback processes to ensure efficient and timely exchange of mission results. Timely feedback is essential to avoiding repeated mistakes. Because most UAS missions end before the supported unit's operation is complete, all participants should provide feedback prior to UAS checkout. The supported and supporting units should proactively share operational feedback. Specific information items required to capture and disseminate the effectiveness of UAS supported missions include:

- Supported unit identifier.
- Supporting unit identifier.
- Operation or objective.
- Date and time of the operation or objective.
- Determination of whether or not the commander's mission intent was met.
- If the UAS task, purpose, and end state were achieved.
- If EEIs were satisfied.
- Where the storyboard and AAR will be available.
- How to retrieve feedback items if archived.
- Immediate mission results.
- Other operational feedback (e.g., identified enemy TTP).
- Additional remarks and mission details.

(b) Post-mission feedback provides the supported unit with a tool to accurately assess and convey the supporting unit's overall effectiveness. It informs the supporting unit of the results or impacts of the reported operation and objective. Supported and supporting units can effectively standardize post-mission information exchanges by passing these items, enhancing the flow of key information relating to mission impact and assessing mission results. Additionally, this process presents the supported unit with an opportunity to offer and receive constructive operational feedback, promoting higher levels of effectiveness in future operations.

(c) The supported unit should provide additional or clarifying feedback as soon as possible after the mission. It is most valuable within 24–48 hours after the UAS completes the mission to ensure the information provided is timely and relevant.

(d) All units should archive post-mission results and debriefs since this information is essential for developing best practices and issuing mitigation strategies for future operations. It is vital that the supporting and supported units keep open lines of communication relating to past mission details. It is a good practice for supported and supporting units to know where they have archived mission data so that they can easily retrieve and share it.

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Appendix A
SPECTRUM MANAGEMENT

1. Frequency Management

Tables 5, 6, and 7 and figures 19 and 20 depict the typical unmanned aircraft system (UAS) usage of specific spectrum bands. Each column (in table 5) provides examples of other entities competing for spectrum in the operational environment. These entities may be useful to help identify or troubleshoot interference issues.

Note: The data presented in this appendix is not all-inclusive and is presented as a guide only. Spectrum usage restrictions will vary by country; therefore, coordination and approval are required prior to use in the intended operating area.

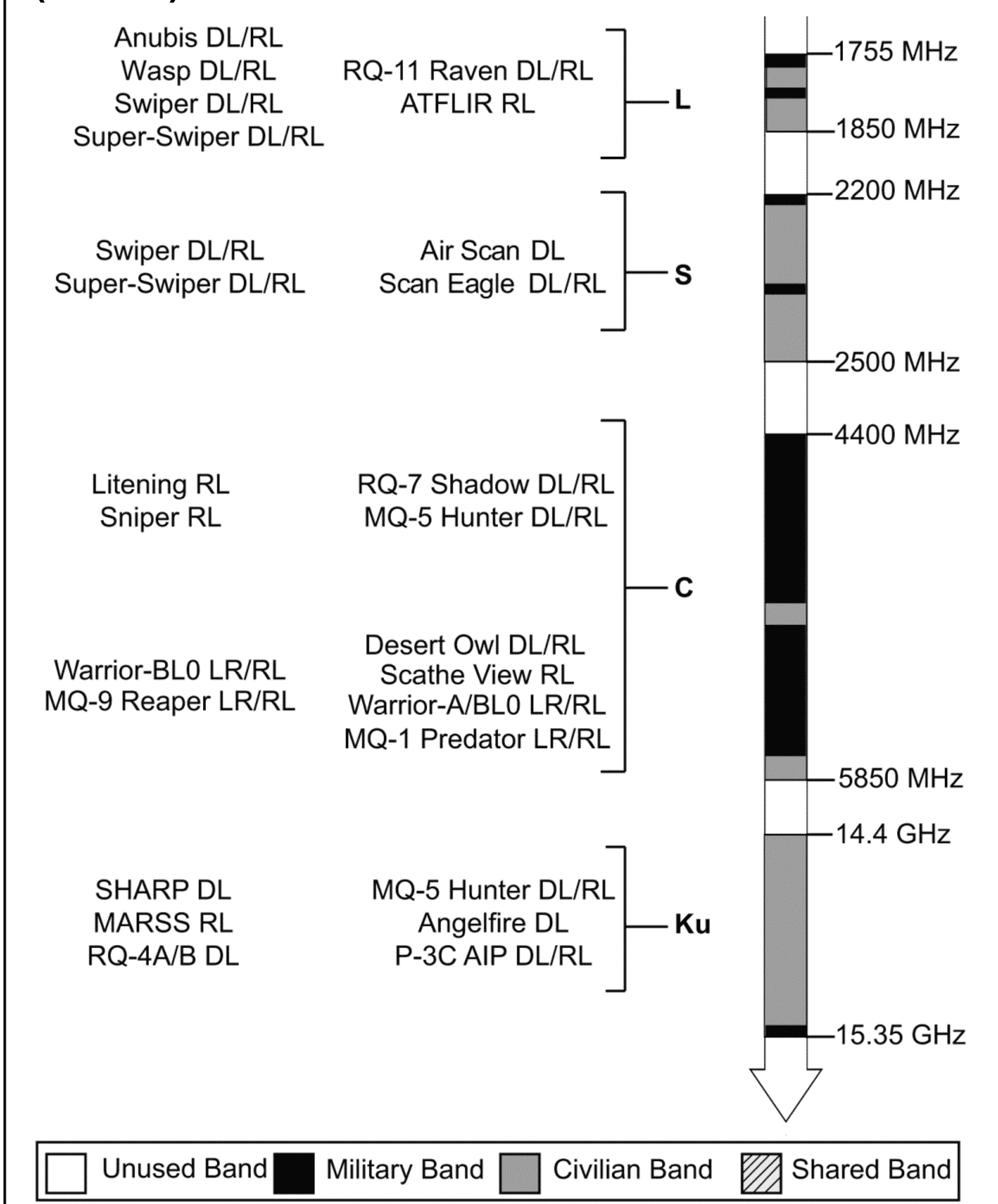
Table 5. Spectrum Bands of Interest (FOUO)

Frequency Band	225-380 MHz	380-399 MHz	406-430 MHz	430-449 MHz	902-928 MHz
Military Use	• Air-to-ground and air–to-air communications • Mobile tactical satellite • Line–of-sight communication links • Shadow C2 • ATC communications • Handheld radios • FPASS perimeter security • Fire Scout C2 • CQ-10 WSADS • Coalition small UASs C2 • Electrical distribution system	• Handheld radios • FPASS Perimeter security • Shadow C2 • Fire Scout C2 • CQ-10 WSADS • Coalition small UAS C2 • Electrical distribution system	• Handheld radios • Airborne personnel recovery aids • EPLRS based BFT and FFT	• EPLRS based BFT • Airborne personnel recovery aids	• Tigershark C2 • Tactical mini UAV C2 • PTDS telemetry
Civilian Usage and Other Services	• Long range, cordless phones • TETRA mobile radio • Aero radio navigation	• TETRA mobile radio	• Land mobile radio for civilian infrastructure • Personal mobile radios • WLL	• Radio • WLL • Land mobile radio for civilian infrastructure • Mobile radios	• GSM mobile phones operating in 870-960MHz

Table 5. Spectrum Bands of Interest (FOUO) (Cont'd.)					
Frequency Band	**1700–1850 MHz**	**2200–2500 MHz**	**4400–4999 MHz**	**5250–5475 MHz**	**5625–5850 MHz**
Military Use	• Pacwind • A/C video DL • Puma DDL C2 • Raven DDL C2 • Wasp AE C2 • Eagle eye • Raven C2	• Pacwind transceivers • MARSS • Shadow C2 • Scan Eagle video • A/C video DL • EOD Robots • COTS wireless networking devices	• Shadow video • Hunter video and C2 • Long range network links • Relay links for video surveillance	• Predator video • Reaper video • Shadow video • ASR radar • Remote control vehicles • COTS wireless networking devices	• Predator C2 • Reaper C2 • COTS wireless networking devices
Other usage and other services	• GSM mobile phones • WLL		• Commercial microwave	• Radio navigation • Space research	• Commercial satellite • WIMAX Broadband data

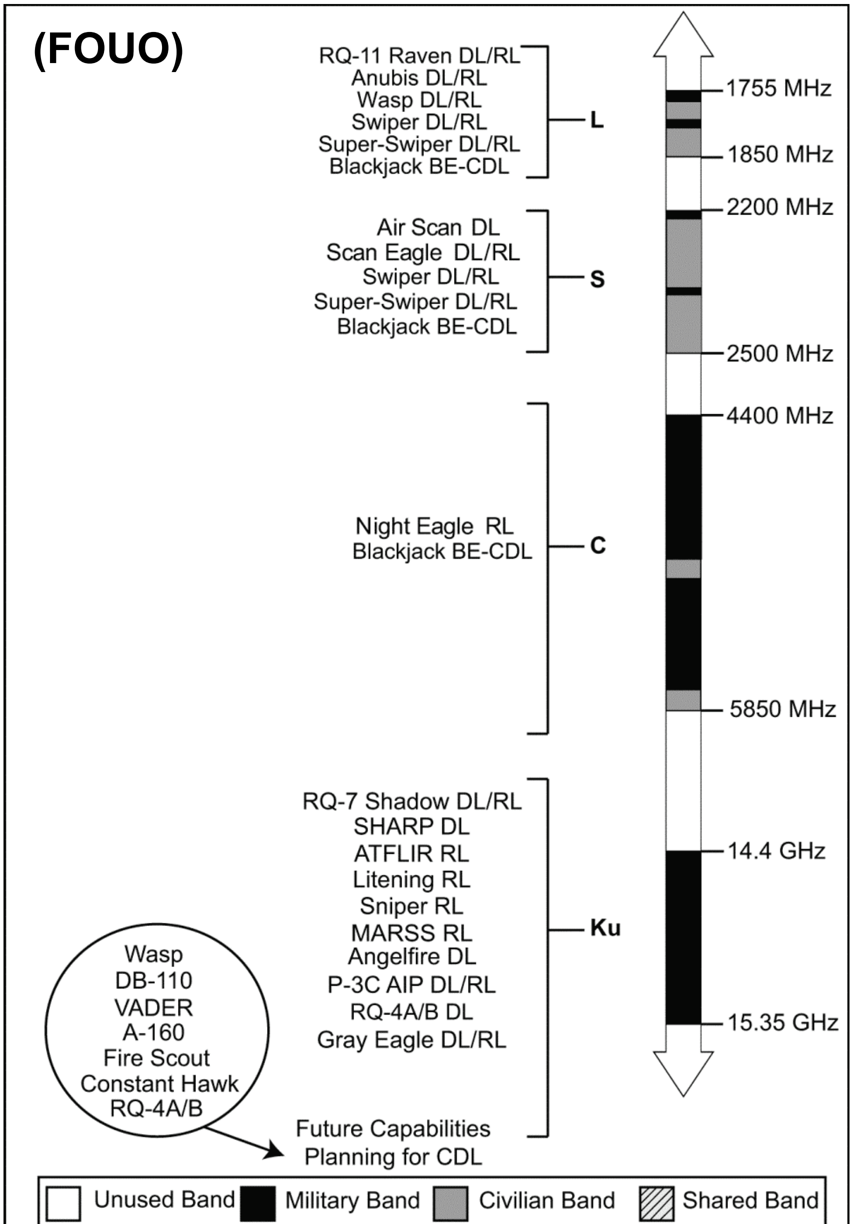
Legend:
A/C—aircraft
AE—all environment
ASR—air surveillance radar
ATC—air traffic control
BFT—blue force tracking
C2—command and control
COTS—commercial off-the-shelf
DL—downlink
DDL—digital downlink
EOD—explosive ordnance disposal
EPLRS—enhanced position location reporting system
FFT—friendly force tracking
FPASS—force protection airborne surveillance system
GSM—global system mobile
MARSS—medium altitude reconnaissance and surveillance system
MHz—megahertz
PTDS—persistent threat detection system
TETRA—terrestrial trunked radio
UAS—unmanned aircraft system
UAV—unmanned aerial vehicle
WIMAX—worldwide interoperability for microwave access
WLL—wireless local loop
WSADS—wind supported aerial delivery system

(FOUO)



Legend:
AIP—antisurface warfare improvement programs
ATFLIR—advanced targeting forward looking infrared
DL—downlink
GHz—gigahertz
MARSS—Medium Altitude Reconnaisance and Surveillance System
MHz—megahertz
SHARP—Stationary High Altitude Relay Platform
RL—return link

Figure 19. Spectrum Usage for Aircraft Data Links



Legend:

AIP—antisurface warfare improvement programs
ATFLIR—advanced targeting forward looking infrared
BE-CDL—bandwidth efficient command data link
CDL—command data link
DL—downlink
GHz—gigahertz
MARSS—Medium Altitude Reconnaisance and Surveillance System
MHz—megahertz
SHARP—Stationary High Altitude Relay Platform
RL—return link
VADER—vehicle and dismounted exploitation radar

Figure 20. Spectrum Usage for Data Links with Transition to Common Data Link

Table 6. United States (US) UAS Line of Site Data Link Table (FOUO)					
Group	**Name**	**MDS**	**Frequency Ranges**	**Data Link Format**	**Proposed Format**
1	T-Hawk/gMAV	RQ-16	4400–5000 MHz	DDL-compliant	SUAS-DDL
	Puma	RQ-20A	1625–1850 MHz	SUAS-DDL	SUAS-DDL
	Raven	RQ-11B	1625–1725 MHz 1755–1850 MHz	SUAS-DDL	SUAS-DDL
	Wasp	RQ-12A	1625–1850 MHz	SUAS-DDL	SUAS-DDL
2	Scan Eagle	Not applicable	1350–1390 MHz 1750–1850 MHz 2200–2500 MHz	Proprietary TACT 1.6, 3.2, 6.4	SUAS-DDL
3	Blackjack	RQ-21A	1350–1390 MHz 1750–1850 MHz 2200–2500 MHz	Proprietary TACT 1.6, 3.2, 6.4	
	Shadow	RQ-7Bv1	4400–4950 MHz 5250–5850 MHz	S Band	BE-CDL
	Shadow	RQ-7Bv2	15.0 GHz	T-CDL	BE-CDL
4	Gray Eagle	MQ-1C	4400–5850 MHz	T-CDL	BE-CDL
	Fire Scout	MQ-8B	14.4–15.35 GHz	T-CDL	BE-CDL
	Humming Bird	YMQ-18A	14.4–15.35 GHz	T-CDL	BE-CDL
	Hunter	MQ-5B	4400–5850 MHz 14.4–15.35 GHz	T-CDL	BE-CDL
	K-Max	Not applicable	4800–5850 MHz 14.4–15.35 MHz	C-Analog T-CDL	C-Analog BE-CDL
	Predator	MQ-1B	5250–5850 MHz 14.4–15.35 GHz	Proprietary	T-CDL BE-CDL
	Viking 400	Not applicable	Up link 2200–2400 MHz, Down link 1710–1850 MHz	Enerdyne Proprietary	PPDL
5	Triton	MQ-4C	14.4–15.35 GHz	T-CDL	BE-CDL
	Global Hawk	RQ-4B	14.5–15.35 GHz	CDL	BE-CDL
	BAMS-D	RQ-4A	8–12.5 MHz 14.4–15.35 MHz	CDL T-CDL	No Change Planned
	Reaper	MQ-9	4400–5850 MHz 14.4–15.35 MHz	Proprietary	T-CDL BE-CDL

Legend:
BAMS-D—Broad Area Maritime Surveillance Demonstrator
BE—bandwidth efficient
CDL—common data link
DDL—digital data link
GHz--gigahertz
MDS—mission design series
MHz—megahertz
PPDL—Predator proprietary data link
SUAS—small unmanned aircraft system
T—tactical

Table 7. US Frequency Bands	
Band	**Frequency Ranges**
L Band	1000–2000 megahertz (MHz)
S Band	2000–4000 MHz
C Band	4000–8000 MHz
X Band	8000–12000 MHz
Ku Band	12000–18000 MHz
Ka Band	26500–40000 MHz

2. Remotely Operated Video Enhanced Receiver (ROVER)

a. (FOUO) ROVER III. ROVER III provides real-time, full motion video for situational awareness (SA), targeting, battle damage assessment (BDA), surveillance, convoy operations, and other situations where eyes on target are required. ROVER provides enhanced air-to-ground coordination and shortens talk-on-target for time-critical operations. It has interoperable data links in the Ku-, C-, and L-bands with platforms such as Predator and Shadow. ROVER is small, lightweight, and rugged. The following list provides the ROVER III technical characteristics:

(1) Range: Based on environmental conditions and terrain features.

(2) Weight: Total system weight is 10.25 pounds (lbs).

(3) (FOUO) RF: Ku = 14.4 gigahertz (GHz) to 15.35 GHz, 5.0 megahertz (MHz) steps.

(4) (FOUO) L = 1.71 GHz to 1.85 GHz, 0.5 MHz steps.

(5) (FOUO) C Analog = 4.40 GHz to 5.85 GHz, 1.0 MHz steps.

(6) (FOUO) C Digital = 5.25 GHz to 5.85 GHz, 1.0 MHz steps.

(7) (FOUO) Power: Single 5590 battery 10–12 hour operations.

(8) Battery eliminator allows direct current (DC) or alternating current (AC) input.

(9) (FOUO) 11-36 voltage DC, 95-270 voltage AC, 47-440 hertz (Hz).

(10) Video display software—moving picture experts group (MPEG)-2- H.261.

(11) Analog or digital video recorder (DVR) with standard Windows Media Video (WMV) file format.

(12) (FOUO) Integrated MPEG-2 H.261 decoder, wireless access point 802.11 b/g.

(13) Allows untethered operation video display, ruggedized laptop via Ethernet.

(14) (FOUO) National Television Standards Committee (NTSC)/RS-170 video port-directional C-band antenna for increased range.

b. (FOUO) ROVER 4. ROVER 4 provides real-time, full motion video for SA, targeting, BDA, surveillance, and other situations where eyes on target are required. ROVER 4 provides enhanced air-to-ground coordination, which shortens talk-on-target for time-critical operations. It is interoperable with data links in Ku-, C-, S-, and L-bands with platforms such as Predator, Shadow, Dragon Eye, and Litening Pod. ROVER 4 is small, lightweight, and rugged. It comes as a complete, ready-to-use system housed in a rugged transit case, including antennas, cables, video displays, recording capabilities, and a wireless access point. The following list provides the ROVER 4 technical characteristics:

(1) Range: Based on environmental conditions and terrain features.

(2) Weight: Total system weight 48 lbs.

(3) (FOUO) Ku-band Digital: 14.4 GHz to 15.35 GHz, 5.0 MHz steps.

(4) (FOUO) C-band Digital: 5.25 GHz to 5.85 GHz, 1.0 MHz steps.

(5) (FOUO) C-band Analog: 4.40 GHz to 5.85 GHz, 1.0 MHz steps.

(6) (FOUO) L-band Analog: 1.71 GHz to 1.85 GHz, 0.5 MHz steps.

(7) (FOUO) S-band Analog: 2.30 GHz to 2.5 GHz, 1.0 MHz steps.

(8) (FOUO) Power: Single 5590 battery 10–12 hour operations.

(9) Battery eliminator allows DC or AC input.

(10) DC vehicle accessory power plug cable.

(11) Video display software:

(a) MPEG-2.

(b) MPEG-4.

(c) H.261.

(d) Analog.

(12) Control graphical user interface (GUI):

(a) Pre-mission configuration.

(b) Automatic frequency acquisition.

(c) Software configurable.

- Waveform.
- Band and frequency.
- Video protocol.

c. (FOUO) ROVER 5. ROVER 5 is a small, lightweight, and rugged software defined radio which provides a digital capability for full motion video, SA, targeting, BDA, surveillance, and other situations where eyes on target are required. ROVER 5 provides enhanced air-to-ground coordination, which shortens talk-on-target for time-critical operations. ROVER 5 can operate with encryption. Because ROVER 5 is a versatile, software defined radio, it is forward compatible through easily loadable upgrades for radio and video codecs. ROVER 5 is also backward compatible and interoperable with the thousands of ROVER III, eROVER, and ROVER 4 units fielded to date; as well as the platforms they support, such as Predator, Shadow, Dragon Eye, and Litening Pod. The following list provides the ROVER 5 technical characteristics:

(1) Range: Based on environmental conditions and terrain features.

(2) Weight: Total system weight 3.5 lbs.

(3) (FOUO) Ku-band: 14.4 to 15.35 GHz, 1.0 MHz steps.

(4) (FOUO) C-band: 4.40 to 4.950 GHz, 1.0 MHz steps.

(5) (FOUO) 5.25 to 5.85 GHz, 1.0 MHz steps.

(6) (FOUO) S-band: 2.2 to 2.5 GHz, 0.5 MHz steps.

(7) (FOUO) L-band: 1.71 to 1.85 GHz, 0.5 MHz steps.

(8) (FOUO) Ultrahigh frequency (UHF): 400 to 470 MHz.

(9) Power: Lithium-polymer battery.

(10) AC/DC vehicle accessory power cable.

(11) Integrated video display.

(12) Highly compatible and interoperable:

(a) Digital and analog waveforms.

(b) Metadata (Key-length-value (KLV) supported).

(c) Video encode and decode.

- MPEG-2.
- MPEG-4.
- H.261 (decode only).
- H.264.
- Analog.

(13) Intuitive control GUI:

(a) Pre-mission configuration.

(b) Waveform control.

(c) Band and frequency.

d. (FOUO) ROVER 6. ROVER 6 is an improved version of the ROVERs 3 and 4 transceivers. While it is man portable, its antenna, laptop, and large radio are more suited to tactical operations centers, vehicles, and ships. ROVER 6 features 5-band operation (C-, L-, S-, and Ku-bands, and UHF) and two external receiver interfaces. ROVER 6 adds digital data link Raven and CDL, which makes it compatible with tactical aircraft, targeting pods, and almost all UASs. It has upgraded security capability with Triple Data Encryption Standard, Advanced Encryption Standard, and Type 1 encryption. ROVER 6 can receive on two different channels in either of two different frequency bands, which improves operational flexibility and reliability. The system supports data rates up to 44.73 megabits per second.

e. Table 8 contains information on ROVER versions fielded on current US platforms.

Table 8. US UAS ROVER Matrix						
Name	**Mission Design Series**	**Analog**	**Digital**	**Encrypted**	**ROVER 4/5**	**ROVER 6**
Wasp AE DDL	RQ-12A		X	X		X
Puma AE DDL	RQ-20A		X	X		X
Raven B DDL	RQ-11B		X	X		X
Scan Eagle	Not applicable	X			X	X
Blackjack	RQ-21A		X	X	X	X
Shadow	RQ-7Bv1	X			X	X
Shadow	RQ-7Bv2		X	X	X	X
Gray Eagle	MQ-1C	X	X	X		X
Fire Scout	MQ-8B	X	X	X	X	X
Hunter	MQ-5B		X			X
K-Max	Not applicable					
Predator	MQ-1B	X	X	X [1]	X	X[1]
Viking 400	Not applicable					
Warrior A	MQ-1	X	X			X
Reaper	MQ-9	X	X	X	X	X[1]

Note:
1. Requires specific VORTEX transceiver not available on all aircraft.

Legend:
AE—all environment
DDL—digital data link
ROVER—remotely operated video enhanced receiver

3. One System Remote Video Transceiver (OSRVT)

a. (FOUO) OSRVT is a kit integrated with the ROVER systems providing enhanced SA with near-real-time video and telemetry data from multiple manned and unmanned platforms, including: Raven, Shadow, Hunter, Predator, Reaper, and other UASs. Software supports decoding telemetry and metadata from multiple UASs, links data onto Falcon View maps and supports off-target calculations (see figure 21). The following list provides the OSRVT technical characteristics:

(1) Range: 10 kilometers (km) and ~50 km with extended range antenna (mobile directional antenna system).

(2) Weight: 22 to 60 lbs base system with case.

(3) (FOUO) Radio frequency (RF): C-band (4.4 to 4.85 gigahertz (GHz), 5.25 to 5.85 GHz).

(4) (FOUO) L-band: 1.71 to 1.859 GHz.

(5) (FOUO) Ku bands: 14.4 to 15.35 GHz.

(6) (FOUO) UHF: 340 to 400 MHz.

(7) (FOUO) Power: AC, DC, and battery (4 to 12 hours based on configuration).

(8) (FOUO) DVR: 10 hours of recording video.

(9) Telemetry data linked to falcon view with 2525 symbology.

(10) Joint photographic experts group (JPEG) files with embedded metadata.

(11) Off target calculations.

(12) (FOUO) Tri-band (C, L, and Ku) extended range antenna, up to 50 km (optional).

(13) S-band.

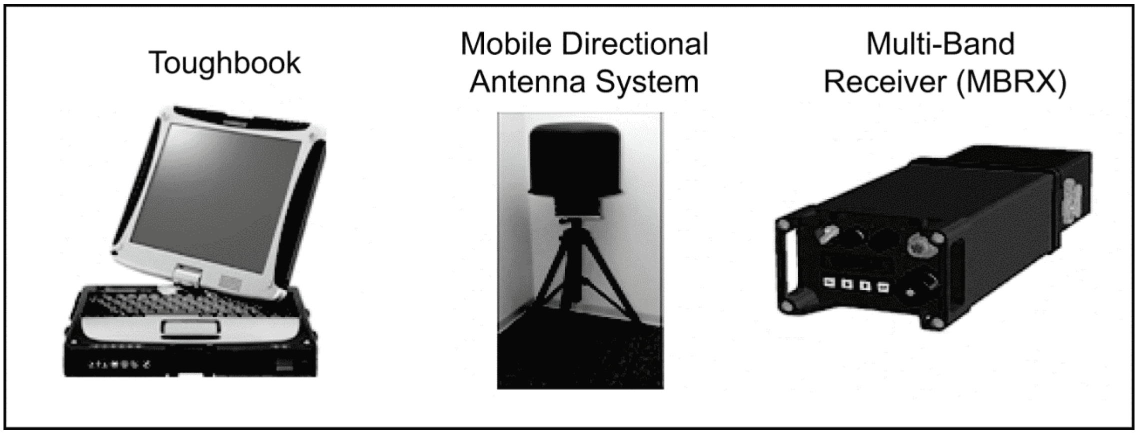


Figure 21. Different Receivers

4. VideoScout®

a. VideoScout®. VideoScout® offers direct “plug and play” connectivity with electro-optical (EO) and infrared (IR) sensors, as well as fixed or mobile receivers, to capture live digital or analog video and metadata. VideoScout® can synchronize and archive video with UAS metadata to create “geo-location rich” video intelligence by associating time and location with motion and still imagery. The system stores captured metadata with the video, then extracts and displays it separately from the video for convenient search and retrieval by date, location, or textual annotations.

b. Remote Video Exploitation Terminal VideoScout®-MC. VideoScout®-MC is a lightweight, portable laptop with an integrated L- and Full C-, L- and S-, or S- and full C-band receivers for mobile, forward, and dismounted personnel to receive video and telemetry data directly from L-, S-, and C-band tactical UASs.

c. Micro Exploitation System VideoScout®–MXA. VideoScout®-MXA is a “pocket-sized”, hand-held VideoScout® computer with an integrated L-, S-, or C-band receiver allowing the user to view and exploit real-time video and metadata directly from UASs and other common sensors.

d. Technical Characteristics. The following list provides the Video Scout® technical characteristics:

(1) Weight: 8.5 lbs

(2) DVR Capacity: Up to 90 minutes of video recording

(3) Data Standards: MPEG-2 Video, JPEG and NITF Images, KLV Metadata, DODIIS Compliance for secure networks, FalconView, Google Earth, Joint photographic experts group (JPEG) files with embedded metadata.

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Appendix B
PLATFORM SPECIFICS

1. Unmanned Aircraft System (UAS) Platform Comparison

Table 9 contains common performance characteristics and missions associated with selected unmanned aircraft (UA).

Table 9. UA Performance Characteristics and Missions

Group	Name	Mission Design Series	Service or Country	Mission	Maximum Airspeed (kts)	Cruise Airspeed (kts)	Maximum Altitude (ft MSL)	Normal Operating Altitude (ft MSL)	Endurance (hours)	Radius (nm)
1	Anubis		USAF	ISR	35	15	10k	500	1	1–2
	gMAV	RQ-16	USA	RSTA/ ISR	45	0–45	10k	500	0.8	5.3
	Puma	RQ-20A	USA USN USMC USAF USSOCOM	ISR	40	26	10.5k	1,000	2	12
	Raven	RQ-11B DDL	USA USMC USAF USSOCOM	RSTA/ ISR	44	26	10.5k	1,000	1.5	6
	Wasp	RQ-12A	USA USMC USAF USSOCOM	RSTA/ ISR	45	26	10.5k	500–1,000	0.8	3
2	Scan Eagle		USMC USAF USN USSOCOM	ISR	70–80	49	16.4k	1–5k	15–20	60
3	Blackjack	RQ-21A	USMC	ISR	90	55	15.0k	3,000	>12	50
	Shadow	RQ-7B	USA USMC	RSTA/ ISR	110	70	15k	6–8k	9	77
	Viking 400	Not applicable	USSOCOM	RSTA/ ISR	90	58–90	15k	3–8k	6–12	75

Table 9. UA Performance Characteristics and Missions (Cont'd.)										
Group	**Name**	**Mission Design Series**	**Service or Country**	**Mission**	**Maximum Airspeed (kts)**	**Cruise Airspeed (kts)**	**Maximum Altitude (ft MSL)**	**Normal Operating Altitude**	**Endurance (hours)**	**Radius (nm)**
4	Gray Eagle	MQ-1C	USA	Multi	150	75	25k	8–20k	36	648
	Fire Scout	MQ-8B	USN	ISR	120	60–120	12.5k	8–10k	4.5	150
	Hunter	MQ-5B	USA	ISR Multi	110	70	18k	3–15k	20.5	144
	K-Max		USA USMC	Cargo	100	80	20k	0–5k	3	130
	Predator	MQ-1B	USAF USSOCOM	Multi	120	75–85	25k	15k	24	1,100
	Warrior A	MQ-1	USA	Multi	120	70	25k	15k	24	500
5	Global Hawk	RQ-4B	USAF	Multi	340	310	60k	50–60k	28	5,400
	BAMS-D	RQ-4A	USN	ISR	340	340	60k	50–60k	31	5,300
	Triton	MQ-4C	USN	ISR	330	310	60k	50–60k	24	9,950
	Reaper	MQ-9	USAF UK	Attack Multi	249	230	40k	10–30k	14–17	1,400

Legend:
BAMS-D—Broad Area Maritime Surveillance-Demonstrator
ft—feet
ISR—intelligence, surveillance, and reconnaissance
k—kilometer
kt—knot
MSL—mean sea level
nm—nautical mile
RSTA—reconnaissance, surveillance, and target acquisition
UK—United Kingdom
USA—United States Army
USAF—United States Air Force
USMC—United States Marine Corps
USN—United States Navy
USSOCOM—United States Special Operations Command

2. UAS Platform Payload Crosswalk

Table 10 contains payload information for selected UA.

Table 10. UA Payloads

Name	Mission Design Series	EO/IR	FMV	LRD/LRF	IR Pointer	SAR	GMTI	SIGINT	AIS	Communication Relay	Weapons and Cargo
Fire Scout	MQ-8B	X	X	X	X	X[1]			X	X	
Gray Eagle	MQ-1C	X	X	X	X	X	X	X		X	AGM-114
Global Hawk Block 20	RQ-4B									X	
Global Hawk Block 30i	RQ-4B	X				X					
Global Hawk Block 30m	RQ-4B	X				X		X			
Global Hawk Block 40	RQ-4B					X	X				
Triton	MQ-4C	X	X			X[1]		X	X	X	2,400 pounds external payload
BAMS-D	RQ-4A	X				X[1]	X		X		
gMAV	RQ-16	X	X								
Hunter	MQ-5B	X	X	X	X			X		X	
K-Max											Cargo sling load 6,500 pounds
Predator	MQ-1B	X	X	X	X			X			AGM-114
Puma	RQ-20A	X	X		X			X		X	

Name	Mission Design Series	EO/IR	FMV	LRD/LRF	IR Pointer	SAR	GMTI	SIGINT	AIS	Communication Relay	Weapons and Cargo
Table 10. UA Payloads (Cont'd.)											
Raven	RQ-11B	X	X		X						
Reaper	MQ-9	X	X	X	X	X	X	X			AGM-114, GBU-12, GBU-38
Scan Eagle		X	X					X			
Blackjack	RQ-21A	X	X	X	X				X	X	
Shadow	RQ-7B	X	X	X	X					X	
Viking 400		X	X		X						
Warrior A	MQ-1	X	X	X	X	X[2]	X[2]			X	AGM-114
Wasp	RQ-12A	X	X		X						

Legend:
AGM—air-to-ground missile
AIS—Automatic Identification System
BAMS-D—Broad Area Maritime Surveillance-Demonstrator
EO—electro-optical
FMV—full motion video
GBU—guided bomb unit
GMTI—ground moving target indication
IR—infrared
LRD—laser range detector
LRF—laser range finder
SAR—synthetic aperture radar
SIGINT—signals intelligence

Notes:
1. This has inverse SAR.
2. Hellfire cannot be carried simultaneously with SAR and GMTI payloads.

3. Current Platforms

Tables 11–24 contain capabilities related to several currently fielded platforms. This group is not all-inclusive, but represents the majority of current platforms.

Table 11. RQ-12A (Commonly called Wasp all environment [AE])	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; combat search and rescue; force protection; situational awareness; battle damage assessment
Propulsion	Direct–drive, electric motor propeller
Wingspan	40 inches
Length	32 inches
Weight	2.75 pounds
Battery	Lithium-ion (rechargeable)
Flight Duration	50-55 minutes
Cruise Speed	26 knots
Slow Speed	20 knots
Maximum Speed	45 knots
Service Ceiling	12,500 feet mean sea level
Maximum Range	5 kilometers (line of sight)
Crew	2: vehicle operator and mission operator
Sensors	Gimbaled electro-optical, infrared, and long-wave infrared
Control Data link	L-Band digital data link (single frequency encryption)
Navigation	P(y)-code Global Positioning System and Selective Availability Anti-Spoofing Module (World Geodetic System 1984) and electronic compass
Aircraft Communications	Remote video terminal (digital)
Aircrew Reachback	None
Armament	None
Launcher	None
Launch	Hand launched
Recovery	Deep stall autoland

Table 12. RQ-11B Raven Digital Data Link (DDL)	
Characteristics	**Platform Details**
Tasks	Force protection, battle damage assessment, convoy security, target acquisition
Propulsion	Direct drive electric motor propeller push propeller
Wingspan	55 inches
Length	36 inches
Weight	4.8 pounds
Battery	Lithium-ion (rechargeable)
Flight Duration	60–90 minutes
Cruise Speed	26 knots
Slow Speed	17 knots
Maximum Speed	44 knots
Service Ceiling	10,500 feet mean sea level
Maximum Range (kilometers)	10 kilometers (line of sight)
Crew	2: vehicle operator and mission operator
Sensors	Electro-optical or long-wave infrared with laser pointer
Control Data link	I-band digital data link (single frequency encryption)
Navigation	P(y)-code Global Positioning System/Selective Availability Anti-Spoofing Module (World Geodetic System 1984) and electronic compass
Aircraft Communications	Remote video terminal (digital)
Aircrew Reachback	None
Armament	None
Launcher	None
Launch	Hand launched
Recovery	Deep stall autoland
Note: Some units employ a gimbaled payload with a dual electro-optical and long-wave infrared sensor with laser.	

Table 13. RQ-20A Puma DDL	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; combat search and rescue; force protection; situational awareness, battle damage assessment
Propulsion	Direct drive electric motor propeller
Wingspan	110 inches
Length	56 inches
Weight	12.9 pounds
Battery	Lithium-ion (rechargeable)
Flight Duration	60–120 minutes (180–240 minutes with long endurance battery)
Cruise Speed	26 knots
Slow Speed	20 knots
Maximum Speed	45 knots
Service Ceiling	10,500 feet mean sea level
Maximum Range	15 kilometers (line of sight)
Crew	2: vehicle operator and mission operator
Sensors	Gimbaled payload with a dual electro-optical and long-wave infrared sensor with a pointer
Control Data link	L-Band digital data link (single frequency encryption)
Navigation	P(y)-code Global Positioning System/Selective Availability Anti-Spoofing Module (World Geodetic System 1984), and electronic compass
Aircraft Communications	Remove video terminal (digital)
Aircrew Reachback	None
Armament	None
Launcher	None
Launch	Puma tactical launcher (spring catapult) available
Recovery	Deep stall autoland (capable of being recovered at sea)

Table 14. Scan Eagle	
Characteristics	**Platform Details**
Tasks	Land or maritime intelligence, surveillance, and reconnaissance; target acquisition; communications relay; battle damage assessment
Propulsion	1.5 horsepower driven propeller
Wingspan	10.2 feet
Length	5.2 feet (electro-optical single), 6.5 feet (electro-optical dual), 5.8 feet (blind single), 6.3 feet (blind dual), 6.3 feet (medium-wave infrared 2.0/3.0/super electro-optical)
Weight	29.7–36.7 pounds
Maximum Takeoff Weight	Electro-optical = 48.5 pounds Heavy fuel with medium-wave infrared = 49.4 pounds
Maximum Payload Weight	1–2.5 pounds
Fuel Capacity	12.1 pounds
Cruise Speed	48 knots indicated airspeed
Maximum Speed	65 knots indicated airspeed
Endurance	20 hours (single bay) 15 hours (dual bay)
Service Ceiling	>19,500 feet, configuration dependent (turret and engine type)
Maximum Range	81 nautical mile radius for line of sight operations
Crew	1: ground control system or remote video terminal operator
Sensors	Electro-optical, medium-wave infrared, and laser target marker
Command and Control Data link	Ultrahigh frequency L-Band encrypted and unencrypted
Payload Video Data link	S-Band (Key-Length-Value metadata), remote video terminal compatible, encrypted and unencrypted
Payload system options	Remotely operated video enhanced receiver, one system remote video transceiver, and VideoScout® remote video terminal (digital or analog)
Armament	None
Launcher	Mk-4 launcher
Launch	Catapult
Recovery	SkyHook (50-foot, vertical cable, runway independent)
Note: The Automatic Identification System capability is in analog and digital configurations.	

Table 15. RQ-21 Blackjack	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; battle damage assessment; search and rescue; target acquisition; communications relay
Propulsion	8 horsepower, heavy fuel engine
Wingspan	15.3 feet
Length	7.2 feet
Height	2.8 feet
Weight	110.0 pounds
Maximum Takeoff Weight	135 pounds
External Payload	Not yet established; 7 payload installation locations
Fuel Capacity	44.1 pounds (not to exceed maximum gross takeoff weight)
Cruise Speed	55–80 knots indicated airspeed
Loiter Speed	47–60 knots indicated airspeed
Maximum Speed	90 knots indicated airspeed
Endurance	12–14 hours
Service Ceiling	20,000 feet density altitude
Maximum Range	50 nautical miles (line of sight)
Sensors	Electro-optical, medium-wave infrared, laser range finder, laser target marker, and automated information system
Crew	2(+): unmanned aircraft commander and air vehicle operator + intelligence analyst
Control Data link	L-Band
Tactical Data link	S-Band (ground control station), L-Band (remote video terminal)
Aircraft Communications	PRC-152 ultrahigh frequency and very high frequency
Aircrew Reachback	Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), tactical chat, various mission nets
Armament	Not applicable
Launcher	Pneumatically-controlled launch device
Launch	Catapult
Recovery	Hydraulically-controlled, telescoping crane retriever

Table 16. RQ-7B Shadow	
Characteristics	**Platform Details**
Tasks (USA)	Airborne weather station, reconnaissance, surveillance, and target acquisition; close combat attack (lase only); communications relay; personnel recovery
Tasks (USMC)	Close air support, strike coordination and reconnaissance, suppression of enemy air defenses, multisensor imagery reconnaissance, aerial escort, coordinate electronic warfare with fires
Propulsion	38 horsepower driven propeller
Wingspan	14 feet (v1), 20.5 feet (v1 increased endurance (IE)) 20.5 feet (v2 T-CDL)
Length	11.4 feet (v1), 12 feet (v1 IE) 12 feet (v2 T-CDL)
Height	3.2 feet
Weight	186 pounds (empty)
Maximum Takeoff Weight	404 pounds at 9,000 DA (v1), 467 pounds at 10,500 feet DA (v1 IE) 467 pounds at 10,500 DA (v2 T-CDL)
External Payload	Wings qualified for two 25 pounds each (v1 IE)
Fuel Capacity	44 liters (v1), 58 liters (v1 IE), 58 liters (v2 T-CDL)
Cruise Speed	90 knots indicated airspeed
Loiter Speed	60 knots indicated airspeed
Maximum Speed	110 knots indicated airspeed
Endurance	6 hours (v1), 9 hours (v1 IE), 9 hours (v2 T-CDL)
Service Ceiling	Up to 15,000 feet mean sea level
Maximum Range	125 kilometers (line of sight)
Crew	5 (USA): aircraft commander, aircraft operator, payload operator, mission coordinator, and crew chief 4 (USMC): unmanned aircraft commander, air vehicle operator, mission payload operator, and analyst
Control Data link	Primary: S-band, secondary: ultrahigh frequency, video: C-band (v1) Primary: video: Ku-band, Secondary: ultrahigh frequency (v2)
Tactical Data link (USA)	T-CDL, blue force tracking, Automatic Identification System (AIS)
Tactical Data link (USMC)	T-CDL, blue force tracking, and variable message format (VMF)
Aircraft Communications	Frequency modulation retransmission (PRC-152), ultrahigh frequency (ground only)
Aircrew Reachback	Tactical chat, Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), mission specific networks, voice over secure internet protocol
Sensors	POP300 (D): electro-optical, infrared, laser range finder, laser designator, and improved video tracking
Armament	Not applicable
Launcher	Hydraulic and pneumatic launcher
Launch	Catapult
Recovery	Tactical automated landing system (60–70 knots indicated airspeed)
Legend: DA—density altitude CDL—common data link T—tactical USA—United States Army	USMC—United States Marine Corps v1—version 1 v2—version 2
Note: The intelligence or imagery analyst positions are non-standard crew positions.	

Table 17. MQ-8B Fire Scout	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; surface surveillance coordination; personnel recovery (support only); strike coordination and reconnaissance; and mine countermeasure
Wingspan (Rotor Diameter)	27.5 feet
Length	30 feet
Height	9 feet, 9 inches
Maximum Takeoff Weight	3,150 pounds
Fuel Capacity	190 gallons
Cruise Speed	80–90 knots indicated airspeed
Loiter Speed	55–60 knots indicated airspeed
Maximum Speed	120 knots indicated airspeed
Maximum Endurance	4.5 hours
Service Ceiling	Up to 12,500 feet
Maximum Range	Up to 110 nautical miles (line of sight)
Crew	2–3: air vehicle operator, mission payload operator, mission coordinator (mission dependent)
Sensors	Automatic Identification System, VORTEX, signals intelligence BRITESTAR II: electro-optical, infrared, eyesafe laser range finder, laser target marker, and laser target designator
Control Data link	Ku-band tactical common data link or ultrahigh frequency
Tactical Data link	Ku-band tactical common data link
Aircraft Communications	3 ultrahigh frequency or very high frequency (ARC-210) remote video terminal (digital or analog) (Ku- and C-band)
Aircrew Reachback	Tactical chat, Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), mission specific networks, and other ship-specific communication methods
Armament	Advanced Precision Kill Weapons System (not currently utilized)
Launch	Vertical takeoff or landing
Recovery	Vertical takeoff or landing (aircrew controlled)
Note: The COBRA system may replace BRITESTAR II with COBRA for some mission packages.	

Table 18. MQ-1C Gray Eagle	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; close air support; personnel recovery; area security
Propulsion	160 horsepower driven propeller
Wingspan	56.3 feet
Length	28.97 feet
Height	9.5 feet
Weight	2,600 +/-50 pounds empty
Maximum Takeoff Weight	3,600 pounds
External Payload	500
Fuel Capacity	590 pounds JP-8
Cruise Speed	75–85 knots indicated airspeed
Loiter Speed	70–80 knots indicated airspeed
Maximum Speed	130 knots indicated airspeed
Endurance	20+ Hours (clean)/18 Hours (1 AGM-114)
Service Ceiling	Up to 25,000 feet
Maximum Range	Up to 1,100 nautical mile*
Crew	2: air vehicle operator and mission payload operator
Sensors	High definition, common sensor payload: electro-optical, infrared, low-light level television, laser spot tracker, laser range finder/designator, laser target marker, signals intelligence
Control Data link	Ku satellite communications, line of sight, C-Band, tactical common data link
Tactical Data link	Blue force tracking
Aircraft Communications	1 ultrahigh frequency and very high frequency, HAVEQUICK II, single-channel ground and airborne radio system (SINCGARS), 2 frequency modulation SINCGARSs and remote video terminals (digital or analog)
Aircrew Reachback	Tactical chat, Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), mission specific networks, and voice over secure internet protocol (VoSIP)
Armament	Up to 4 AGM-114
Launcher	Not applicable
Launch	Wheeled (aircrew controlled)
Recovery	Wheeled (aircrew controlled)
Legend: AGM—air-to-ground missile Note: Maximum range capability depends on aircraft configuration, satellite footprint, and desired loiter time.	

Table 19. MQ-1B Predator	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; close air support; air interdiction; strike coordination and reconnaissance; personnel recovery; situational awareness; suppression of enemy air defense; and aviation operations in maritime surface warfare
Propulsion	115 horsepower driven propeller
Wingspan	55.25 feet
Length	27 feet
Height	6.9 feet
Weight	1,130 pounds empty
Maximum Takeoff Weight	2,250 pounds
External Payload	300 pounds
Fuel Capacity	670 pounds
Cruise Speed	75–85 knots indicated airspeed
Loiter Speed	65–75 knots indicated airspeed
Maximum Speed	120 knots indicated airspeed
Endurance	24+ hours (clean)/22 hours (armed)
Service Ceiling	Up to 25,000 feet
Maximum Range	Up to 1,100 nautical miles
Crew	2: pilot and sensor operator
Sensors	AN/AAS-52 multi-spectral targeting system: electro-optical, infrared, low-light level television, laser range detector, and laser target marker, and signals intelligence
Control Data link	Ku satellite communications, line of sight, direct line of sight
Tactical Data link	Link 16, situational awareness data link, blue force tracking
Aircraft Communications	1 ultrahigh frequency/very high frequency (HAVEQUICK II, KY-100), Quickdraw II, remote video terminal (digital and analog)
Aircrew Reachback	Tactical chat, Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), Joint Worldwide Intelligence Communications System (JWICS), mission specific networks, and voice over secure internet protocol (VoSIP)
Armament	2 AGM-114
Launcher	M299
Launch	Runway (aircrew controlled)
Recovery	Runway (aircrew controlled)
Legend: AGM—air-to-ground missile Note: For MQ-1 mission specific information, refer to Air Force tactics, techniques, and procedures publication 3-1.MQ-1, *Combat Aircraft Fundamentals MQ-1*, on the 561st Joint Tactics Squadron secure website.	

Table 20. MQ-5B Hunter	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; reconnaissance, surveillance, and target acquisition; signals intelligence
Propulsion	2 x 56 horsepower heavy fuel engine driven propeller
Wingspan	34.25 feet
Length	23 feet
Height	6 feet 1 inch
Weight	1,950 pounds (gross)
Maximum Takeoff Weight	1,950 pounds
Payload Capacity	6,600 Cu in (internal), no published limits for external payloads
Fuel Capacity	534 pounds
Cruise Speed	62 knots indicated airspeed
Loiter Speed	62 knots indicated airspeed
Maximum Speed	110 knots indicated airspeed
Endurance	24 hours (clean)/no published limits with payloads
Service Ceiling	18,000 feet maximum ceiling
Maximum Range	200 kilometers
Crew	3: aircraft operator, mission payload operator, and launch and recover pilot
Control Data link	Line of sight
Tactical Data link	Tactical common data link or C-Band
Aircraft Communications	Single-channel ground and airborne radio system (SINCGARS), small unit transceiver
Aircrew Reachback	Tactical chat, Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), voice over secure internet protocol (VoSIP), and mission specific networks
Sensors	MOSP 300: electro-optical and infrared, signals intelligence, communications relay package
Armament	GBU-44
Launcher	M299
Launch	Runway (minimum 1,600 feet improved or unimproved)
Recovery	Runway
Legend: GBU—guided bomb unit	

Table 21. MQ-9 Reaper	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance; close air support; air interdiction; strike coordination and reconnaissance; personnel recovery; situational awareness; suppression of enemy air defense; aviation operations in maritime surface warfare
Propulsion	900 shaft horsepower driven propeller
Wingspan	66 feet
Length	36 feet
Height	12.5 feet
Weight	4,900 pounds empty
Maximum Takeoff Weight	10,500 pounds
External Payload	3,750 pounds
Fuel Capacity	3,764 pounds
Cruise Speed	230 knots true airspeed
Loiter Speed	150–175 knots true airspeed
Maximum Speed	249 knots true airspeed
Endurance	17 hours (clean)/14 hours (armed)
Service Ceiling	Up to 40,000 feet
Maximum Range	Up to 1,400 nautical miles
Crew	2: pilot and sensor operator
Control Data link	Ku satellite communications, line of sight, direct line of sight
Tactical Data link	Link 16, situational awareness data link, blue force tracking
Aircraft Communications	1 x ultrahigh frequency/very high frequency (HAVEQUICK II, KY-100), Quickdraw II, remote video terminal (digital and analog)
Aircrew Reachback	Tactical chat, Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), Joint Worldwide Intelligence Communications System (JWICS), mission-specific networks, voice over secure internet protocol (VoSIP)
Sensors	AN/DAS-1 multi-spectral targeting system: electro-optical, infrared, low-light level television, laser range detector, and infrared marker, Lynx synthetic aperture radar and ground moving target indicator, and signals intelligence
Armament	4 AGM-114 and 2 GBU-12 or GBU-38; 4 GBU-12 or GBU-38
Launcher	M299, BRU-15, BRU-71
Launch	Runway (aircrew controlled)
Recovery	Runway (aircrew controlled)
Legend: AGM—air-to-ground missile GBU—guided bomb unit Note: For MQ-9 mission-specific information, refer to Air Force tactics, techniques, and procedures publication 3-1.MQ-9, *Combat Aircraft Fundamentals MQ-9*, on the 561st Joint Tactics Squadron secure website.	

Table 22. MQ-4C Triton	
Characteristics	**Platform Details**
Tasks	Persistent maritime intelligence, surveillance, and reconnaissance
Propulsion	Rolls-Royce AE3007H generates 8,500 pounds thrust
Wingspan	130.9 feet
Length	47.6 feet
Height	15.4 feet
Weight (Zero Fuel)	16,800 pounds
Maximum Takeoff Weight	32,250 pounds
External Payload	2,400 pounds
Fuel Capacity	various
Cruise Speed	310 knots true airspeed
Loiter Speed	Not applicable
Maximum Speed	331 knots true airspeed
Endurance	24 hours
Service Ceiling	56,500 feet
Maximum Range	9,950 nautical miles (persistent intelligence, surveillance, and reconnaissance at a mission radius of 2,000 nautical miles)
Crew	4: air vehicle operator, tactical coordinator, and 2 mission payload operators (additional air vehicle operators for launch, recovery, and transit operations, as required)
Sensors	360-degree field of regard sensors: Multi-Function Active Sensor Maritime Radar, electro-optical and infrared sensor, Automatic Identification System receiver, and electronic support measures
Control Data link	Beyond line of sight satellite communications, line of sight, common data link
Tactical Data link	Line of sight, beyond line of sight
Aircraft Communications	Communications relay capability, line of sight, beyond line of sight
Aircrew Reachback	Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), mission specific networks
Armament	Not applicable
Launcher	Not applicable
Launch	Runway (aircrew controlled)
Recovery	Runway (aircrew controlled)
Note: The Block 20 Global Hawk airframe has significant enhancements to include anti-ice, de-ice, reliability improvements, and organic maintenance training and documentation.	

Table 23. RQ-4B Global Hawk	
Characteristics	**Platform Details**
Tasks	Intelligence, surveillance, and reconnaissance
Propulsion	Rolls-Royce F137-RR0100 turbofan generates 7,600 pounds thrust
Wingspan	130.9 feet
Length	47.6 feet
Height	15.3 feet
Weight (Zero Fuel)	14,950 pounds
Maximum Takeoff Weight	32,250 pounds
Payload	3,000 pounds
Fuel Capacity	17,300 pounds
Cruise Speed	310 knots true airspeed
Loiter Speed	Not applicable
Maximum Speed	331 knots true airspeed
Endurance	28 hours
Service Ceiling	60,000 feet
Maximum Range	8,700 nautical miles
Crew	3: launch and recovery pilot, mission control pilot, sensor operator
Sensors	Block 20: Battlefield Airborne Communication Node Block 30: electro-optical, infrared, synthetic aperture radar (with limited ground moving target indicator), airborne signals intelligence payload Block 40: Multi-Platform Radar Technology Insertion Program (enhanced synthetic aperture radar and ground moving target indicator)
Control Data link	Beyond line of sight satellite communications, line of sight, common data link
Tactical Data link	Line of sight and beyond line of sight
Aircraft Communications	Communications relay capability, line of sight and beyond line of sight
Aircrew Reachback	Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), and mission specific networks
Armament	Not applicable
Launcher	Not applicable
Launch	Runway (aircrew controlled)
Recovery	Runway (aircrew controlled)

Table 24. Broad Area Maritime Surveillance-Demonstrator	
Characteristics	**Platform Details**
Missions	Maritime intelligence, surveillance, and reconnaissance
Propulsion	Rolls-Royce AE3007H turbofan generates 8,500 pounds thrust
Wingspan	116.2 feet
Length	44.4 feet
Height	14.2 feet
Weight (Zero Fuel)	11,300 pounds
Maximum Takeoff Weight	26,750 pounds
Payload	2,000 pounds
Fuel Capacity	15,450
Cruise Speed	340 knots true airspeed
Loiter Speed	Not applicable
Maximum Speed	340 knots true airspeed
Endurance	31 hours (nominal mission is 24 hours)
Service Ceiling	60,000 feet
Maximum Range	10,300 nautical miles
Crew	5 (flight): 5: 2 air vehicle operators, 2 mission payload operators, 1 unmanned tactical coordinator 4 (mission): 1 tactical auxiliary ground system operations officer, 1 common tactical picture plotter, 2 tactical auxiliary ground system operators
Sensors	Integrated sensor suite: side-looking maritime radar, electro-optical and infrared sensors 360-degree field of regard sensors: Automatic Identification System receiver, and electronic support measures
Control Data link	Beyond line of sight satellite communications, line of sight common data link, tactical common data link
Tactical Data link	Line of sight and beyond line of sight
Aircraft Communications	Line of sight and beyond line of sight
Aircrew Reachback	Nonsecure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), and mission specific networks
Armament	Not applicable
Launcher	Not applicable
Launch	Runway (automatic, air vehicle operator monitor)
Recovery	Runway (automatic, air vehicle operator monitor)

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GLOSSARY

PART I – ABBREVIATIONS AND ACRONYMS

A

A/C	aircraft
AAR	after action report
AC2	airborne command and control
AC	alternating current
ACA	airspace control authority
ACE	aviation combat element
ACM	airspace coordinating measure
ACO	airspace control order
ACP	airspace control plan
ADAM	air defense airspace management
AE	all environment
AFI	air force instruction
AFSOC	United States Air Force Special Operations Command
AFTTP	Air Force tactics, techniques, and procedures
AGL	above ground level
AGM	air-to-ground missile
AI	air interdiction
AIP	antisurface warfare improvement program
AIS	Automatic Identification System
ALSA	air land sea application [center]
AO	area of operations
AOC	air and space operations center
ASOC	air support operations center
ASR	air surveillance radar
ASTAC	antisubmarine/antisurface tactical air controller
ATC	air traffic control
ATFLIR	advanced targeting forward-looking infrared
ATP	Army tactical publication
ATO	air tasking order

ATTP	Army tactics, techniques, and procedures
AVO	air vehicle operator

B

BAE	brigade aviation element
BAMS-D	Broad Area Maritime Surveillance-Demonstrator
BCD	battlefield coordination detachment
BCT	brigade combat team
BDA	battle damage assessment
BE	bandwidth efficient
BFSB	battlefield surveillance brigade
BFT	blue force tracking
BLOS	beyond line of sight

C

C2	command and control
CA	coordinating altitude
CAB	combat aviation brigade
CAC	combined arms center
CADD	combined arms doctrine directorate
CAS	close air support
CBRN	chemical, biological, radiological, and nuclear
CCA	close combat attack
CCD	camouflage, concealment, and deception
CDL	command data link
COA	course of action
COIC	current operations integration cell
CONOPS	concept of operations
COP	common operational picture
COTS	commercial off-the-shelf
CP	command post

D

DA	density altitude
DASC	direct air support center
DC	direct current

DCGS	distributed common ground/surface system
DDL	digital data link
DL	downlink
DOD	Department of Defense
DODD	Department of Defense directive
DVR	digital video recorder

E

EEI	essential element of information
EO	electro-optical
EOD	explosive ordnance disposal
EPLRS	enhanced position location (and) reporting system

F

FAA	federal aviation administration
FFT	friendly force tracking
FIB	fires brigade
FM	field manual
FMV	full motion video
FOPEN	foliage penetration
FOV	field of view
FPASS	force protection airborne surveillance system
ft	feet

G

G-2	assistant chief of staff for intelligence
G-3	assistant chief of staff, operations
GBS	global broadcast service
GBU	guided bomb unit
GCS	ground control station
GHOC	Global Hawk Operations Centers
GHz	gigahertz
GMTI	ground moving target indicator
GSM	global system for mobile communications
GUI	graphical user interface

H

HF	high frequency
HQ	headquarters
HSI	hyperspectral imagery
Hz	hertz

I

IAW	in accordance with
ICAO	international civil aviation organization
IE	increased endurance
INTSUM	intelligence summary
IR	infrared
IRC	internet relay chat
ISAR	inverse synthetic aperture radar
ISR	intelligence, surveillance, and reconnaissance

J

JFACC	joint force air component commander
JFC	joint force commander
JFMCC	joint force maritime component commander
JP	joint publication
JPEG	joint photographic experts group
JTAC	joint terminal attack controller
JWICS	Joint worldwide Intelligence Communications System

K

KIAS	knots indicated airspeed
KLV	key-length-value
km	kilometer
kt	knot

L

lb	pound
LD	line of departure
LIDAR	light detection and ranging
LLLTV	low-light level television
LOA	limit of advance
LOS	line of sight

LR	launch and recovery
LRD	laser range detector
LRF	laser range finder
LRF/D	laser range finder/detector
LRS	launch and recovery site
LTM	laser target marker
LWIR	long-wave infrared

M

MAAP	master air attack plan
MACCS	Marine air command and control system
MAGTF	Marine air-ground task force
MARSS	medium altitude reconnaissance and surveillance system
MAWTS-1	Marine Aviation Weapons and Tactics Squadron One
MCRP	Marine Corps reference publication
MCWP	Marine Corps warfighting publication
MDS	mission design series
MHz	megahertz
MILSTRIP	military standard requisition and issue procedure
MILSTRAP	military standard transaction reporting and accounting procedure
MISREP	mission report
MO	mission operator
MPCS	mission planning and control site
MPEG	moving pictures experts group
MPO	mission payload operator
MSL	mean sea level
MTI	moving target indicator
MTS	multispectral targeting system
MTTP	multi-Service tactics, techniques, and procedures
MWIR	medium-wave infrared

N

NAI	named area of interest
NAS	National Airspace System

NATOPS	Naval Air Training and Operating Procedures Standardization
NIPRNET	Nonsecure Internet Protocol Router Network
nm	nautical mile
NTSC	national television standards committee
NTTP	Navy tactics, techniques, and procedures
NWDC	Navy Warfare Development Command

O

OSD	office of the secretary of defense
OSRVT	one system remote video transceiver

P, Q

PED	processing, exploitation, and dissemination
PL	phase line
PO	payload operator
POI	point of interest
PPDL	Predator proprietary data link
PR	personnel recovery
PTDS	persistent threat detection system

R

RF	radio frequency
RL	return link
ROVER	remotely operated video enhanced receiver
ROZ	restricted operations zone
RP	release point
RPA	remotely piloted aircraft
RSTA	reconnaissance, surveillance, and target acquisition

S

SA	situational awareness
SAR	synthetic aperture radar
SCAR	strike coordination and reconnaissance
SEAD	Suppression of enemy air defenses
SHARP	Stationary High Altitude Relay Platform
SIGINT	signals intelligence
SINCGARS	Single-channel ground and airborne radio system

SIPRNET	SECRET Internet Protocol Router Network
SO	sensor operator
SOC	squadron operations center
SOF	special operations forces
SP	start point
SPINS	special instructions
SUAS	small unmanned aircraft system
SWIR	short-wave infrared

T

T	tactical
TACC	tactical air command center
TAI	target area of interest
TETRA	terrestrial trunked radio
TF	task force
TRADOC	united states army training and doctrine command
TTP	tactics, techniques, and procedures

U

UA	unmanned aircraft
UAC	unmanned aircraft commander
UAS	unmanned aircraft system
UAV	unmanned aerial vehicle
UHF	ultrahigh frequency
UK	United Kingdom
UMC	unmanned mission commander
US	United States
USA	United States Army
USAF	United States Air Force
U.S.C.	United States Code
USMC	United States Marine Corps
USN	United States Navy
USSOCOM	United States Special Operations Command

V

v1	Version 1

v2	Version 2
VADER	vehicle and dismounted exploitation radar
VHF	very high frequency
VMF	variable message format
VMU	Marine unmanned aerial vehicle squadron
VO	vehicle operator
VoIP	voice over internet protocol
VoSIP	voice over secure internet protocol

W, X, Y, Z

WIMAX	worldwide interoperability for microwave access
WLL	wireless local loop
WMV	windows media video
WSADS	wind supported aerial delivery system

PART II – TERMS AND DEFINITIONS

air interdiction—Air operations conducted to divert, disrupt, delay, or destroy the enemy's military potential before it can be brought to bear effectively against friendly forces, or to otherwise achieve objectives. Air interdiction is conducted at such distance from friendly forces that detailed integration of each air mission with the fire and movement of friendly forces is not required. (JP 1-02. SOURCE: JP 3-0)

airspace control—A process used to increase operational effectiveness by promoting the safe, efficient, and flexible use of airspace. (JP 1-02. SOURCE: JP 3-52)

airspace control authority—The commander designated to assume overall responsibility for the operation of the airspace control system in the airspace control area. Also called ACA. (JP 1-02. SOURCE: JP 3-52)

airspace control order—An order implementing the airspace control plan that provides the details of the approved requests for airspace coordinating measures. It is published either as part of the air tasking order or as a separate document. Also called ACO. (JP 1-02: SOURCE: JP 3-52)

airspace control plan—The document approved by the joint force commander that provides specific planning guidance and procedures for the airspace control system for the joint force operational area. Also called ACP. (JP 1-02. SOURCE: JP 3-52)

air support operations center—The principal air control agency of the theater air control system responsible for the direction and control of air operations directly supporting the ground combat element. It coordinates air missions requiring integration with other supporting arms and ground forces. It normally collocates with the Army tactical headquarters senior fire support coordination center within the ground combat element. Also called ASOC. See also air support; close air support; tactical air control center. (JP 1-02. SOURCE: JP 3-09.3)

air tasking order—A method used to task and disseminate to components, subordinate units, and command and control agencies projected sorties, capabilities and/or forces to targets and specific missions. Normally provides specific instructions to include call signs, targets, controlling agencies, etc., as well as general instructions. Also called ATO. (JP 1-02. SOURCE: JP 3-30)

close air support—Air action by fixed- and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and that require detailed integration of each air mission with the fire and movement of those forces. Also called CAS. See also air interdiction. (JP 1-02. SOURCE: JP 3-0)

coordinating altitude—An airspace coordinating measure that uses altitude to separate users and as the transition between different airspace coordinating entities. (JP 1-02 SOURCE: JP 3-52)

fires—The use of weapon systems to create a specific lethal or nonlethal effect on a target. (JP 1-02: SOURCE: JP 3-0)

fire support—Fires that directly support land, maritime, amphibious, and special operations forces to engage enemy forces, combat formations, and facilities in pursuit of tactical and operational objectives. See also fires. (JP 1-02: SOURCE: JP 3-09.3)

intelligence—The product resulting from the collection, processing, integration, evaluation, analysis, and interpretation of available information concerning foreign nations, hostile or potentially hostile forces or elements, or areas of actual or potential operations. The term is also applied to the activity which results in the product and to the organizations engaged in such activity. (JP 1-02. SOURCE: JP 2-0)

intelligence, surveillance, and reconnaissance—An activity that synchronizes and integrates the planning and operation of sensors, assets, and processing, exploitation, and dissemination systems in direct support of current and future operations. This is an integrated intelligence and operations function. Also called ISR. See also intelligence; reconnaissance; surveillance. (JP 1-02. SOURCE: JP 3-0)

joint terminal attack controller—A qualified (certified) Service member who, from a forward position, directs the action of combat aircraft engaged in close air support and other offensive air operations. A qualified and current joint terminal attack controller will be recognized across the Department of Defense as capable and authorized to perform. Also called JTAC. See also terminal attack control. (JP 1-02. SOURCE: JP 3-09.3)

operational control—The authority to perform those functions of command over subordinate forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction necessary to accomplish the mission. Also called OPCON. (JP 1-02. SOURCE: JP 1)

personnel recovery—The sum of military, diplomatic, and civil efforts to prepare for and execute the recovery and reintegration of isolated personnel. Also called PR. (JP 1-02. SOURCE: JP 3-50)

reconnaissance—A mission undertaken to obtain, by visual observation or other detection methods, information about the activities and resources of an enemy or adversary, or to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area. (JP 1-02. SOURCE: JP 2-0)

spot report—A concise narrative report of essential information covering events or conditions that may have an immediate and significant effect on current planning and operations that is afforded the most expeditious means of transmission consistent with requisite security. (Note: Do not use spot report in reconnaissance and surveillance.) (JP 1-02. SOURCE: JP 3-09.3)

surveillance—The systematic observation of aerospace, surface, or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means. (JP 1-02. SOURCE: JP 3-0)

tactical air command center—The principal US Marine Corps air command and control agency from which air operations and air defense warning functions are directed. It is the senior agency of the US Marine air command and control system that serves as the operational command post of the aviation combat element commander. It provides the facility from which the aviation combat element commander and his battle staff plan, supervise, coordinate, and execute all current and future air operations in support of the Marine air-ground task force. The tactical air command center can provide integration, coordination, and direction of joint and combined air operations. Also called Marine TACC. (JP 1-02. SOURCE: JP 3-09.3)

target acquisition—The detection, identification, and location of a target in sufficient detail to permit the effective employment of weapons. (JP 1-02. SOURCE: JP 3-60)

unmanned aircraft—An aircraft that does not carry a human operator and is capable of flight with or without human remote control. Also called UA. (JP 1-02. SOURCE: JP 3-30)

unmanned aircraft system—That system whose components include the necessary equipment, network, and personnel to control an unmanned aircraft. Also called UAS. (JP 1-02. SOURCE: JP 3-30)

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MCRP 3-42.1A
NTTP 3-55.14
AFTTP 3-2.64
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