HANDBOOK

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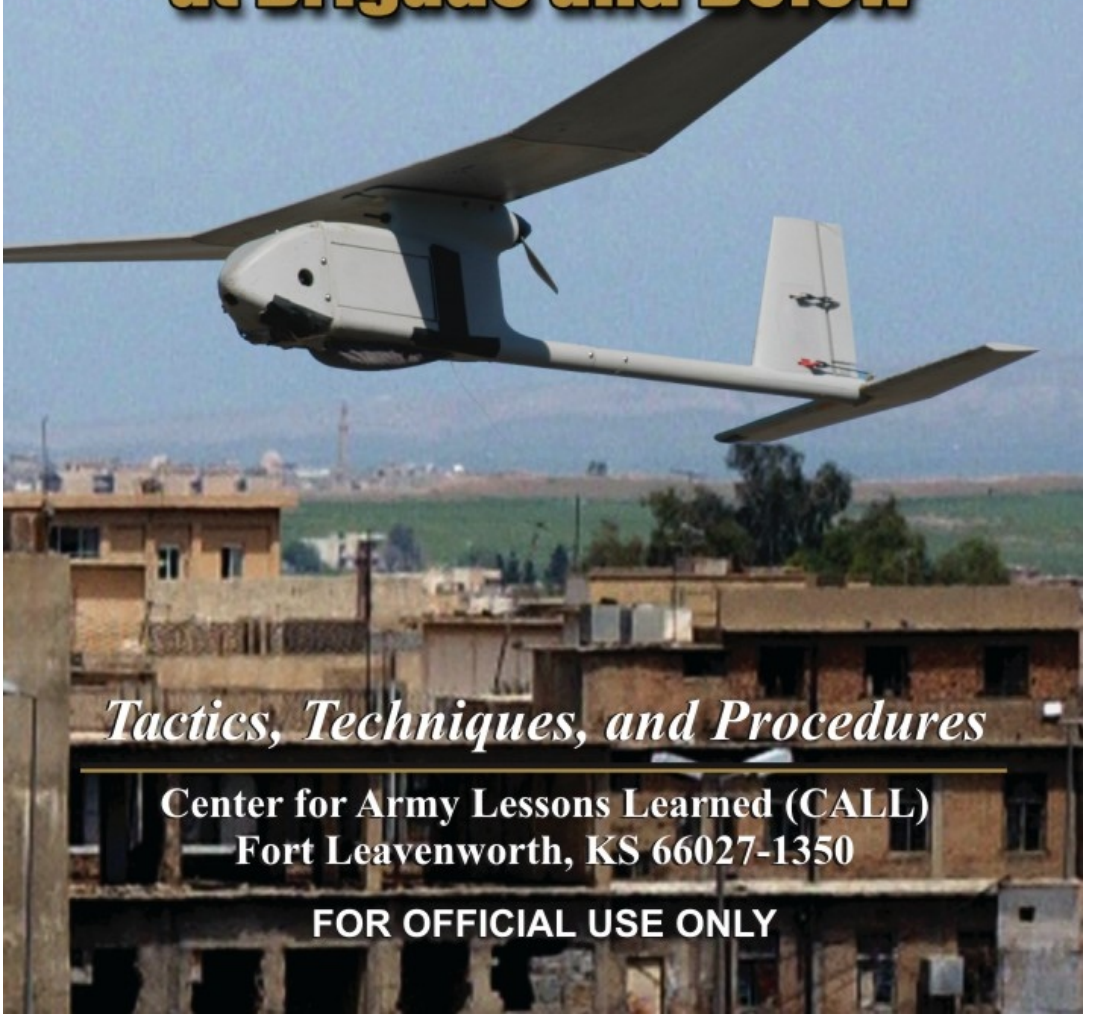
Leader's Guide to A2C2 at Brigade and Below



Tactics, Techniques, and Procedures

Center for Army Lessons Learned (CALL)
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Purpose

The purpose of this handbook is to enhance understanding of Army airspace command and control (A2C2) to mitigate risks between small unit unmanned aerial vehicles (SUAVs) and rotary wing operations below the coordinating altitude. This handbook provides leaders at the brigade and below with guidelines in the form of airspace coordination techniques and procedures regarding SUAV mission planning and airspace deconfliction.

This handbook is the result of combining information from several sources, including Raven operators currently deployed in support of Operation Enduring Freedom and Operation Iraqi Freedom.

Scope

This handbook provides an overview of A2C2, to include types of airspace control, modular design, and unit-level duties and responsibilities. It also focuses on SUAV operations and A2C2. Finally, it discusses common SUAV airspace coordination techniques and procedures.

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Due to the dynamic nature of both rotary wing and SUAV operations, A2C2 procedures must be established and enforced by the Chain of Command.

WARNING

Failure to conduct airspace coordination prior to SUAV operations may contribute to a mid-air collision resulting in severe injury or death to personnel.

LEADER'S GUIDE TO A2C2 AT BRIGADE AND BELOW

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CENTER FOR ARMY LESSONS LEARNED	
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CHAPTER 1
ARMY AIRSPACE COMMAND AND CONTROL

GENERAL

Army airspace command and control (A2C2) is the Army's application of airspace control to coordinate airspace users for concurrent employment in the accomplishment of assigned missions. Effective A2C2 enables all the battlefield operating systems to function efficiently while synchronizing air operations to support the commander's intent. Successful A2C2 is dependent upon the ability to perform the functions of identification, coordination, integration, and regulation of airspace users. A unit's proficiency in performing these functions correlates to its aptitude in command and control, air defense, fire support coordination, air traffic control, and airspace management activities.

It is important to understand that the term A2C2 does not denote Army ownership of a block of airspace or command over activities within that airspace. Rather, it refers to Army users of the airspace. All air missions are subject to the airspace control order (ACO) published by the Airspace Control Authority (ACA). It provides direction to deconflict, coordinate, and integrate the use of airspace within the operational area. Joint forces also use airspace to conduct air operations, deliver fires, employ air defense measures, and conduct intelligence operations. At times, these missions may be time sensitive and preclude the ability to conduct detailed coordination with the land force. It is imperative that land forces provide their higher headquarters with all airspace control measures in order to provide visibility to other Joint users and prevent fratricide.

Airspace control does not infringe on the authority vested in commanders to approve, disapprove, or deny combat operations. The primary objective of airspace control is to maximize the effectiveness of combat operations without adding undue restrictions and with minimal adverse impact on tactical operations. See **FM 3-52,** ***Army Airspace Command and Control in a Combat Zone,*** Aug 2002.

1. TYPES OF AIRSPACE CONTROL

Brigade operations require the commander to utilize airspace control to synchronize air and ground battlespace in support of the scheme of maneuver. Airspace users are controlled by positive and procedural means, or a combination of both. Examples which combine both procedural and positive control measures are located in Chapter 3.

Positive Control

Positive control is conducted by elements designated by the ACA that positively identify, track, and direct air assets in the airspace control area. It uses electronic means such as radar; other sensors; identification, friend or foe (IFF) systems; selective identification feature capabilities; digital data links; and other elements of the command, control, communications, and computer systems. Normally, the brigade combat team (BCT) does not have the capability to provide positive control unless augmented with an air traffic services (ATS) support package.

Procedural Control

Procedural control relies on previously agreed to and disseminated airspace control measures; these may include rules of engagement (ROE), restricted operating areas/zones (ROA/ROZ), standard use Army aircraft flight route (SAAFR), aircraft identification maneuvers, fire support coordinating measures (FSCM), and coordinating altitudes. Chapter 4 of FM 3-52 describes the different types of procedural control measures. Furthermore, it provides Army airspace control measures standing operating procedures, which aid in deconfliction.

Among the procedural airspace control measures, it is particularly important for leaders at brigade, battalion, company, and platoon levels to understand the following:

a. *An air control point (ACP)* is an easily identified point on the terrain or an electronic navigational aid used to provided necessary control during air movement. ACPs are generally designated at each point where the flight route or air corridor makes a definite change in any direction and at any other point deemed necessary for timing or control of operations. It is a graphic control measure used to segment an air corridor similar to checkpoints on a ground route.

b. *An air corridor* is a restricted air route of travel specified for use by friendly aircraft and established for the purpose of preventing friendly aircraft from being fired on by friendly forces. Air corridors are used to route combat aviation elements between such areas as forward arming and refueling points (FARPs), holding areas, and battle positions. These corridors also deconflict artillery firing positions with aviation traffic, including unmanned aerial vehicles (UAVs). Altitudes of an air corridor do not exceed the coordinating altitude.

c. *A base defense zone (BDZ)* is an air defense zone established around an air base and limited to the engagement envelope of short-range air defense weapon systems defending that base (JP 3-52). BDZs have established entry, exit, and IFF procedures. The base defense zone may be thought of as a specific type of ROA or special-use airspace. Employment of counter-rocket, artillery, and mortar (C-RAM) capabilities at fixed sites or bases within a BCT's area of operations (AO) may necessitate the establishment

of a BDZ.

d. *Coordinating altitude* is a procedural airspace control method used to separate fixed and rotary wing aircraft. This method determines an altitude below which fixed-wing normally will not fly and above which rotary wing will normally not fly. The airspace control plan (ACP) normally specifies the coordinating altitude and may include a buffer zone for small altitude deviations.

e. *Restricted operating zones/areas (ROZ/ROA)* is airspace of defined dimensions created in response to specific operational situations or requirements within which the operation of one or more airspace users is restricted. Establishing an ROZ helps prevent fratricide by closely restricting access over a designated surface area. Typical uses are over Army Tactical Missile System (ATACMS) launch and target areas as well as UAV launch and recovery areas. Depending upon the ACP, a specific area of responsibility (AOR) may or may not be included on the ACO.

ROZ/ROAs can be established over areas where combat operations involving a mix of air vehicles are likely to be employed (i.e. over urban operations areas). The ROZ/ROA is disseminated throughout theater using the ACO. Information about the ROZ includes contact frequency for the aircraft desiring to transition through the ROZ.

The BCT responsible for the AO is also in charge of monitoring frequency and communicating with aircraft as required for the entire period the ROZ is active. Although the brigade tactical operations center (TOC) radio-telephone operator (RTO) may be responsible for monitoring the frequency, the brigade fire support element (FSE) coordinates and tracks all fires and aviation activity in the ROZ/ROA. Refer to FM 3-52 for more information.

WARNING

Failure to conduct airspace coordination prior to SUAV operations may contribute to a mid-air collision resulting in severe injury or death to personnel.

2. TYPES OF SEPARATION

There are three primary means of maintaining separation between manned and unmanned aircraft: lateral, time, and vertical separation. Beyond the need to ensure physical separation exists, leaders must plan for frequency separation between unmanned vehicles.

a. Lateral separation spaces aircraft that may be operating at the same altitude by not having them operate in the same geographic space. This can be done through the assignment of flight corridors, ROA/ROZ, and other graphic control measures such as phase lines and unit boundaries.

b. Time separation spaces aircraft that may be operating in the same geographic area or at the same operating altitudes by not allowing them to operate at the same time. Time separation may also be required when aircraft, manned and unmanned, must fly near indirect-fire trajectories or ordnance effects. The timing of surface fires must be coordinated with aircraft routing. This ensures that, even though aircraft and surface fires may occupy the same space, they do not do so at the same time.

c. Vertical separation spaces aircraft based on operating altitude or by assigning different operating altitudes to other aircraft that may be working in the same geographic area. Vertical separation is the least preferred method since SUAVs and rotary wing aircraft normally operate from the surface to 500 feet above ground level (AGL).

3. A2C2 UNDER THE MODULAR DESIGN

In the Modular Force, airspace management occurs in A2C2 cells, organic to units from the BCT through the unit of employment (UEy). These cells combine aviation and air defense artillery personnel who operate in close coordination with the unit's fires and effects cell (FEC). Fires and airspace deconfliction in the FEC at the BCT level is closely coordinated between the targeting officer, air liaison officer (ALO), effects coordinator (ECOORD) and the Air Defense Airspace Management/Brigade Aviation Element (ADAM/BAE) cell. The FEC and the ADAM/BAE cells should be located side by side in the BCT command post (CP) to facilitate rapid coordination.

These A2C2 cells from the BCT through the UEy have full digital connectivity to the theater level, enabling the BCT to request airspace digitally. This digital connectivity should drastically reduce the processing and staffing time associated with airspace requests. The Tactical Airspace Integration System (TAIS) is the component of the Army Battle Command System (ABCS) for automating and integrating airspace management at the BCT and above.

Note: For units that have not yet transitioned to the Modular Force, commanders must assign these critical duties and responsibilities of airspace coordination to someone within their organization (usually a member of the S3 staff).

See battalion A2C2 tasks on the following page. Other methods are available and used for non-TAIS equipped organizations or when TAIS digital connectivity does not exist. See Appendix C for examples.

Brigade A2C2 Organization

a. Brigade Combat Teams: BCTs have an ADAM/BAE cell to conduct the function of airspace management. The ADAM/BAE combines air and missile defense and aviation personnel, along with enhanced digital capabilities, to provide the BCT with a capability to perform A2C2 and maintain a near real-time airspace picture. The ADAM/BAE coordinates A2C2 requirements with higher headquarters and may be required to coordinate with Joint or Multi-National Forces to integrate the BCT requirements into the operations.

The brigade aviation officer (BAO) is the lead integrator among the brigade staff members responsible for A2C2 tasks. The primary duty of the BAO is to integrate aviation into the scheme of maneuver. The BAO accomplishes this by close coordination with the S-3 and BCT commander. The BAO works for the BCT commander and is an integral part of his staff. He must also maintain a relationship with the aviation brigade commander and his staff. The BAO must ensure that appropriate information is exchanged between the aviation brigade, the BCT, and the rest of the BAE to facilitate smooth and timely aviation support.

Within the ADAM/BAE, the BAE supports the BCT commander by planning and synchronizing Army aviation operations and conducting A2C2 throughout the BCT AOR. Paired to this effort, the ADAM provides the BCT commander with a joint capability. It can link with an air picture provider, (joint or local) to detect aircraft as they become airborne, assign them a friendly identification (ID), and transmit the track information and ID to reduce the chance of fratricide. The ADAM cell air defense coordinating officer is in charge of air and missile defense (AMD) operations within the ADAM/BAE and provides situational awareness, situational understanding, and early warning for the brigade.

The ADAM/BAE implements and disseminates the airspace control order (ACO) for brigade and below and the FEC provides the same function for the air tasking order (ATO). The BAE is responsible for the integration and synchronization of the ACO/ATO. The BAE is responsible for the integration and synchronization of Army aviation and UAVs and submits airspace control means requests (ACMREQ) to the next higher A2C2 element. When the BCT works directly for a Joint Task Force, the ADAM/BAE is capable of interfacing directly with the battlefield coordination detachment (BCD) (the Army's liaison at the air operations center).

b. Other Brigades: The ADAM/BAE is a standardized organization that exists in the heavy and light BCTs. A similar organization, the ADAM cell, exists in the Stryker brigade combat team (SBCT) with a smaller aviation element. Variants of the ADAM/BAE also exist in other brigades such as the Battlefield Surveillance Brigade (BFSB), Fires Brigade, and Aviation Brigade. While the structure may be different from the ADAM/BAE in the BCT, the functions and responsibilities remain the same.

Battalion and Below A2C2 Organization

The battalion and below have no formal A2C2 element. **The battalion S3 has overall responsibility for coordinating, deconflicting, and managing airspace within the battalion AO.** The ADAM/BAE at the BCT minimizes the A2C2 workload on battalion/company/platoon SUAV operators. The battalions must coordinate with the ADAM/BAE at the BCT to ensure their mission requests are processed as efficiently and expeditiously as possible.

4. BATTALION A2C2 TASKS

- Establish "S3 Air" equivalent, from existing personnel assigned to the S3 section, that has staff responsibility for all SUAV operations.
- Receive and disseminate SUAV airspace request approvals/ changes/ disapprovals.
- Review planned and immediate airspace requests and resolve conflicts within the battalion.
- Monitor and analyze aviation, SUAVs, field artillery, air defense, and maneuver operations to determine and resolve conflicts.
- Submit to ADAM/BAE all planned and immediate airspace requests including SUAV (Appendix C).
- Communicate any deviations from pre-planned mission to the ADAM/BAE or higher headquarters immediately.
- Ensure no SUAV flies without prior airspace coordination through the ADAM/BAE or higher headquarters.
- Inform airspace users at each echelon of any communication loss during operations.
- Track and report aviation, field artillery, air defense, and SUAV systems and personnel status.
- Monitor rotary/fixed wing aircraft in the battalion AOR to aid in deconflicting SUAVs and other air traffic.
- Manage separation and frequencies of battalion and below UAV operations.

5. SUAV MISSION REQUEST FORMAT

There are two types of mission requests: planned and immediate. Further, there are two formats for requesting planned missions and one format for an immediate mission. Examples of mission requests are located in Appendix C. The battalion

will consolidate and deconflict subordinate mission requests and send to the ADAM/BAE at the BCT. The ADAM/BAE will extract the pertinent information for airspace management. If TAIS is used to deconflict airspace, the ADAM/BAE will enter the data into the TAIS workstation. Mission requests can be sent by radio (Single Channel Ground and Airborne Radio System [SINCGARS], very high frequency [VHF], ultra high frequencey [UHF]), advanced mobile phone system [AMPS], Force XXI battle command brigade and below (FBCB2), TAIS Web page for Airspace Control Means Requests and Tracking [WebACMR], or Blue force tracking (BFT).

6. MISSION APPROVAL FLOW GUIDE
(See Appendix A for abbreviated checklist)

The ADAM/BAE, representing the brigade commander/S3, has the responsibility to deconflict air missions between battalions. Conflicts may result in mission modifications or cancellation dependant upon mission priority.

ABCS provides a means for rapid deconfliction and the ability to quickly share digital airspace information between units and higher echelons. Because the ADAM/BAE will have visibility of airspace requests across the network, most deconfliction will occur at the brigade level.

For non-Modular Forces or forces lacking digital connectivity, the mission approval flow remains the same but the systems used and the personnel executing specific responsibilities will be different. The S3/G3 and the S3/G3 Air carry out the roles and responsibilities of the ADAM/BAE/UEx A2C2 Cell. While TAIS is the primary intended means for managing airspace, other methods are available and used for non-TAIS equipped organizations or when TAIS digital connectivity does not exist. An example of another method would be to create a Falcon View screen capture that is then imported into a Power Point slide. See Appendix C for example format and detailed information.

SUAV MISSION PLANNING FLOW

1. Battalion commander, S3, S2, fire support officer (FSO), or company commander determines a need for SUAV mission.

2. Battalion S3 (or S3 Air, if assigned) ensures no internal battalion conflict with other internal SUAV operations and other known airspace users (aircraft; close air support [CAS]; fires; counter-rocket, artillery, and mortar [C-RAM], etc.) and passes initial mission data down to supporting company to begin planning. The company, with assistance from the SUAV mission commander, creates a detailed flight plan that includes specific routes, times, and locations. The battalion S3 also submits a mission request up to the BCT's ADAM/BAE (see Appendix C).

3. If the ADAM/BAE receives the request by voice or text, they enter the pertinent airspace data into the TAIS. If the data is received via WebACMR, the data will be automatically entered into TAIS. The ADAM/BAE reviews the mission request to determine any airspace conflicts between the SUAV and other airspace users in the brigade AO.

- Since most SUAV missions fly below the coordinating altitude, the focus for deconfliction will be with Army aviation or CAS weapons effects.
- Theater-specific directives will determine mission request approval authority.
- When C-RAM capabilities are employed in the brigade AOR, a base defense zone (BDZ) or similar airspace control measures (ACM) may impose certain additional deconfliction or coordination requirements on UAV operations, to include coordination with any C-RAM unit operating at intended SUAV launch/recovery sites.

4. If a conflict exists, the ADAM/BAE determines mission priority based upon the commander's guidance and makes recommendations to the brigade airspace approval authority (the brigade S3 or brigade CDR). Once a course of action is approved, the ADAM/BAE notifies the affected battalion S3/S3 Air and provides recommended modifications to support mission request, if possible.

- Battalion S3/S3 Air accepts modifications or provides an alternative course of action (COA).
- The ADAM/BAE then updates the modified/alternate mission data with higher headquarters.

5. Once the ADAM/BAE deconflicts the mission request, it is forwarded to higher headquarters A2C2 Cell and G3 Aviation (AVN) Cell (usually the UEx).

- As the company further refines the mission details, it sends the updated data to the battalion S3/S3 Air, who in turn forwards it to the ADAM/BAE.
- The ADAM/BAE adds any additional detail/modifications to the mission request, which is now potentially visible at every brigade and above level A2C2 cell in theater.

6. The UEx A2C2 cell forwards the approved mission request to higher A2C2 cells and all subordinate BCTs and support brigades (ie, Fires Brigade, Maneuver Enhancement [ME] Brigade, Battlefield Surveillance Brigade [BFSB], and Aviation [AVN] Brigade) for coordination and safety purposes. If the approval authority is UEx or higher, formal approval methods will be used and the mission request will be approved once it is deconflicted.

- If the mission request conflicts with other missions, UEx A2C2 cell determines mission priority based upon the commander's guidance and makes recommendations to the UEx approval authority (usually the UEx G3).

- Once the airspace approval authority approves a COA, the UEx A2C2 cell notifies the affected brigade ADAM/BAE cell of the conflict and provides recommended modifications to support the mission request.
- The ADAM/BAE deconflicts the mission with appropriate requesting organization.
- ADAM/BAE sends modified approved mission request back to UEx A2C2 cell for deconfliction/approval/situational awareness (approving authority dependent), simultaneously updating and modifying previously submitted mission requests.

7. Once the UEx deconflicts the mission request across the entire UEx force, the mission request is forwarded to the higher headquarters in accordance with theater-specific procedures.

CHAPTER 2
SMALL UNIT UNMANNED AERIAL VEHICLE (SUAV) OPERATIONS AND A2C2

1. SUAV PLANNING AND MISSION EXECUTION

The mission of the SUAV is to provide reconnaissance, surveillance, and target acquisition (RSTA); day/night imagery to support situational awareness; and battle damage assessment (BDA). The SUAV operates from platoon to battalion level and is suited for rapid employment to meet the needs of the commander.

Due to the dynamic nature of both rotary wing and SUAV operations, A2C2 procedures must be established and enforced by the chain of command.

2. AIRSPACE MANAGEMENT FOR SUAVs

Airspace control procedures must be used to safely employ SUAVs in conjunction with rotary and fixed wing aircraft, other UAVs, friendly air defense fires, and indirect fires in the unit of employment (UEx) airspace. Each unit will have unique airspace challenges based on its area of operations (AO) (civilian airports, controlled airspace, urban operations, etc.) and mission set (tactics, techniques, and procedures [TTP] for employment of air and fires assets). Because of these distinct differences in AOs, SUAV planners must know and comply with the established airspace procedures and applicable area of responsibility (AOR) aviator planning guide to prevent loss of life and/or damage to equipment.

SUAV flights must be coordinated to ensure deconfliction with other airspace users. **The primary means for ensuring that the SUAVs are deconflicted with all other airspace users is through the Air Defense Airspace Management / Brigade Aviation Element (ADAM/BAE) at the brigade.** The ADAM/BAE serves as the "one stop shop" in the Modular Force for airspace deconfliction at the brigade level. The ADAM/BAE deconflicts all airspace missions within the brigade and forwards requests to higher headquarters to ensure deconfliction occurs with units above the brigade level. The ADAM/BAE will coordinate among battalions, through higher headquarters, to safely separate SUAVs from manned aircraft and to prevent engagement by friendly air defense systems.

The Airspace Control Authority (ACA) may use the coordinating altitude to separate fixed wing traffic from SUAV traffic in the same manner it sometimes uses the coordinating altitude to separate fixed wing traffic from rotary wing traffic. If this occurs, the approval authority for most SUAV missions will reside at either

the UEx or, possibly, at the brigade level and mission requests will be sent higher for situational awareness.

WARNING

Failure to conduct airspace coordination prior to SUAV operations may contribute to a mid-air collision resulting in severe injury or death to personnel.

3. PREPLANNED SUAV OPERATIONS

Preplanned SUAV flights should, when possible, appear on the Airspace Control Order (ACO) allowing for advanced notice of SUAV operations to manned rotary wing aircraft. Airspace requirements are identified and requested through airspace management channels (ADAM/BAE) during planning to ensure deconfliction. If approval authority resides below the Joint Forces Air Component Commander (JFACC), these missions may not appear on the air tasking order (ATO)/ACO if the SUAV operating altitude remains below the coordinating altitude. Instead, the UEx may manage a separate list or matrix of missions below the coordinating altitude that, nevertheless, must be deconflicted and receive approval internal to the UEx.

The information required can be found in Appendix C, Mission Request Format. This should be submitted as soon as possible to the ADAM/BAE for deconfliction.

4. IMMEDIATE SUAV OPERATIONS

Immediate SUAV missions are conducted with limited or no prior planning. Despite being time sensitive, airspace coordination must still occur. It is incumbent upon units at all levels to develop battle drills to expedite planning, A2C2, and mission execution. Immediate SUAV missions will be coordinated with the appropriate airspace control agencies (the ADAM/BAE at the BCT) to safely separate SUAVs from manned aircraft and to prevent inadvertent engagement by friendly air defense elements.

At a minimum, the Immediate Mission Request Format (below) must be submitted to the ADAM/BAE. The requestor will be informed by the ADAM/BAE when launch permission is granted and a UAV launch alert should be broadcasted to notify all BCT airspace users.

Immediate Mission Request Format:

Line 1: Unit identification (call sign and frequency)
Line 2: Launch and recovery site
Line 3: Restricted operating areas (ROA) location (includes global positioning system [GPS] coordinates and operating altitude)
Line 4: Ingress route azimuth and distance
Line 5: Egress route azimuth and distance
Line 6: Times and durations of mission
Line 7: SUAV operating channel

CHAPTER 3
COMMON SMALL UNIT UNMANNED AERIAL VEHICLE (SUAV) AIRSPACE COORDINATION TECHNIQUES AND PROCEDURES

1. TYPES OF PROCEDURAL AIRSPACE CONTROL

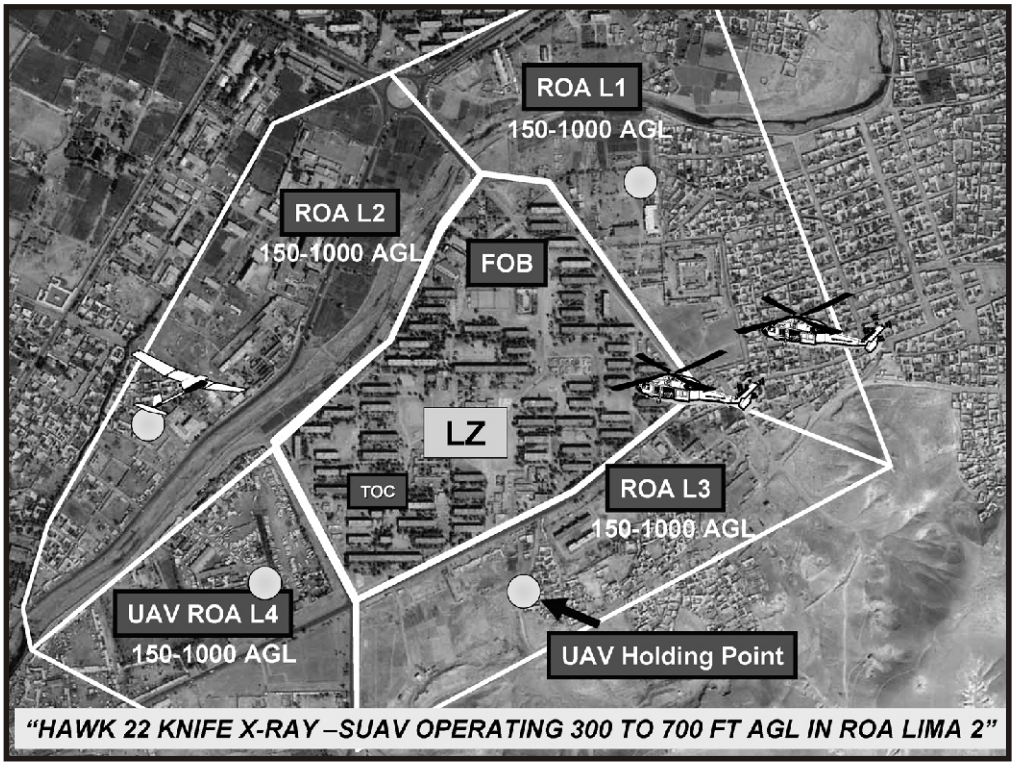


Figure 1. SUAV Operations within Vicinity of Forward Operating Base (FOB)

SUAV Operations within Vicinity of FOB

- This procedure involves two basic principles: Pre-establishment of ROAs and operating only within approved/active ROAs.
- Pre-establish ROAs around the FOB over key areas to facilitate rapid launch of SUAV as part of a quick reaction force.
- Battalion S3 submits SUAV mission request to ADAM/BAE cell.
- If a Battalion FOB, the battalion S3/fire support officer (FSO) will manage the airspace.
- Operators call tactical operations center (TOC) and obtain clearance from S3/FSO prior to launching SUAV and remain in radio contact during entire mission.
- Higher headquarters is advised of SUAV launch for quick reaction mission.
- TOC deconflicts airspace with rotary wing aircraft.

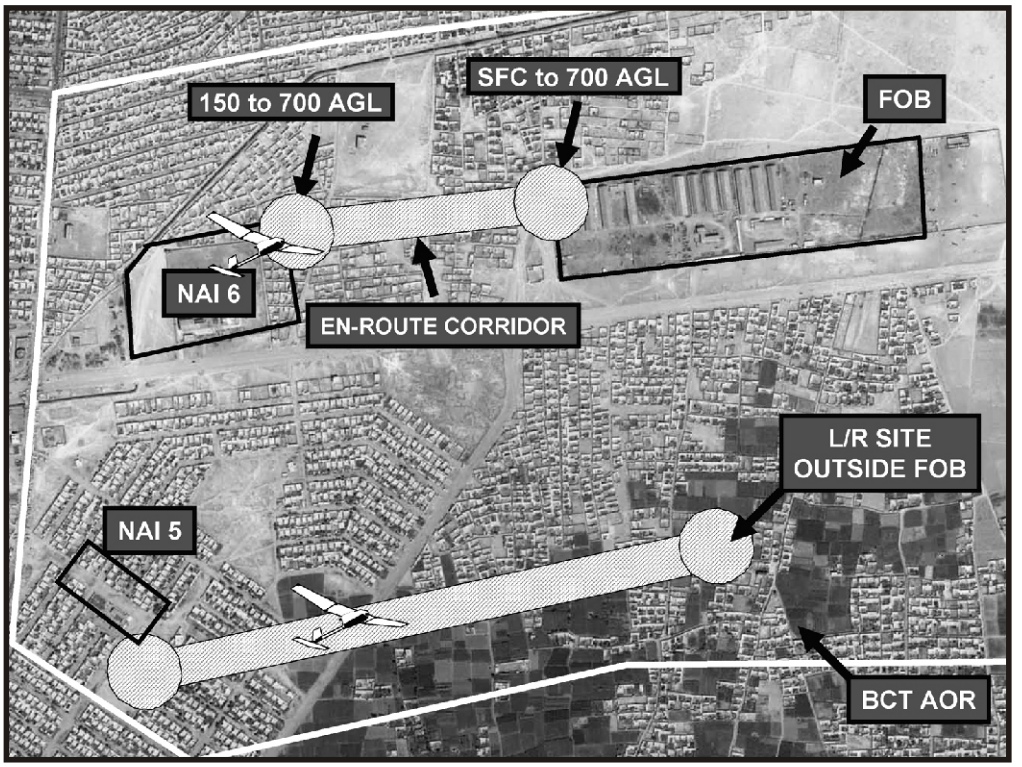


Figure 2. SUAV Operations within a BCT AOR

SUAV Operations within a Brigade Combat Team (BCT) Area of Responsibility (AOR)

- SUAV operations within a BCT AOR follow the principles of a pre-planned or immediate mission.
- SUAV operators request to establish an ROA (within the AOR) to support the mission.
- Airspace controlling agency establishes ROA and disseminates to rotary wing units operating in AOR.
- Rotary wing assets requesting to transition through AOR are notified of ongoing SUAV operations on the brigade/battalion TOC net.
- SUAV operators contact battalion TOC prior to launch.
- Battalion TOC notifies higher headquarters TOC.
- SUAV operators maintain radio/digital contact during entire mission with airspace controlling agency of AOR.

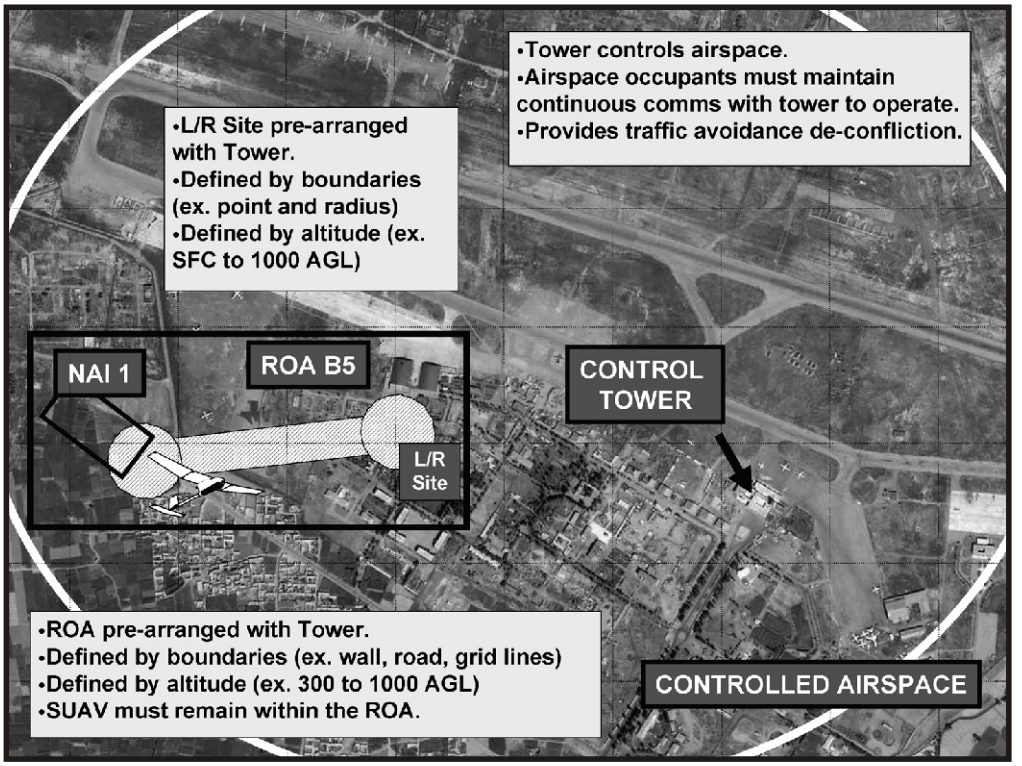


Figure 3. SUAV Operation Vicinity Airfield/Airport

SUAV Operations Vicinity Airfield/Airport

- SUAV mission is within controlled airspace.
- Tower controls the airspace and is responsible for deconfliction.
- SUAV operators or staff representative conduct coordination with tower and establish procedures for SUAV operations within the controlled airspace.
- SUAV operators establish means of two-way communications with tower.
- SUAV operators submit mission plan in advance, if possible.
- SUAV operators request permission to launch and recover the SUAV.
- SUAV operators must maintain positive communications with the control tower during SUAV operations in the controlled airspace.
- SUAV operators take commands from the tower during operations, as required, to allow other traffic to move through ROA.
- Upon mission completion, the operators call tower and close the ROA.

Note: This example does not circumvent the normal planning sequence, but since the operation occurs within controlled airspace, the SUAV operator must coordinate and communicate directly with the airspace controller during execution of the mission.

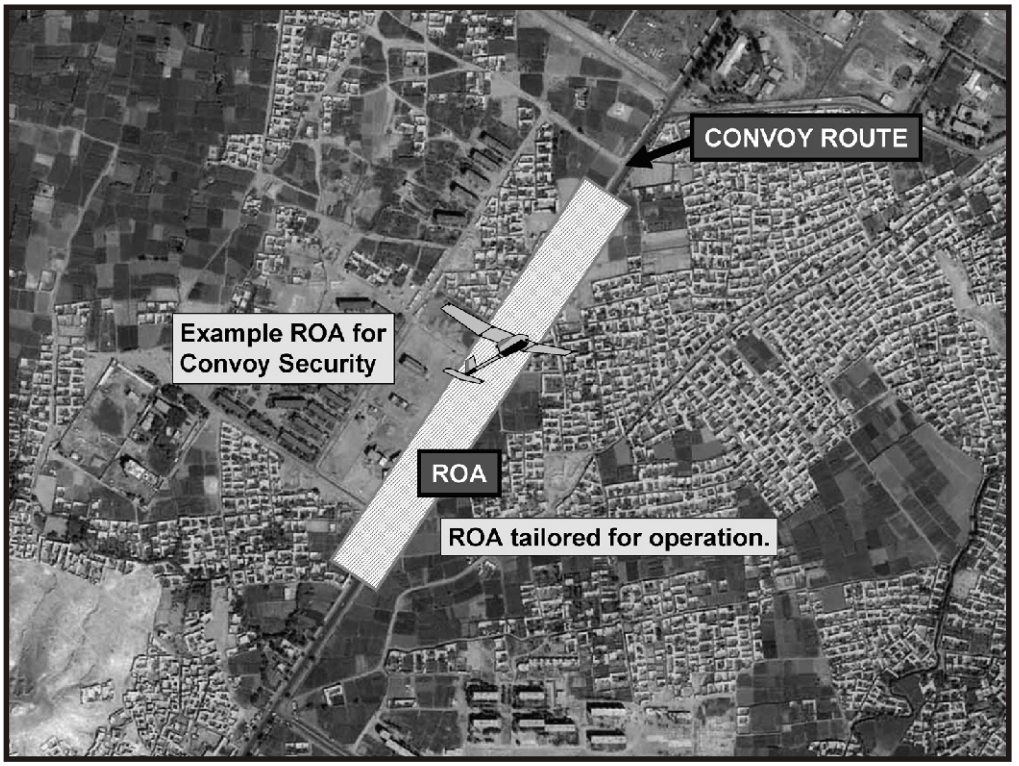


Figure 4. SUAV Operations outside BCT AOR

SUAV Operations outside BCT AOR

- Mission required for convoy security or route reconnaissance operations when operating outside the BCT AOR (i.e., convoy/route recon/improvised explosive device [IED] sweep).
- May be used in non-contiguous operations, where SUAV operates between BCTs' AORs in areas controlled by UEx.
- SUAV operators request, in advance, (through battalion and BCT) to establish an ROA to support the mission.
- Use of an air route, with multiple air control points (ACP), is a suitable form of airspace control for these types of missions.
- If a standard use Army aircraft flight route (SAAFR) already exists, this route could be used. To prevent an entire route being activated, battalion notifies the ADAM/BAE to activate segments as the convoy moves, freeing the remainder of the SAAFR for other airspace users.
- ADAM/BAE submits request through the UEx for coordination.
- SUAV operator maintains communications with higher headquarters or airspace controlling agency during entire mission.
- Common procedures also established to separate SUAV from other aircraft.
- Battalion communicates with rotary wing aircraft as required to facilitate traffic avoidance.

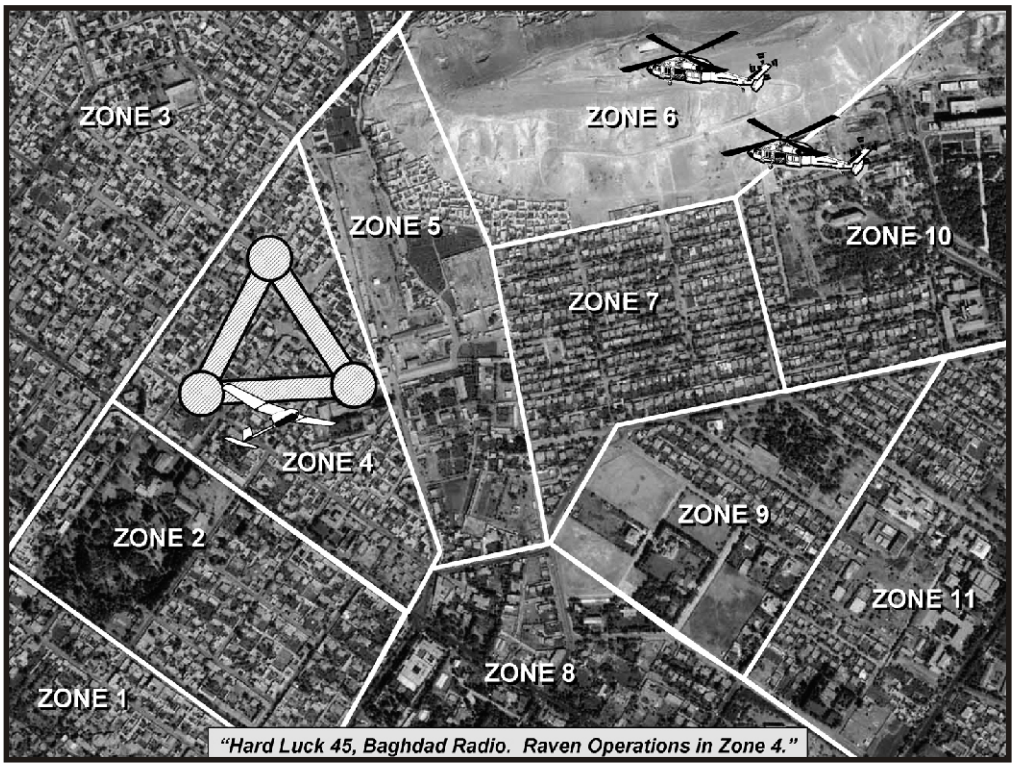


Figure 5. SUAV High Density Urban Operations

SUAV High Density Urban Operations

- It is an area with a high volume of rotary wing/fixed wing and UAV traffic.
- A high density urban area is segmented into zones for ease of procedural control, and managed by an airspace control agency (i.e. Baghdad Radio).
- Two-way communications is required for all participants.
- SUAV operators submit mission request in accordance with standard request procedures (including L/R point and mission ACPs).
- After mission approval from battalion, SUAV operators call the airspace control agency prior to launch and maintain positive communications during operation.
- SUAV operators must request permission from the airspace control agency prior to movement between ACPs or zones prior to descending below transit altitude.

2. LOSS OF LINK RECOVERY OPERATIONS

Loss of link is a function of no uplink from the ground control unit (GCU) to the air vehicle, no down link from the air vehicle to the GCU, or both. When this loss of link occurs, the air vehicle will initiate whatever program was planned into the GCU (i.e., rally to a predetermined point or land as soon as loss of link is detected). Failure to adequately prepare for loss of link may result in loss of air vehicle. If link quality degrades to the point where the operator no longer has control of the air vehicle, the operator must do the following:

- Immediately notify higher airspace controlling agency (i.e. fires and effects cell [FEC], combat control teams [CCT]) of air vehicle loss of link to include: last known position, heading, airspeed, altitude, and approximate battery time remaining.
- Continue attempts to regain control of the air vehicle, including commanding AUTOLAND.
- Assess the situation (proximity of other aircraft, restricted airspace, etc.) and report possible entry of the air vehicle into any known hazards.

Upon notification of an SUAV that is no longer controlled by the operator, the ADAM/BAE or airspace control agency (tower, Baghdad Radio, FOB TOC) will broadcast an advisory on appropriate frequencies to notify any other airspace users of the errant SUAV.

APPENDIX A: MISSION FLOW GUIDE

- SUAV mission requirement determined
- Mission planning at appropriate levels begins
- Mission request submitted from battalion to ADAM/BAE
- ADAM/BAE reviews mission request for conflicts
- If there are no conflicts, the ADAM/BAE notifies the battalion S3 of acceptance and forwards to next higher level authority
- If there is a conflict, ADAM/BAE:
  - » Makes recommendations to the airspace approval authority
  - » Notifies the battalion S3 along with recommended modifications
  - » Battalion S3/S3Air accepts or provides an alternative
  - » The ADAM/BAE updates the mission
- Mission request is forwarded to the next higher A2C2 cell (usually the UEx)
- Mission refinements are continually forwarded for update

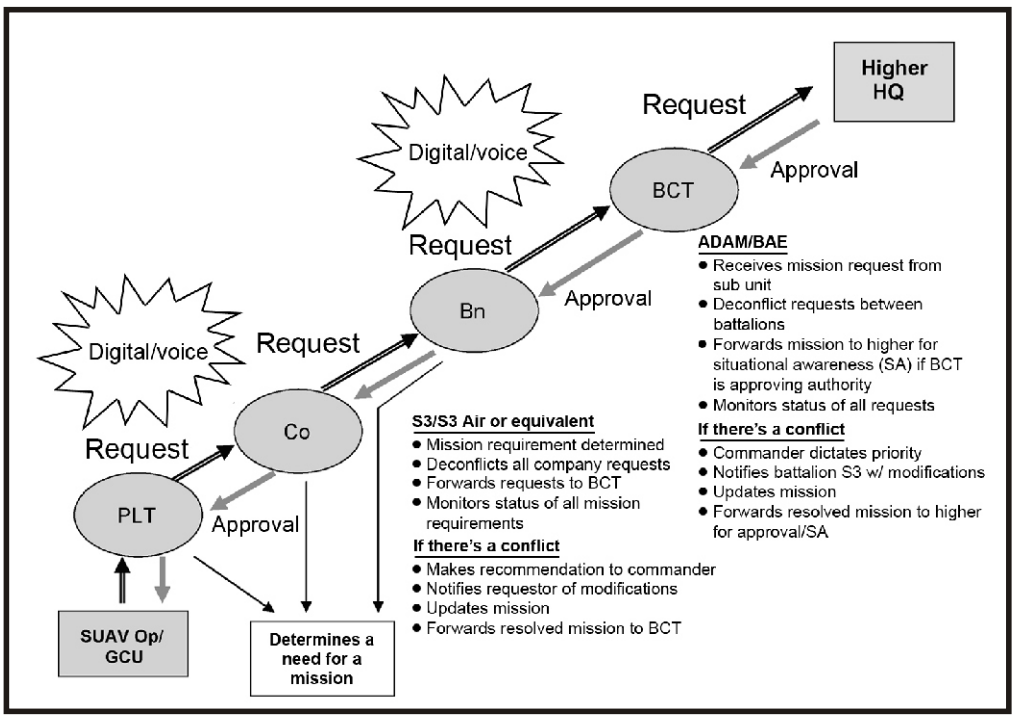


Figure 1. Mission Flow

APPENDIX B:
SUAV TROOP-LEADING PROCEDURES CHECKLIST

RECEIVE THE MISSION

- Identify priority information requirements (PIR), specific named areas of interest (NAIs)
- Time of mission execution
- Get target approval from battalion
- Request weather forecast from S2

ISSUE WARNING ORDER

- Charge / confirm charge of aircraft / video recorder batteries
- Prep aircraft (two aircraft if available or as per SOP), GCU, and remote video terminal (RVT)
- PCI equipment list
    - Binoculars
    - Hand-held GPS
    - Map
    - Charged batteries (GCU and AV)
    - Battery charger and generator or power source
    - Compass
    - Repair kit with tape
    - Flashlight and chemlights
    - Recording device
    - Flight logs
    - SUAV Operator's Manual
    - Notebook
    - Wind meter

MAKE A TENTATIVE PLAN

- Refer to SUAV Operator’s Manual for planning considerations
- Initiate the mission planning process with consideration given to:
    - Aircraft availability
    - Location and compliance with ACMs (ROZ/ROA, etc.)
    - Mission launch criteria
    - Weather
    - Target location
    - Collection requirements
    - Threat
    - Battery requirements
    - Altitude and speed
    - Loiter times
    - Crew manning
    - UAVs return to home locations
    - Emergency recovery options

- Plot target and mission (utilize Portable Flight Planning Software (PFPS)/Falcon View if available)
- Conduct line of sight analysis using digital terrain evaluation data (DTED) and planned flight altitudes
- Print graphics of specific NAIs
- Determine launch site

INITIATE MOVEMENT

- Prepare all equipment for mission

CONDUCT RECONNAISSANCE

- Recon launch site
- Conduct map / imagery recon of objectives

COMPLETE THE PLAN

- Utilize the Mission Request Format found in APPENDIX C.
- Plan flight route on PFPS/Falcon View (airspace control measures, mission graphics, etc.)
- Program above ground level (AGL) altitudes for entire flight on PFPS/Falcon View
- Submit the Mission Request (APPENDIX C)
- Once the Mission Request is approved, proceed with the mission

ISSUE THE ORDER

- **Conduct the SUAV Mission Team Briefing**

SUPERVISE

- Verify grids
- Sanity check all altitudes, azimuths, and distances
- Triple check to ensure all equipment is loaded and inspections are completed

CONDUCT INSPECTIONS

- Perform pre-combat inspections (PCIs) on vehicles
- Load radios, conduct commo checks
- Ensure all radios loaded with current communications security (COMSEC) and tuned to appropriate frequencies
- Setup RVT antenna and link to TOC
- Ensure mission essential equipment on hand

CONDUCT REHEARSALS

APPENDIX C: MISSION REQUEST FORMAT
Example (Preferred Method)

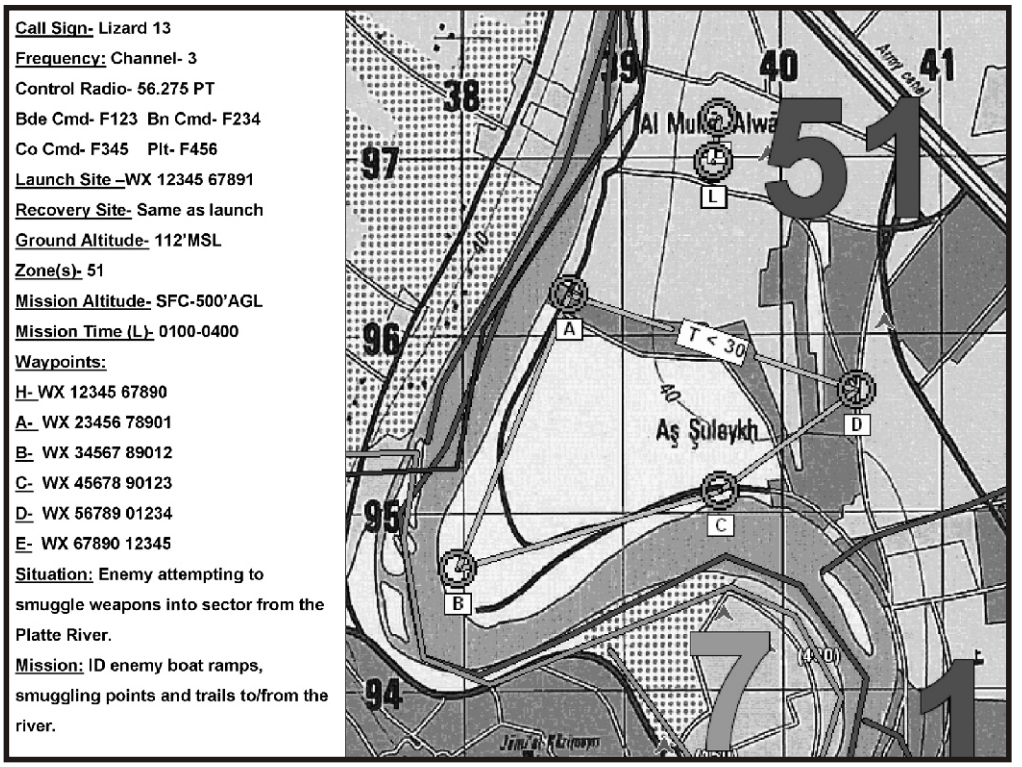


Figure 1. Mission Request Format

APPENDIX C: MISSION REQUEST FORMAT Example

Requestor Information

Unit: _____
POC: _____
Phone: _____
Email: _____

Contact Frequency: _____

Mission Purpose:_____

Requested Name of Airspace Control Measure:_____

Launch Site (Grid)_____ Recovery Site (Grid)_____

Launch Site Altitude (MSL) _____ Recovery Site Altitude (MSL) _____

SUAV Channel _____

Type of Measure (Shape) Mark an "X" next to type requested:

- **ROZ** (Circle) Grid coordinate of center point_____Radius___(Nm/miles/Km)
- **Route** (Corridor) Enter two coordinates & width for each segment. Identify (Nm/m/km)

1._____w:____	5._____w:___	9._____w:____
2._____w:____	6._____w:___	10._____w:____
3._____w:____	7._____w:___	11._____w:____
4._____w:____	8._____w:___	12._____w:____

- **Box** (Can have more than 4 points.) Enter a coordinate for each corner of the shape:

1.	5.	9.
2.	6.	10.
3.	7.	11.
4.	8.	12.

Flight Altitude in AGL Minimum: _____ Maximum: _____

DTG of Mission: Start (Launch)_____ Stop (Recovery)_____

NOTE: ZULU TIME ONLY! Zulu = Local +/- ___ Hours.

DTG Request Submitted to Battalion S-3: _____

OFFICE USE

Battalion S-3: Reviewed By_____

Sent to ADAM/BAE (POC and DTG) _____

Comments:

ADAM/BAE: Received By_____

Approved/Disapproved (Circle One) By_____

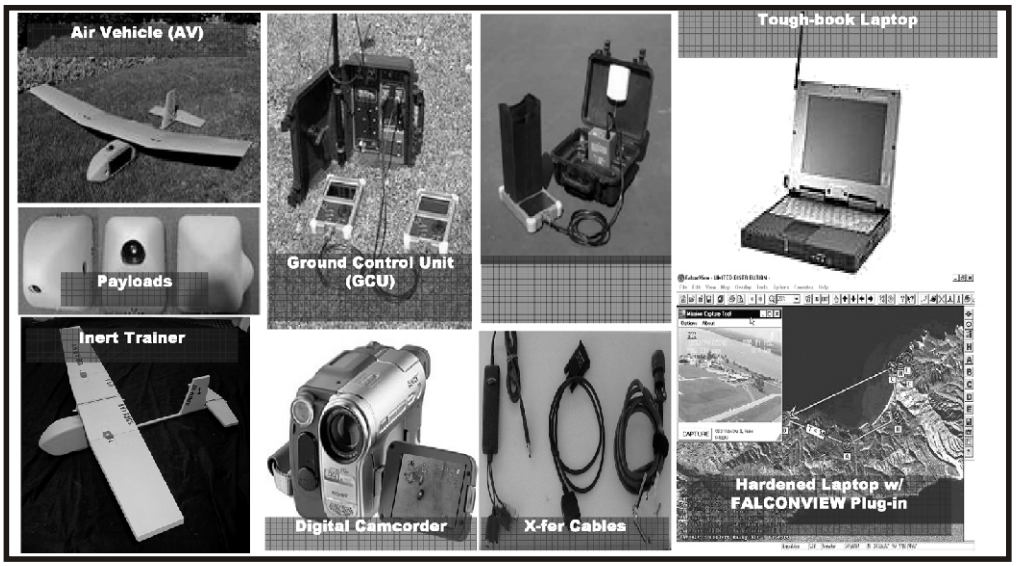
Sent to HHQ for inclusion in ACO (POC and DTG)_____

Comments:

APPENDIX C: IMMEDIATE MISSION REQUEST FORMAT:

Line 1: Unit identification (call sign and frequency)
Line 2: Launch and recovery site
Line 3: ROA location (includes GPS coordinates and operating altitude)
Line 4: Ingress route azimuth and distance
Line 5: Egress route azimuth and distance
Line 6: Times and durations of mission
Line 7: SUAV operating channel

APPENDIX D: RAVEN SUAV SPECIFICATIONS



System Components

- 3 air vehicles per system
- 3 payloads
- One (1) ground control unit
- Remote video terminal (RVT)
- Batteries: rechargeable
- Carry / protective cases
- Battery charger / power supply
- Field maintenance kit

Characteristics / Description:

- Power: rechargeable lithium ion battery
- Wing span: 4.5 feet
- Weight: 4.2 lbs (w/ carrying case, 12 lbs)
- GCU weight: 17 lbs
- Range: 5-12 + km
- Endurance (mins): 60-90 (lithium ion)
- Speed: 27-70 mph, cruise 30 mph
- Payload(s): high resolution, day / night camera and thermal imagery
- Crew / Manpower: 2 Soldiers

Mission:

Army tactical-level reconnaissance, surveillance, target acquisition, and battle damage assessment

Capabilities:

- Hand-launched / AutoLand recovery
- Military P(y) - Code GPS
- Auto-navigation
- Quick assembly (< 3 min)
- Man portable / backpackable
- Quiet
- Reusable
- Typical operational altitude 150-500 ft AGL
- Climb to operational altitude in 1-2 minutes

ACRONYMS

A2C2	Army airspace command and control
ABCS	Army Battle Command System
ACA	Airspace Control Authority
ACM	airspace control measures
ACMREQ	airspace control means requests
ACO	airspace control order
ACP	airspace control plan
ADAM	Air Defense Airspace Management
AGL	above ground level
ALO	air liaison officer
AMD	air and missile defense
AMPS	advance mobile phone system
AO	area of operations
AOR	area of responsibility
ATACMS	Army Tactical Missile System
ATO	air tasking order
ATS	air traffic services
BAE	Brigade Aviation Element
BAO	brigade aviation officer
BCD	battlefield coordination detachment
BCT	Brigade combat team
BDA	battle damage assessment
BDZ	base defense zone
BFSB	battlefield surveillance brigade
BFT	blue force tracking
CAS	close air support
CCT	combat control team
COA	course of action
COMSEC	communications security
CP	command post
C-RAM	counter-rocket, artillery, and mortar
DTED	digital terrain evaluation data
DTG	date-time group
ECOORD	effects coordinator
FARP	forward arming and refueling point
FBCB2	Force XXI battle command brigade and below
FEC	fires and effects cell
FSCM	fire support coordinating measures
FSE	fire support element
FSO	fire support officer
GCU	ground control unit
GPS	global positioning system
IED	improvised explosive device
IFF	identification, friend or foe
JFACC	Joint Force Air Component Commander
NAI	named areas of interest
PCI	pre-combat inspections
PFPS	Portable Flight Planning Software

PIR	priority information requirements
ROA	restricted operations areas
ROE	rules of engagement
ROZ	restricted operations zones
RSTA	reconnaissance, surveillance, and target acquisition
RTO	radio-telephone operator
RVT	remote video terminal
SAAFR	standard use Army aircraft flight route
SBCT	Stryker brigade combat team
SINCGARS	Single-Channel Ground and Airborne Radio System
SUAV	small unit unmanned aerial vehicle
TAIS	Tactical Airspace Integration System
TOC	tactical operations center
TTP	tactics, techniques, and procedures
UAV	unmanned aerial vehicles
UEx	unit of employment, division level
UEy	unit of employment, corps level
UHF	ultra-high frequency
VHF	very high frequency
WebACMR	TAIS Webpage for Airspace Control Means and Requests

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NOTE: USAAVNC DOTD is currently drafting a new Army Field Manual that will be the Army's doctrine for how to fight and sustain Army UAVs. The final draft of this manual is scheduled for approval NLT 30 October 2005, and will be entitled: **FM 3-04.155,** ***Army Unmanned Aerial Vehicle System Operations.***

Center For Army Lessons Learned

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