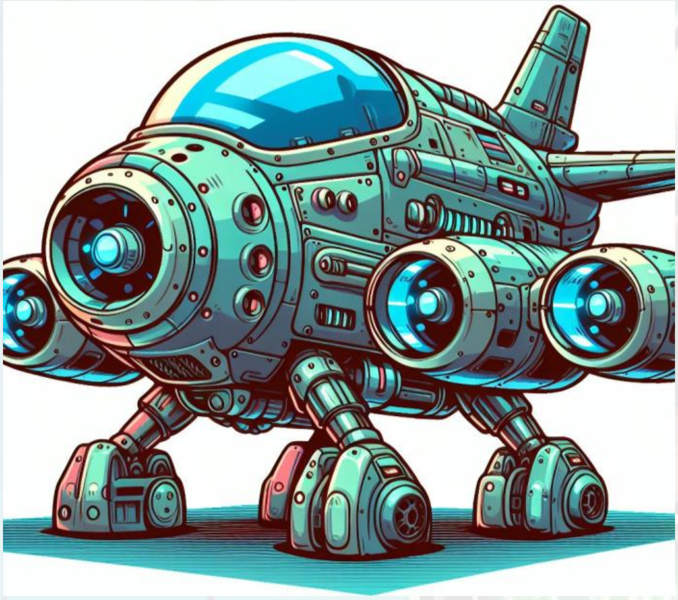

***Abstract* – This document provides a comprehensive analysis of the "Counter-Unmanned Aircraft System (CUAS)" published by the Headquarters, Department of the Army in August 2023. The analysis delves into various aspects, including its technological components, operational considerations, and the implications for security professionals and various industries.**

The document provides a quality summary of the C-UAS, detailing the technological advancements, operational strategies, and market dynamics. It is instrumental for security professionals, offering insights into the development, testing, and implementation of C-UAS technologies. The analysis underscores the significance of C-UAS in enhancing national security, protecting critical infrastructure, and maintaining airspace safety. It also emphasizes the need for continuous innovation and collaboration among industry stakeholders to address the evolving threats posed by unmanned aircraft systems. Additionally, the document's insights are valuable for different industries, enabling them to develop robust defense mechanisms against UAS threats and to stay ahead in the competitive market.

I. INTRODUCTION

The document, titled "Counter-Unmanned Aircraft System (C-UAS)" was published in August 2023 by the Headquarters, Department of the Army and superseded the previous version of the same document dated 13 April 2017.

It provides guidelines and considerations for military forces to counteract enemy unmanned aircraft systems (UASs) and prevent them from accomplishing their mission. It covers a range of topics including the description of threat UASs, planning for them at brigade and below, defensive and offensive actions for soldiers and units to take, resources for additional training, and example counter-unmanned aircraft system equipment a unit.

The principal audience is brigade and below commanders and staff, junior leaders at the company, platoon, and squad level. It is applicable to all members of the Army profession: leaders, soldiers, and Army civilians, and applies to the Active Army, Army National Guard, and United States Army Reserve.

The purpose of this document is to establish how the Army prevents threat UASs from impacting Army operations. It emphasizes that countering UASs is not a stand-alone effort or the sole responsibility of any warfighting function or branch. Rather, it is part of local security and counter reconnaissance missions that is the responsibility of every soldier and unit. The goal is to create a layered defense through a combination of active and passive measures that prevent threat UASs from detecting, targeting, or destroying its intended target

- The document is designed to provide brigades and below with actions and considerations for conducting local security and counter reconnaissance to deny enemy unmanned aircraft systems (UAS) from accomplishing their mission.
- It includes a description of threat unmanned aircraft systems, how to plan for them at brigade and below, defensive and offensive actions for Soldiers and units to take, resources for additional training, and example counter-unmanned aircraft system equipment a unit.
- The principal audience for this manual is brigade and below commanders and staff, junior leaders at the company, platoon, and squad level.
- The manual provides the foundation for counter-unmanned aircraft systems, training and Army education system curricula and future capabilities development across doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy (known as DOTMLPF-P).
- Commanders, staffs, and subordinates are expected to ensure that their decisions and actions comply with applicable United States, international, and in some cases, host-nation laws and regulations, and all applicable international treaties and agreements.
- It applies to the Active Army, Army National Guard, and United States Army Reserve unless otherwise stated.
- The proponent is the Commanding General, United States Army Fires Center of Excellence and Fort Sill

II. THREAT UNMANNED AIRCRAFT SYSTEMS

A. Introduction

The proliferation of Unmanned Aircraft Systems (UASs) presents a significant challenge to United States forces, allies, and partners. Adversaries are leveraging these relatively inexpensive, flexible, and expendable systems while exploiting inherent difficulties with attribution and its implications for deterrence.

UASs come in a variety of sizes and capabilities. Larger UASs can have similar lethality to cruise missiles and can launch from a wide array of locations. Smaller UASs can launch virtually undetected and are difficult to detect as they maneuver across the battlefield, making them an increasingly preferred method to carry out tactical-level strikes.

UASs can conduct several different missions separately or simultaneously while on one flight. These missions include intelligence, surveillance, and reconnaissance; situational awareness; communications relay; weapon delivery; fire support; and psychological warfare.

UASs are categorized into Groups 1 through 5 based on weight, operating altitude, and speed. The larger the platform, the more robust its suite of capabilities. The lines of differentiation between different groups operationally are not rigid.

A UAS is composed of everything required to operate an unmanned aircraft vehicle (UAV). This includes the personnel, UAV, payload (sensors or weapons), control station, communication links, launch system, and recovery system. Different echelons and capabilities focus on defeating different parts of the system.

The document emphasizes that countering UASs is a shared joint and combined arms responsibility. Commanders and staffs must be prepared to address these across the entire competition continuum

B. UAS Missions

UAS technology and capability are growing, and as a result, their military employment is also expanding. A UAS may conduct several different missions separately or simultaneously while on one flight.

- **Intelligence, surveillance, and reconnaissance**: UASs can provide adversaries with contemporary intelligence, surveillance, and reconnaissance capabilities in near real time via a video downlink.
- **Situational awareness**: UASs can provide an aerial view for the threat to know "what is around a hill" and allow the enemy commander to adjust operational orders based on real-time intelligence.
- **Communications relay**: UASs can serve to extend the communications between ground forces in an otherwise degraded or limited communications environment.
- **Weapon delivery**: UASs have been used to either deliver ordnance to a target or the UAS itself can become a loitering munition. This includes chemical and radiological attacks.
- **Fire support**: UASs can be used to provide forward observer functionality that can enable adjustment of indirect fire.
- **Psychological warfare**: UASs seen as a weapon delivery platform or conducting intelligence, surveillance, or reconnaissance prior to an attack can cause panic by their presence alone.
- A loitering munition is a type of UAS designed to engage beyond line-of-sight ground targets with an explosive warhead. They are equipped with high-resolution electro-optical and infrared cameras that enable the controller to locate, surveil, and guide the vehicle to the target. A defining characteristic of loitering munitions is the ability to "loiter" in an area of airspace for an extended period before striking, giving the controller time to decide when and what to strike

C. UAS Groups

It provides an overview of the different groups of Unmanned Aircraft Systems (UAS) based on their weight, operating altitude, and speed.

UAS are categorized into five groups, from Group 1 to Group 5. The categorization is based on the weight, operating altitude, and speed of the UAS. The larger the platform, the more robust its suite of capabilities.

- **Group 1 UAS**, also known as micro/mini UAS, weigh between 0-20 lbs, operate at speeds less than 100 knots, and at altitudes less than 1,200 feet above ground level (AGL). They are generally hand-launched, commercial-off-the-shelf, radio-controlled platforms with limited ranges and small payload capabilities.
- **Group 2 UAS**, or small tactical UAS, weigh between 21-55 lbs, operate at speeds between 101-250 knots, and at altitudes less than 3,500 feet AGL. They have small airframes with low radar cross sections, providing medium range and endurance.
- **Group 3 UAS**, or tactical UAS, weigh between 56-1,320 lbs, operate at any speed, and at altitudes less than 18,000 feet (FL 180). They require a larger logistical footprint and their range and endurance vary significantly among platforms.
- **Group 4 UAS**, or strategic/theater UAS, weigh more than 1,320 lbs, operate at any speed, and at altitudes less than 18,000 feet (FL 180). They are relatively large systems operated at medium to high altitudes with extended range and endurance capabilities. They normally require a runway for launch and recovery.
- **Group 5 UAS**, or strategic UAS, weigh more than 1,320 lbs, operate at any speed, and at altitudes greater than 18,000 feet (FL 180). They operate at medium to high altitudes and have the greatest range, endurance, and airspeed. They require a large logistical footprint and have a suite of optics for targeting and weaponry for engagements.

UAS Groups 1 and 2 are commonly known as small-unmanned aircraft systems (sUASs). They have a lower radar cross-section than **Group 3, 4, and 5 UASs**, making them harder to detect by friendly forces' early warning and detection capabilities. For instance, the DJI MAVIC and Enterprise Dual are examples of threat Group 1 UAS, while the RQ-11 Raven is a friendly example

D. UAS Components

- A UAS is composed of the personnel, the unmanned aircraft vehicle (UAV), payload (sensors or weapons), control station, communication links, launch system, and recovery system. Different echelons and capabilities focus on defeating different parts of the system.
- When a UAV is in use, there are potentially up to four different communication links in action: L1 channel Global Positioning System (GPS) downlink, Command-and-control (C2) link, video downlink, and data link.

Each of these links can be targeted for disruption or exploitation.

- The L1 channel GPS downlink is needed to establish which way is up or down and its altitude. It is required if the UAS needs to fly to a specific point.
- The C2 link is the communication between the controller and the UAV. It is used to control the UAV and can be disrupted to cause the UAV to return to its home point or to land.
- The video downlink is used to send real-time video from the UAV to the controller. Disrupting this link can blind the operator.
- The data link is used to send other data from the UAV to the controller. This could include system status, GPS coordinates, or other sensor data.
- Targeting cells should focus on the three main components: the UAV, the controller, and the communication links.

E. *UAV Types*

UAS falls into groups based on weight, operating altitude, and speed. Each type of UAS has its advantages and limitations. Fixed-wing UAS have long endurance and can cover large areas, but they require a runway for takeoff and landing. Rotary-wing UAS can take off and land vertically, making them suitable for operations in confined areas, but they typically have shorter range and endurance compared to fixed-wing UAS. Balloon UAS can stay aloft for extended periods, providing persistent surveillance over an area, but they are subject to wind and weather conditions and have limited maneuverability

1) *Fixed-wing UAS*

Fixed-wing UAS are typically found in Groups 4 and 5, which are characterized by weights greater than 1,320 lbs and can operate at any speed. These UAS operate at medium to high altitudes and have the greatest range, endurance, and airspeed. They require a large logistical footprint similar to manned aircraft and have a suite of optics for targeting and weaponry for engagements. Examples of fixed-wing UAS include the MQ-1C Gray Eagle, MQ-1A/B Predator, RQ-4 Global Hawk, and MQ-9 Reaper.

2) *Rotary-wing / Multirotor UAS*

Rotary-wing or multirotor UAS are typically found in Groups 1 and 2, which are characterized by weights ranging from 0 to 55 lbs and speeds less than 100 knots. These UAS operate at altitudes less than 1,200 feet above ground level (AGL) for Group 1 and less than 3,500 feet AGL for Group 2. They are generally hand-launched, radio-controlled platforms with limited ranges and small payload capabilities. They offer real-time video and are operated within the line of sight of the user. Examples of rotary-wing UAS include the DJI MAVIC and the RQ-11 Raven.

3) *Balloon UAS*

The balloon UAS could potentially fall into any of the groups depending on their weight, operating altitude, and speed. They are typically used for surveillance and reconnaissance missions due to their ability to stay aloft for extended periods.

III. PLANNING

It emphasizes the importance of a comprehensive and integrated approach to C-UAS planning and execution, involving coordination across all echelons and warfighting functions to ensure effective defense against UAS threats.

A. *Planning considerations*

Effective counter-UAS (C-UAS) planning requires a combined arms approach that employs capabilities from all warfighting functions. Planning considerations include a layered defense approach, rules of engagement, airspace control, air defense warning conditions, weapon control status, early warning networks, and the Prioritized Protection List (PPL).

B. *Layered approach*

It emphasizes the importance of a layered defense strategy in countering unmanned aircraft systems (UAS). This approach combines active and passive measures to prevent threat UASs from detecting, targeting, or destroying their intended targets. Every action taken at each echelon makes the threat UAS harder to employ by increasing its risk and range it travels to accomplish its mission.

Every echelon contributes to Soldier survivability by creating a layered defense. This layered defense is a combination of active and passive measures that prevents threat UASs from detecting, targeting, or destroying its intended target. Every action taken at each echelon makes the threat UAS harder to employ by increasing its risk and range it travels to accomplish its mission.

A layered defense provides multiple engagement opportunities, ideally starting at the maximum range from friendly forces and before any attacking UAS can release their weapons.

The airspace control plan and area air defense plan should include detailed procedures for threat UAS detection, identification, decision-making, and engagement.

C. *Rules of engagement*

It outlines the responsibilities and considerations for commanders in engaging threat Unmanned Aircraft Vehicles (UAVs). Here are the rephrased key points:

- Commanders are tasked with the duty to take necessary actions to safeguard their forces and assets from attacks while ensuring that operations adhere to the established rules of engagement (ROE).
- The authority to engage threat UAVs can be delegated to lower levels to enable a swifter response. However, this delegation must be balanced against the risk of mistakenly engaging friendly UAVs, known as fratricide

D. *Airspace control*

Divisions and brigades distribute the airspace coordination order (ACO), the unit airspace plan, and the current air picture via command-and-control systems accessible to subordinate units.

Control of airspace is managed by divisions and brigades through the distribution of the airspace coordination order

(ACO), the unit airspace plan, and the current air picture. These are disseminated via command-and-control systems that are accessible to subordinate units. These systems include the command post computing environment (CPCE) and the joint battle command-platform (JBC-P). However, not all brigades and battalions have access to the tactical airspace integration system (TAIS), which is the command-and-control system that manages the air picture, forward area air defense command-and-control (FAADC2), or air and missile defense early warning systems (AMDWS). Units that lack air defense and air management (ADAM) cells and access to these systems are unable to maintain awareness of the current friendly air picture. They rely on higher echelons with these systems to share and create products they can use.

Brigades and battalions distribute airspace coordination orders and the current air picture to subordinate units through a combination of planning, active and passive measures, and the use of specific equipment. The planning phase includes considerations for each echelon, and the active and passive measures are part of a layered defense strategy to prevent threat Unmanned Aircraft Systems (UASs) from detecting, targeting, or destroying their intended target

For command-and-control systems that subordinate units have access to for airspace coordination, the manual mentions that while there are many systems at division and above dedicated to counter enemy air threats, each echelon works to ensure that every soldier - no matter where they are on the battlefield, has the necessary information and ability to detect, identify, decide, and if needed to engage any air threat

Brigades and battalions distribute airspace coordination orders (ACOs) and the current air picture to subordinate units through command-and-control systems that are accessible to these units. These systems include the Command Post Computing Environment (CPCE) and the Joint Battle Command-Platform (JBC-P). However, not all brigades and battalions have access to the Tactical Airspace Integration System (TAIS), which is the command-and-control system that manages the air picture, as well as the Forward Area Air Defense Command-and-control (FAADC2), or Air and Missile Defense Workstation (AMDWS). Units that lack Air Defense and Air Management (ADAM) cells and access to these systems rely on higher echelons with these systems to share information and create products for their use

E. Air defense warning condition

Air defense warning (ADW) conditions are color-coded to correspond to the degree of air threat probability and are used to prepare units based on the assessed threat.

To assess their unit's ability to conduct both passive and active defensive measures against threat UAS, leaders can use video and other data collected from the flown threat UAS. This data can provide insights into the unit's performance and areas for improvement

Units should integrate the following key tasks into their training for air defense warning condition:

- Train visual observers on how to look for and track Unmanned Aircraft Systems (UAS).
- Perform visual air threat recognition training.
- Practice various passive measures.
- Establish and use an early warning notification network

F. Weapon control status

It outlines the conditions under which air defense weapons are authorized to engage aerial threats, including Unmanned Aircraft Systems (UAS).

Weapon control status establishes the conditions under which air defense weapons are permitted to engage threats, with three levels: weapons free, weapons tight, and weapons hold.

- **Weapon Control Status (WCS)**: WCS is a set of measures that dictate the conditions for engaging air threats. It is tailored to the tactical situation and can vary based on the weapon system, volume of airspace, or type of air platform.
- Three WCS for C-UAS:
  - **Weapons Free**: Units are allowed to engage any UAS not positively identified as friendly according to the rules of engagement (ROE). This status is the least restrictive.
  - **Weapons Tight**: Units are only permitted to engage UASs that are positively identified as hostile according to the ROE.
  - **Weapons Hold**: Units may only fire in self-defense or when ordered by a higher authority. This status is the most restrictive.
- **Brigade AMD Cell**: The brigade Air and Missile Defense (AMD) cell may establish separate WCS for different air threats or an overall control status for any air engagement. The cell is responsible for integrating these measures into the broader air defense strategy.
- **Decision-Making**: The WCS reflects the level of control necessary over air defense weapon systems and is influenced by the current tactical situation. Commanders at all levels must balance the need for rapid response against the risk of fratricide or other unintended consequences.

The WCS is a critical component of air defense planning, ensuring that units have clear guidance on when and how to engage potential air threats while minimizing the risk of friendly fire and collateral damage.

G. Early warning network

It discusses the establishment of an air threat early warning network as part of counter-reconnaissance efforts. Units establish an air threat early warning network, usually communicated over frequency modulation (FM), to share air threat situational understanding for units without dedicated air defense command-and-control systems.

- **Establishment of an Early Warning Network**: All units are advised to set up an air threat early warning network, which is typically communicated over frequency modulation (FM). This network is a means of sharing air threat situational understanding for units that do not have dedicated air defense command-and-control systems.

- **Alerting Everyone**: The early warning network is designed to alert all units of potential air threats, enhancing the overall situational awareness and preparedness of the force.
- **Practice and Efficiency**: Units are encouraged to practice relaying information using this network to reduce the time required to notify everyone of air threats. This practice is crucial for ensuring that the network functions efficiently and effectively when real threats are detected.

H. *Prioritized protection list (PPL)*

Units develop a PPL to prioritize the use of assigned or allocated protection capabilities, focusing on defending critical assets.

In military operations, the purpose of a Prioritized Protection List (PPL) is to identify and prioritize the protection of critical assets that are essential for mission success. The PPL helps commanders focus their limited protection resources on defending the most important elements within their area of responsibility, such as command-and-control nodes, logistics areas, or high-value units.

The key components of a PPL include:

- **Critical Assets**: These are the people, property, equipment, activities, operations, information, facilities, or materials that are deemed essential for the mission.
- **Criticality**: The importance of the asset to the mission.
- **Threat Vulnerability**: The susceptibility of the asset to potential threats.
- **Threat Probability**: The likelihood that a threat will target or impact the asset.

A PPL can be used to prioritize protection measures for personnel and equipment by:

- **Identifying Critical Assets**: Determining which assets are vital to the mission's success.
- **Assessing Risks**: Evaluating the vulnerability and threat probability to each critical asset.
- **Prioritizing Assets**: Ranking the critical assets based on their criticality and the assessed risks.
- **Allocating Resources**: Directing protection capabilities, such as air defense assets, physical security measures, or camouflage and concealment efforts, to the highest-priority assets.
- **Continuous Assessment**: Regularly reviewing and updating the PPL to reflect changes in the operational environment, asset criticality, or threat assessment.

The PPL is a dynamic tool that is continuously assessed and revised throughout each phase or major activity of an operation. It is developed by the brigade's protection cell using guidance from the brigade commander and division's PPL during mission analysis. The protection working group recommends protection priorities and establishes the brigade's PPL based on criticality, threat vulnerability, and threat probability

A PPL, or Prioritized Protection List, is the most critical assets in an organization that need to be protected. These assets can include physical assets, such as buildings or equipment, as well as digital assets, such as data or software systems. The PPL is typically used in the context of military or cybersecurity operations, where it helps to guide resource allocation and strategic planning for defense and protection efforts.

On the other hand, a protection plan is a broader term that can refer to any strategy or policy designed to protect something. This could include insurance policies, security protocols, or disaster recovery plans. A protection plan outlines the steps that will be taken to protect the assets or individuals covered by the plan.

The frequency of updating a PPL can depend on various factors such as changes in the threat landscape, introduction of new assets, or changes in the value or importance of existing assets. However, it's generally recommended to review and update the PPL regularly, at least annually, or whenever significant changes occur.

Examples of protection measures that can be prioritized on a PPL could include:

- Implementing robust cybersecurity measures for critical digital assets, such as firewalls, encryption, and intrusion detection systems.
- Physical security measures for important buildings or equipment, such as surveillance systems, access controls, and security personnel.
- Regular audits and inspections to ensure the effectiveness of the protection measures.
- Training and awareness programs for personnel to ensure they understand the importance of the assets and how to protect them

I. *Planning capabilities and considerations by echelon*

Brigades and higher headquarters integrate C-UAS into the military decision-making process, targeting, intelligence preparation of the battlefield (IPB), and protection processes.

Each echelon employs different air defense capabilities, with divisions and above analyzing and planning to mitigate the UAS threat.

Brigade and higher headquarters are tasked with incorporating C-UAS into the military decision-making process, including targeting, intelligence preparation of the battlefield (IPB), and protection strategies. The Air Defense and Airspace Management (ADAM) and Brigade Aviation Element (BAE) cells support airspace management and the deployment of air defense weapons. A multi-echelon approach is required for the C-UAS fight, with higher echelons providing resources to help lower echelons mitigate UAS threats. Brigades and below are responsible for executing protection and survivability measures against UAS threats and engaging any immediate threats.

Divisions and higher echelons analyze and plan to counter the UAS threat, directing C-UAS capabilities to improve the survivability of subordinate forces and protect critical assets. These assets may be allocated to a brigade to ensure overlapping and mutual support with the brigade's own weapon systems. Divisions also ensure that a real-time common threat air operating picture is maintained. While most brigades lack dedicated air defense capabilities, they have air defense personnel on staff who assist with planning and coordinating air defense activities with both higher and subordinate echelons. Battalions, with less extensive staff than brigades, rely on brigade products and systems to support their companies. Companies and below, which do not have dedicated staff, treat threat UASs as they would any other threat.

Each echelon possesses distinct air defense capabilities. Divisions and higher echelons analyze and plan to counter the UAS threat, directing C-UAS capabilities to protect subordinate forces and critical assets. These assets may be allocated to a brigade to provide mutual support with the brigade's own weapon systems. Divisions also ensure that a real-time common threat air operating picture is maintained. While most brigades lack dedicated air defense capabilities, they have air defense personnel to assist with planning and coordination. Battalions, with less robust staff, rely on brigade products and systems to support their companies. Companies and below, without dedicated staff, treat threat UASs as they would any other threat.

J. *Brigade planning considerations*

Brigades establish C-UAS plans to protect friendly forces, direct asset positioning, plan sensor coverage, and conduct force movement in line with higher echelon plans.

Brigade planning considerations include reporting techniques, positive identification, alert dissemination, rules of engagement, and coordination with friendly mission command nodes and airspace users.

Brigades are responsible for creating C-UAS plans to safeguard friendly forces within their designated areas. They are tasked with the strategic placement of assets, planning for sensor coverage, and coordinating the movement of forces in alignment with the plans and objectives of division and corps. This includes updating priority tasks and ensuring the security of vital assets.

Brigade planning should consider reporting methods, clear identification of threats, the dissemination of alerts, and adherence to rules of engagement.

- Circulating air defense warnings and weapons control statuses.
- Setting up general and specific air defense warnings based on current assessments of air threats.
- Adjusting the Prioritized Protection List (PPL) according to intelligence preparation of the battlefield, risk levels, and the commander's evaluation.
- Refining the rules of engagement for UAS.
- Establishing who has the authority to identify threats.
- Updating and sharing the division's engagement authority.
- Coordinating sensor coverage that might exceed the brigade's inherent sensor capabilities.
- Collaborating with allied mission command nodes and airspace users to minimize the risk of fratricide.
- Instituting notification procedures.
- Forming suitable command or support relationships among the deployed C-UAS capabilities.

K. *Brigade ADAM/BAE Cell*

The brigade Air Defense and Airspace Management (ADAM) cell and Brigade Aviation Element (BAE) cell work together to maximize the combat effectiveness of counter-air systems and minimize the risk of friendly fire incidents and collateral damage.

The Brigade ADAM cell and the BAE cell collaborate to enhance the combat efficiency of counter-air systems and reduce the likelihood of friendly fire incidents and collateral damage.

- Creating, managing, and executing a C-UAS layered defense plan, which involves planning the use of C-UAS equipment, sensors, and capabilities, understanding the optimal use of various C-UAS systems, and understanding how C-UAS capabilities impact friendly operations.
- Developing and sharing the brigade’s airspace plan, creating standard operating procedures for friendly air actions and responses to air threats, and developing counter-air tactics, techniques, and procedures tailored to the estimated threat environment.
- Integrating friendly C-UAS capabilities into the brigade common operational picture.
- Collaborating with the intelligence section to develop the enemy air situational template (SITEMP).
- Implementing higher headquarters’ C-UAS rules of engagement (ROEs), rules for use of force, and special instructions (SPINS).
- Recommending unit ROEs, rules for use of force, and SPINS to the brigade commander.
- Implementing and adhering to required host-nation policies and procedures for C-UAS.
- Assessing the effectiveness of the C-UAS layered defense after a C-UAS engagement, adjusting as necessary, and providing feedback via lessons learned to both higher echelons and subordinate units.

It's important to note that the ADAM capabilities in a combat aviation brigade and maneuver enhancement brigade do not have an aviation operations component and therefore have a very limited capability to perform BAE functions.

The Brigade ADAM/BAE cell also maintains a C-UAS running estimate, which includes the location and status of all brigade C-UAS assets, capabilities of available C-UAS equipment, and past, current, and anticipated enemy UAS activity

L. Battalion planning considerations

Battalions integrate brigade guidance to form a coherent scheme of protection and shape their C-UAS planning and actions accordingly.

Battalions develop a cohesive scheme of protection by integrating guidance from brigades. To effectively counter unknown UAVs, battalions need situational awareness of friendly aircraft in their area. Battalion C-UAS planning and actions are shaped by:

- Incorporating and sharing the unit airspace plan to maintain awareness of friendly aircraft, aiding in C-UAS identification and reducing fratricide.
- Utilizing attack guidance, targeting processes, and reporting requirements to support the targeting process.
- Following air defense coordinating instructions and ROE guidance, which informs the employment of air defense and C-UAS assets and capabilities.
- Selecting the best combination of C-UAS capabilities to establish a layered defense.
- Understanding and integrating brigade collection efforts and reporting requirements.

The battalion intelligence section, as part of the Intelligence Preparation of the Battlefield (IPB), produces materials that help the battalion develop a concept of protection, including a threat assessment. This assessment covers:

- Potential threat UAS groups in the battalion's area of operations.
- Threat UAS capabilities.
- Expected number of threat UASs.
- UAS employment techniques.
- Likely launch and recovery sites.
- Probable payload capabilities.
- Threat UAS flight profiles.
- Coordination of sensors with the brigade.

The battalion then develops a concept of protection that incorporates C-UAS actions based on intelligence estimates and analysis, focusing resources to effectively mitigate UAS and other threats. Additional instructions for companies, such as threat UAS reporting procedures, weapon control status, and engagement criteria, are included under coordinating instructions. The battalion staff ensures that all subordinate unit C-UAS battle drills align with the battalion's concept of protection.

Companies and below implement the concept of protection developed at the battalion level, focusing on reacting to air contact battle drills and examining their unit's active and passive measures.

The concept of protection, as developed at the battalion level, is implemented by companies and below. The primary emphasis during troop leading procedures is on responding to air contact battle drills. Leaders at the company level and below conduct rehearsals and assess their unit's active and passive measures. These rehearsals evaluate aspects such as air guard locations, assigned sectors, UAS reporting procedures, communication plans, ADW status, weapon control status, engagement criteria, and threat UAS identification."

IV. Defensive C-UAS Actions

It focuses on defensive actions against unmanned aircraft systems (UAS).

- **C-UAS Training**: emphasizes the importance of C-UAS training, which can be a stand-alone situational training exercise. However, greater training benefits would come from incorporating it into already planned training. Units should focus on UAS threat capabilities, the dangers that threat UASs may impose on the unit, and associated battle drills once the UAS is detected.
- **Key Tasks**: Examples of key tasks to integrate into unit training include training visual observers how to look for and track UAS, performing visual air threat recognition training, practicing various passive measures, and establishing and using an early warning notification network.
- **Training Aids and Simulations**: Leaders can leverage specifically designed training aids, devices, simulators, and simulations from their installation's training support center to enhance collective task training in the defeat and mitigation of CUAS threats.
- **Assessment of Defensive Measures**: Leaders use video and other data collected from the flown threat UAS to assess their unit's ability to conduct both passive and active defensive measures.
- **Updating Training and Education**: Threat UASs and their employment techniques change faster than doctrine does. Leaders are encouraged to update their training and education with the most current and relevant information based on lessons learned, enemy trends, and friendly C-UAS tactics, techniques, and procedures.

A. Passive measures

Passive measures are the first line of defense against air threats and are designed to improve survivability by reducing the likelihood of detection and targeting of friendly assets.

These measures include camouflage and concealment, deception, dispersion, displacement, and hardening and protective construction.

Effective camouflage and concealment techniques are crucial, especially against visual sensors, as they make it difficult for threat UAS to detect or identify targets.

Units must consider various sensor types, such as near-infrared and ultraviolet sensors, and employ appropriate countermeasures like light discipline and terrain masking.

Passive measures against Counter-Unmanned Aircraft System (C-UAS) threats are those that do not involve active engagement or destruction of the threat. They are primarily focused on reducing the effectiveness of the threat through methods such as detection, identification, and avoidance.

- **Fundamentals**: Emphasizes the importance of making targets resemble their background to reduce detection by UAS. This involves skills in camouflage and concealment and understanding of threat electromagnetic sensors.
- **Environmental Modification**: Suggests altering the physical environment or employing camouflage to improve concealment and prevent observation.
- **Sensor Challenges**: Highlights the need to plan camouflage and concealment activities to defeat enemy sensors across the electromagnetic spectrum.
- **Signal Management**: Advises on removing signal sources, like Wi-Fi or Bluetooth emissions, that could lead to detection in non-urban environments.
- **Visual and Near-Infrared Sensors**: Discusses effective camouflage against visual sensors and the importance of light discipline to counter near-infrared sensors.
- **Infrared and Ultraviolet Sensors**: Recommends natural materials and terrain to shield heat sources from infrared sensors and specific countermeasures against ultraviolet sensors in snow-covered areas.
- **Movement and Patterns**: Stresses minimizing movement and avoiding operational patterns to reduce detection risk.

1) Defensive C-UAS Actions

It outlines the importance of blending in with the environment to reduce the likelihood of detection by enemy UAS.

- **Principle of Camouflage and Concealment**: The more a target resembles its background, the harder it is for threat UAS to distinguish between them. Proper skills and awareness of threat electromagnetic sensors are crucial for effective camouflage and concealment.
- **Altering the Environment**: When natural concealment is insufficient, military forces can alter the physical environment to improve concealment for personnel and assets. They can also employ camouflage to confuse or mislead the enemy.
- **Sensor Challenges**: Camouflage and concealment must consider the variety of sensors that operate across the electromagnetic spectrum. Leaders must assess their tactical situation and plan accordingly to defeat enemy sensors in visual, infrared, or radar spectrums.
- **Signal Management**: Sometimes it is more effective to remove the source of a signal, such as Wi-Fi or Bluetooth emissions from smart devices, rather than trying to camouflage it, especially in environments where civilian signals do not mask military signatures.
- **Visual and Near-Infrared Sights**: Effective camouflage and concealment techniques in the visual portion of the electromagnetic spectrum are vital. Field uniforms, camouflage screening paint, and battlefield obscurants can provide effective camouflage against visual and near-infrared sensors.
- **Infrared and Ultraviolet Sensors**: Natural materials and terrain can shield heat sources from infrared sensors. In snow-covered areas, winter paint patterns and terrain masking are critical for defending against ultraviolet sensors.
- **Camouflage Techniques**: Units should minimize movement, avoid operational patterns, and manage equipment patterns to reduce detection. They should also consider the reflectance, shape, shadow, texture, and patterns of objects when applying camouflage.
- **Camouflage Discipline**: Camouflage and concealment discipline is continuous and applies to every soldier. It involves regulating light, heat, noise, spoil, trash, and movement to avoid giving away unit positions or activities.
- **Camouflage and Concealment Techniques**: Techniques include hiding, blending, disguising, disrupting, and decoying. These techniques are used to screen, alter, or eliminate target characteristics and create false targets to draw enemy attention away from actual assets.
- **Deception with Decoys**: Decoys can be used to attract enemy attention and draw fire away from real targets, enhancing friendly survivability and deceiving the enemy about the strength and location of friendly forces.
- **Dispersion and Displacement**: Dispersion spreads out troops and material to reduce vulnerability, while displacement involves moving to alternate locations to avoid further attacks or to render the current attack ineffective.
- **Hardening and Protective Construction**: This involves enhancing physical protection of key assets through measures such as adding sandbags or constructing bunkers to protect against UAS-delivered ordnance

2) Threat Sensor Systems

The importance of effective camouflage and concealment techniques in the visual portion of the electromagnetic spectrum cannot be overstated, as visual sensors are the most abundant, reliable, and timely enemy sensors. Being invisible often makes it challenging to detect, identify, and target. Field uniforms, standard camouflage screening paint patterns, ultra-lightweight camouflage-net system (ULCANS), and battlefield obscurants are effective against visual sensors. Full-coverage camouflage and concealment, including vertical camouflage, help evade visual detection by the enemy. When time is limited, prioritize camouflage and concealment to protect from the most probable direction of attack, then address the rest as time permits.

Near-infrared sights are effective at shorter ranges. Red filters, while preserving night vision, cannot prevent near-infrared sensors from detecting light from long distances. Therefore, strict light discipline is a crucial countermeasure to near-infrared sensors and visual sensors, such as image intensifiers. Standard camouflage screening paint patterns, battlefield obscurants, and certain uniforms are designed to counter near-infrared sensors.

Natural materials and terrain can shield heat sources from infrared sensors and disrupt the shape of cold and warm military targets viewed on infrared sensors. Avoid raising vehicle hoods to break windshield glare as this exposes a hot spot for infrared detection. Even if the infrared system can locate a target, the identity of the target can still be disguised. Avoid building fires and using vehicle heaters. Infrared-defeating obscurants, chemical-resistant paints, and certain uniforms are designed to help break up infrared signatures, but they do not defeat infrared sensors.

Enemy use of ultraviolet sensors poses a significant threat in snow-covered areas. Winter paint patterns, the arctic-style lightweight camouflage screen system (known as LCSS), and terrain masking are critical means for defending against these sensors. Any kind of smoke defeats ultraviolet sensors. Field-expedient countermeasures, such as constructing snow walls, also provide a means of defeating ultraviolet sensors.

To defeat these various sensors, units need to minimize movement and avoid operational patterns. Movement attracts enemy attention and produces several signatures (tracks, noise, hot spots, dust). In operations that inherently involve movement (such as offensive tasks), leaders plan and manage movement so that signatures are reduced as much as possible. If movement must be done, slow, regular movement is usually less obvious than fast, erratic movement.

An enemy can often detect and identify different types of units or operations by analyzing the signature patterns that accompany their activities. For example, an offensive is usually preceded by the forward movement of engineer obstacle reduction assets; petroleum oils, and lubricants; and ammunition. Such movements are very difficult to conceal; therefore, as an alternative, the pattern of resupply can be modified. An enemy recognizes repetitive use of the same camouflage and concealment techniques.

To effectively camouflage from aerial observation, units consider the threat viewpoint. Prevent patterns in anti-detection countermeasures by applying the following recognition factors to tactical situations. These factors describe a target's contrast with its background: Reflectance, Shape, Shadow, Texture, and Patterns

Effective camouflage and concealment techniques against visual sensors include:

- **Natural camouflage**: Use of natural elements like foliage, trees, and terrain to blend into the environment.
- **Artificial camouflage**: Use of camouflage nets, paints, and uniforms that match the environment.
- **Disguise**: Altering the appearance to resemble something else, like a natural feature or a harmless object.
- **Shadow and light control**: Utilizing shadows and controlling reflective surfaces to avoid detection.
- **Movement control**: Limiting unnecessary movement, especially during daylight hours, to avoid attracting attention.

To defeat near-infrared sensors, units can:

- **Use IR-blocking materials**: Certain materials can block or absorb IR radiation, making them effective for camouflage.
- **Control heat signatures**: Minimizing heat emissions from bodies, equipment, and vehicles can help evade detection by near-infrared sensors.
- **Use smoke**: Certain types of smoke can block near-infrared sensors.

Countermeasures against ultraviolet sensors in snow-covered areas include:

- **UV-absorbing materials**: Using materials that absorb UV radiation can help camouflage against UV sensors.
- **Snow camouflage**: Using white or snow-patterned camouflage can help blend into the snowy environment.
- **Avoiding UV-reflective materials**: Certain materials, like some metals, can reflect UV light and should be avoided

Effective camouflage and concealment techniques against near-infrared sensors include:

- **Using materials that absorb infrared radiation**: Certain materials, such as specialized paints and fabrics, can absorb infrared radiation, making objects coated or covered with them less visible to near-infrared sensors.
- **Thermal camouflage**: This involves managing heat signatures to blend with the surrounding environment. This can be achieved by using thermal blankets or suits that mask the heat emitted by the human body or equipment.
- **Natural cover**: Using natural elements like trees, bushes, and terrain can help to break up and conceal infrared signatures.

Effective countermeasures against ultraviolet sensors in non-snow-covered areas include:

- **UV-absorbing materials**: Using materials or coatings that absorb UV radiation can help to reduce visibility to UV sensors.
- **Natural cover**: Similar to infrared camouflage, using natural elements can help to conceal UV signatures.

- **Smoke**: Certain types of smoke can effectively scatter UV radiation, making it harder for UV sensors to detect objects.

Effective ways to detect visual sensors used by enemy units include:

- **Visual observation**: Training visual observers to look for and track UAS (Unmanned Aircraft Systems) can be an effective method of detecting visual sensors
- **Electromagnetic warfare packages**: These can assist in detecting threat UAS, which often carry visual sensors.
- **Use of radar systems**: Systems like the AN/APG-78 Longbow fire control radar on the Apache attack helicopter can assist in detecting threat UAS.
- **Early warning notification network**: Establishing and using an early warning notification network can help in detecting and responding to visual sensors used by enemy units

B. *Active measures*

Active measures involve a multi-step sequence to detect, identify, decide, and potentially engage an unknown UAS.

Detection is challenging due to the small, maneuverable, and quiet nature of UAS. Environmental conditions and tactical maneuvers by experienced operators can further complicate detection.

Identification is critical to avoid fratricide and requires early determination of the UAS's friendly or hostile characteristics.

Decision-making involves determining the necessity to engage and selecting the appropriate methods, which can be physical (e.g., small arms, projectiles) or nonphysical (e.g., jamming, spoofing)

Active measures includes tactics, techniques, and procedures for detecting, identifying, deciding, and engaging any air threat, including UASs. These measures may involve the use of various technologies and systems to counter enemy air threats. Every Soldier, regardless of their location on the battlefield, should have the necessary information and ability to implement these active measures

1) ***Detection***

Unmanned Aerial Systems (UAS) are compact, agile, and silent, making them challenging to spot, even for trained observers. Factors such as time of day, light conditions, weather, and observer alertness can affect the ability to detect a potentially hostile UAS. Specialized tracking and identification technology may be necessary due to these environmental conditions.

Experienced UAS operators can employ various tactics to exploit the characteristics of these systems, including:

- Flying at low altitudes, using terrain, vertical obstacles, or urban environments to conceal their approach to a target.
- Performing multiple false take-offs and approaches to the intended target.
- Adopting erratic flight patterns to confuse personnel and make visual tracking difficult.
- Using sunlight or cloud cover to hide the UAS from view.
- Flying against the wind to reduce the detectable sound of the UAS.
- Utilizing sport flying modes to increase speed and agility, reducing observation time.
- Deploying multiple UAS to confuse and overwhelm observers, making tracking and neutralization more challenging.
- Flying a pre-programmed flight path to reduce risk to the operator, allowing for the control link to be disconnected in-flight and re-established over the target area from a different location.

The detection capability of a unit is determined by the types and placement of sensors. Factors such as the types of threat UAS, threat axis of advance, terrain, weather, time-distance analysis, friendly defended assets, desired engagement zone, surveillance requirements, and the number of available assets influence the optimal placement and use of sensors.

Various sensor capabilities, including RADAR, radio frequency, audible, and optical devices, can be used to form an integrated sensor network. Regardless of the sensor capabilities a unit possesses, all soldiers need to be aware of air threats and constantly look up before and during any movements. Dedicated air guards can assist in air threat detection and engagement.

The types of sensors and their placement determine the unit's detection capability. For sensor placement, integrating and networking sensors to develop the enemy threat UAS situation should be applied. The use of various types of sensors is warranted as currently there is no one type of sensor that is 100% effective.

Various sensor capabilities outside of visual (observer) could include RADAR, radio frequency, audible, and optical devices. The goal is to form an integrated sensor network that includes various sensor types. Sensor capabilities in support of low-level air threats are planned accordingly and coordinated in advance. Leaders may have to coordinate through higher echelons for additional sensor capabilities. No matter what sensor capabilities a unit has, all soldiers need to be aware of the air threats and constantly look up before and during any movements. Dedicated air guards are another way units can assist in air threat detection and engagement

2) *Air Guards*

Air guards play a vital role in spotting aerial threats and providing early warnings. They must be vigilant and equipped with the necessary optical gear to perform search and scan techniques.

Air guards should be aware of the air threats and maintain visual contact with the target throughout the engagement.

Air Guards are tasked with maintaining constant vigilance, with their focus on the horizon. They are responsible for identifying aerial threats near the unit's location and providing early warnings of potential air threats. They cover sectors that include likely approaches for enemy aircraft and are utilized during both mounted and dismounted offensive and defensive operations.

If equipped with C-UAS capabilities, air guards are authorized to engage targets following the rules of engagement (ROE) and weapon control status. They should be positioned within visual range of the unit, typically between 500 meters and 1.5 kilometers, to effectively spot, hear, and report threats.

Air guards must be capable of operating in all conditions and should be equipped with the necessary optical equipment to conduct search and scan techniques, reducing the enemy's ability to avoid detection.

When scanning for UAS, air guards should not focus solely on the horizon, as this may cause them to miss higher or lower flying aircraft. The optimal search range is 20 degrees above and below the horizon. An outstretched arm with extended fingers can approximate this 20-degree range.

The vertical scan technique optimizes a soldier's vision for finding air threats by moving the eyes upward towards the sky and then down to the horizon, continuing across the terrain. The horizontal scan involves eye movements across the sky, working upward to about 20 degrees, and then scanning down to detect low-flying threats.

Before starting duty, air guards undergo a precombat inspection to ensure they have the correct equipment and are briefed on the current threat. The air guard checklist includes understanding the types and characteristics of threat UAS, current UAS trends, local air threats, detection equipment, available C-UAS equipment, secure radio operations, unit call signs, military maps, orientation techniques, and range cards.

3) Warning

Engagement decisions are made based on the threat's severity, potential impact on unit effectiveness, and engagement area. Volume fire is an effective method when using small arms against aerial threats.

Upon detection of an air threat, it is crucial to promptly alert all allied forces. This can be achieved through two strategies: a top-down or a bottom-up approach. Small Unmanned Aerial Vehicles (UAVs) are often first spotted by forward units, making it essential to practice the use of the unit early warning network and bottom-up rehearsals. Regardless of the method employed, the SALUTE report format is used to relay the information. Receiving this report should prompt further actions for all units, such as halting in place or engaging the threat with lethal or non-lethal means. If feasible, units that detect air threats should notify neighboring units.

In the top-down approach, Air and Missile Defense (AMD) cells at the brigade level and above identify threats and alert sites by disseminating early warnings both digitally and vocally to all their subordinate units. This is done automatically from the staff planning and battlespace situational awareness tool (currently AMDWs) through the JBC-P. However, as not all digital systems function properly or are monitored, voice communication is also used. The brigade AMD cell uses frequency modulation (FM) radio to transmit a flash message that a threat UAS has been spotted in the area of operations over the brigade operations and intelligence network. This message is quickly relayed over their operations and intelligence networks by battalions, then by companies over their company network, and finally by platoons over their internal networks, and if necessary, over the required squad communication systems to ensure everyone is informed. This process is time-consuming, so the faster these flash messages are relayed, the quicker the force can respond appropriately.

In the bottom-up approach, any observer who detects an air threat initiates the process in reverse. They use their local platoon network to pass their flash message, which is then relayed to the company network, then to the battalion operations and intelligence network, and finally to the brigade operations network. Here, the brigade AMD cell inputs the necessary information into the appropriate system to ensure early warning across the entire formation. The first echelon with a battlefield situational awareness tool (such as the JBC-P) creates a digital warning to assist in quickly alerting the entire formation.

Regardless of how a soldier is alerted, their initial reaction upon receiving the air threat warning should be to freeze, as the threat can detect movement. After quickly assessing that they are not currently being observed, they should move to cover and concealment and wait for the all-clear report before resuming their current mission.

Simultaneously with providing warning, friendly forces track the target and monitor its movement. This tracking should continue until a decision is made to engage or not engage the target and is successful. A location is a static estimated report or display of where an air threat is located at a given moment. A system track is a compilation of location reports over a period of time. Depending on the system used, the system track can be reported as a heat map display, quadrant alert, or a circle to indicate estimated center and location error or line of bearing. The detection plan directly contributes to the unit's ability to continuously and efficiently track airborne objects

4) Identify

Identification is the process of discerning whether an unknown detected contact is friend or foe. For the effective use of Counter-Unmanned Aerial Systems (C-UAS) capabilities, early identification of Unmanned Aerial Systems (UAS) is crucial to maximize engagement times and prevent friendly fire. The challenge lies in differentiating between friendly, neutral, and hostile aerial objects while deploying various weapon systems against threatening UAS, as the same UAS could be operated by both friendly and enemy forces. Accurate identification enables leaders to make engagement decisions and improves situational awareness. Prompt identification enhances weapon employment options, aids in preserving friendly resources, and minimizes the risk of friendly fire.

There are two identification methods: procedural and positive. Positive identification, which is the preferred method, is derived from observing and analyzing target characteristics, including visual recognition, electronic support systems, non-cooperative target recognition techniques, identification friend or foe systems, or other physics-based identification techniques. Procedural identification, on the other hand, differentiates airspace users based on geography, altitude, heading, time, and maneuver. Generally, a combination of positive and procedural identification is used.

Identification of a UAS should ideally lead to a specific name or category or the exact make and model of the UAS. It's also important to identify its payload if possible. The process of assigning an identification to a track will likely depend on several criteria.

5) Decision

The "Decide" phase involves two key decisions. The first is determining whether engagement is necessary. If the decision to engage is made, the second decision involves choosing the methods to mitigate or neutralize the threat posed by a UAS. These methods can be physical or nonphysical, and some organizations may have cyber capabilities that encompass both types. The level of delegation aligns with the rules of engagement, available airspace, potential for collateral damage, and the inherent right of self-defense.

Physical methods aim to destroy or damage the device to render it non-operational.

- Explosive munitions
- Small arms
- Projectiles
- Entanglement methods such as streamers or spray foam
- Directed Energy methods like lasers or high-power microwaves
- Capture methods like nets

Small arms techniques used in air defense involve the use of volume fire and proper aiming points based on the target's direction. These techniques are most effective against low flying UASs due to the range and destructive capability limitations of small arms. The decision to use small arms against threat UASs is made by the unit commander and is based on the situation, including the severity of the threat, potential impact on the unit's effectiveness, and the area of engagement (urban versus rural).

Volume fire is an effective method when using small arms fire against aerial threats. The key to success is to put out a high volume of fire towards the immediate threat. Even if these fires do not hit the enemy, creating a "wall of lead" in the sky can intimidate threat UAS pilots, potentially causing them to break off their attack or distracting them from taking proper aim.

When the decision is made to engage an aircraft with small arms, every weapon (M4, M240, M249, and M2) should be used with the goal of placing as many bullets as possible in the enemy's flight path. This does not mean that everyone fires in some random direction. Instead, everyone selects an aiming point in front of the target and fires at that point. This aiming point is determined using the football field technique. Practical considerations need to be taken into account before engaging, such as the range and capabilities of the available weapons. For example, engaging a UAS from a range of 3 kilometers with small arms is ineffective, while the best possibility may be the use of the main gun on a tank or tracked vehicle. Small arms have a low probability of kill against attacking UAS due to their size, speed, and maneuverability

6) Defeat Techniques

Defeat techniques are initiated once airspace deconfliction and target engagement authority are passed to the tactical level. These techniques can be non-lethal or lethal, and they may require RF deconfliction to prevent frequency fratricide.

7) Exploitation

Exploitation is crucial for developing UAS countermeasures. Efforts should be made to collect downed UAS systems and their components for intelligence and analysis

8) Football Field Technique

The "Football Field Technique" is a straightforward approach to gauge lead distance. The idea is based on the assumption that most individuals have either played or watched football and thus have a sense of the length of a football field. When instructed to lead the target by the length of one football field, everyone aims at roughly the same point in space. Any inaccuracies in one person's estimation of the football field's length will be counterbalanced by another person's estimation. This variation in aiming points ensures that concentrated fire is delivered into a space ahead of the target rather than at a single point. Additionally, the different viewpoints from which soldiers observe the target will further distribute the fire over a larger space.

"Aiming Points" used to engage threat Unmanned Aerial Vehicles (UAVs) vary but can be applied to different threats. For instance, if enemy helicopters are detected and the decision is made to engage, they should be treated as a group 5 rotary wing UAV. The rules for selecting aiming points are straightforward, easy to learn, and remember.

"Firing Position Techniques For Small Arms" are the same for rifle marksmanship and countering threat UAVs with small arms, except for the prone position. When firing at UAVs, soldiers lie on their backs (supine), aiming their rifles into the air. If you are in an individual fighting position, stay there and return fire from the supported standing position. If you are not in an individual firing position, you should look for a tree, a large rock, or supportive object to help stabilize the weapon and provide protection. The following firing positions should be used accordingly.

"Engaging With Machine Guns" is effective against slow-moving UAVs. To maintain the volume of fire and destroy a target, a continuous burst of 20-to-25 rounds should be fired using a tracer on target method, allowing the gunner to adjust rounds on target.

"Nonphysical methods" defeat the device by disrupting, blocking, or controlling the signal between the UAV's optical, flight control, and ground control station. Even though nonphysical methods are used on the UAV, these methods may still cause it to crash and cause collateral damage. Examples of nonphysical methods include, but are not limited to, radio frequency jamming, GPS jamming, GPS spoofing, dazzling, and position, navigation, and timing (known as PNT) jamming

9) Defense

The process of defeating a small Unmanned Aircraft System (sUAS) begins once airspace deconfliction and target engagement authority are delegated to the tactical level. To avoid friendly fire and confirm the identity of the sUAS, several procedures and processes are implemented. Depending on the method of engagement, Radio Frequency (RF) deconfliction might be necessary. There could be instances where operational RF spectrums overlap with the control frequency of the sUAS. It is the responsibility of key leaders to identify and mitigate frequency fratricide during defeat measures.

Defeat measures can be either non-lethal or lethal. In non-lethal responses, continuous jamming is crucial until the UAS is rendered inoperable. After a lethal or non-lethal response, and once the UAS has lost its control-link, explosive ordnance disposal should be requested to ensure the UAS is safe. Once the UAS is deemed safe, it can be submitted for weapons intelligence and analysis.

Once the decision to engage is made and the capability to do so is determined, the chosen capability is deployed. Other capabilities continue to track the target in case the initial engagement misses, allowing for re-engagement as necessary.

Exploitation is a key aspect in the development of UAS countermeasures. Efforts should be made to collect downed UAS systems and their components. When soldiers encounter a downed UAS, they should use their optics from a safe distance to look for indicators of suspicious items such as explosives, modifications, or other types of explosive payloads. If possible, they should check the immediate area for potentially dropped payloads or additional grounded UAVs. If no explosive hazards are found, they should collect as much of the UAV as possible and expedite its movement to their higher echelon for exploitation.

If an explosive hazard is suspected, the UAV should be marked and reported for action by explosive ordnance disposal or other trained personnel once operational conditions allow. Units should mark the hazard with engineer tape, VS-17 panel, or any other high visibility durable material that allows the explosive ordnance disposal team to identify the hazard's location from 50 to 100 meters. The location of the item should be marked on the units' situational awareness system (such as JBC-P) or Joint Capabilities Release (known as JCR) with a ten-digit grid. Units request explosive ordnance disposal through their chain of command using the necessary reports.

V. Offensive C-UAS Actions

It underscores the importance of offensive actions in countering UAS threats. It provides a comprehensive guide for planning and executing offensive C-UAS operations, emphasizing the need for intelligence, information collection, and effective targeting strategies. It focuses on offensive C-UAS actions.

A. Intelligence Preparation of the Battlefield

IPB is crucial for identifying threat UAS capabilities, employment concepts, strategies, and tactics. It is a continuous process involving defining the operational environment, describing environmental effects, evaluating the threat, and determining the threat course of action.

UAS are small, maneuverable, and quiet, making them difficult to observe in flight. Environmental conditions, time of day, light levels, and observer alertness all impact the ability to detect a potential hostile UAS.

Experienced operators can exploit UAS characteristics to enhance their ability to remain undetected. Tactics include flying at low levels, using terrain and urban environments to mask an approach, making false take-offs and approaches, using erratic flight profiles, and using multiple UAS to confuse and overwhelm observers.

The types of sensors and their placement determine the unit's detection capability. Factors such as threat UAS types, terrain, weather, and the number of available assets impact how best to place and employ sensors.

Various sensor capabilities outside of visual (observer) could include RADAR, radio frequency, audible, and optical devices. The goal is to form an integrated sensor network that includes various sensor types.

B. Information Collection

Information collection is adjusted to include threat UAS information requirements developed during IPB. Analysts identify areas and times where the threat is most likely to employ UASs and task information collection assets to answer priority intelligence requirements. Air guards are responsible for spotting aerial threats within proximity to the unit's location and to provide early warning by alerting the unit of air threats.

Air guards should have the ability to conduct operations under all conditions. They should be equipped with the necessary optical gear to perform search and scan techniques to reduce the enemy's ability to evade detection.

The air guard checklist includes understanding on types and characteristics of threat UAS, understanding of current UAS trends, specific data on local air threats and named areas of interest, detection equipment, secure radio operations and frequencies to send out early warning, and unit call signs to request support.

C. Targeting

Effective targeting of threat UASs builds on the knowledge gained during IPB and execution of information collection activities. Units align delivery assets to provide lethal and nonlethal means to attack UASs. Identification is the process of determining the friendly or hostile characteristics of an unknown detected contact. The employment of Counter-UAS (C-UAS) capabilities requires early identification of UAS to maximize engagement times and avoid fratricide.

There are two methods of identification, procedural and positive. Positive identification is an identification derived from observation and analysis of target characteristics including visual recognition, electronic support systems, non-cooperative target recognition techniques, identification friend or fore systems, or other physics-based identification techniques.

The decision to engage is based on the severity of the threat versus the potential impact of the unit's effectiveness and the area of engagement (urban versus rural). Physical methods engage with and either destroy or damage the device so that it is not operational. Nonphysical methods defeat the device by disrupting, blocking, or controlling the signal between the UAV's optical, flight control, and ground control station.

Defeat techniques begin once airspace deconfliction and target engagement authority has been passed down to the tactical level. To confirm the identity of the sUAS and prevent fratricide multiple processes and procedures are used

D. Joint Considerations

Countering UASs is a joint responsibility, with U.S. Air Force, Navy, and Marine Corps aviation assets assisting against larger UAS groups through air interdiction. Elevated sensors and Army assets like the AN/APG-78 Longbow fire control radar on the Apache attack can also assist in detecting threat UAS

VI. Example C-UAS Equipment'

It provides detailed information on the detection, identification, decision-making, and defeat of Unmanned Aerial Systems (UAS). It discusses various techniques and equipment used in these processes, including the BLA CHATRI 2, DRONE BUSTER, MODI, and SMART SHOOTER.

- **Detection**: UAS are small, maneuverable, and quiet, making them difficult to observe in flight. Detection can be influenced by environmental conditions, time of day, light levels, weather, and observer alertness. It emphasizes the importance of sensor placement and the use of an integrated sensor network.
- **Identification**: The document discusses the importance of identifying the friendly or hostile characteristics of a detected UAS. Accurate identification allows leaders to make engagement decisions and enhances situational awareness. Identification of a UAS should lead to a specific name or category or the exact make and model of the UAS.
- **Decision-making**: The document discusses the decision-making process in engaging a UAS. This includes deciding whether there is a need to engage and, if so, the methods used to lessen or eliminate the threat posed by a UAS. These methods include physical and nonphysical methods.
- **Defeat**: The document discusses various techniques for defeating a UAS. These include physical methods such as explosive munitions, small arms, projectiles, entanglement, directed energy, and capture, as well as nonphysical methods such as radio frequency jamming, GPS jamming, GPS spoofing, dazzling, and position, navigation, and timing (PNT) jamming.

The Bal Chatri 2 is a system designed for passive detection of radio frequencies, primarily used for identifying potential threat Unmanned Aerial Systems (UASs). It utilizes a software-defined radio frequency detection system specifically for detecting and identifying drones. The system can be adjusted for personal wear or for use in a small, stationary location.

Bal Chatri is a drone detection system that operates passively on radio frequencies. Key specifications of this system include a detection range of 3-5 kilometers, a power source that can either be a PRC-148 battery or a plug-in, a battery life of 4 hours, and a weight of 2.5 lbs.

The Drone Buster is a handheld, battery-powered device designed to counteract threats from Unmanned Aerial Systems (UASs). It is specifically engineered to neutralize Group 1 and 2 UASs. The device takes advantage of vulnerabilities in commercial drone communication protocols, allowing the operator to jam the control signal and trigger the drone's pre-set "lost signal" procedures.

The Drone Buster operates on a line-of-sight basis, necessitating the operator to keep the target in view throughout the engagement. If the line of sight is lost during the engagement, the threat may regain control of the UAV. The device is designed to disrupt both remote-controlled and GPS-guided UASs. Key specifications for the Drone Buster include:

- Range: 400m
- Power source: 1x BB2847 rechargeable battery
- Battery life:
  - **Continuous jamming:** approx 1 hour
  - **Continuous detection**: approx 4-6 hours
  - **Complete battery discharge:** approx 10 days

The Modi is a portable electronic warfare system designed for dismounted use. It offers the ability to detect and neutralize threats, with a particular focus on unmanned aerial systems (UASs). The system can function independently or be enhanced with a mounted power amplifier for use in fixed or mounted configurations and can be dismounted as needed. It operates within a temperature range of -4 to 140 degrees Fahrenheit. Key specifications of the Modi system include:

- **Operational range:** 400 meters.
- **Power source:** Three BB2590 batteries.
- **Battery life:** Not specified.
- **Weight:** 40.25 pounds when dismounted and packed.

Smart Shooter is a sight attachment for individual weapon systems, designed to counter Unmanned Aircraft System (UAS) threats. It can be fitted onto any rail of a weapon system and is compatible with existing military rifles. The Smart Shooter only allows the weapon to fire when the sight is correctly aligned with the target, including accounting for the necessary "lead" for moving targets. Key specifications of this system include a range of 120 meters, a power source of a rechargeable smart lithium-ion battery, a battery life of 72 hours or up to 3,600 assisted shots, and a weight of 2 pounds and 1 ounce