Chapter 2
The Threat

“If you know the enemy and yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.” —Sun-Tzu

Assessing the Enemy

Combat staff planners at every level of the MAGTF must consider the threat’s expected nature, composition, and ability to affect our aviation missions. The threat’s nature and intensity influence the tactics and techniques selected during mission planning, and will help define what type(s) of SEAD assets must be dedicated to effectively suppress the threat. The same considerations identified with other MAGTF missions apply to SEAD operations; the mnemonic METT-T helps to identify the key components to be considered.

Sun-Tzu’s statement remains valid today. To ensure victory, a great deal of effort must be exerted in assessing the enemy and identifying unique capabilities and limitations. With respect to SEAD, that analysis focuses on the specifics of the enemy’s air defense organizational structure, weapon systems capabilities, physical deployment, C2 doctrine, and operator training and proficiency. MAGTF planners must analyze air defense capabilities, identify vulnerabilities, and exploit these weaknesses through SEAD efforts. This includes target area tactics, ordinance delivery profiles, and the integration of onboard aircraft
survivability equipment (ASE) with dedicated disruptive and destructive attack platforms.

The majority of this chapter will address the most potent threat to MAGTF aviation—IADS. The methodology used to analyze an IADS remains valid for all other air defense structures. It is beyond the scope of this manual to provide specific data on air defense and C2 equipment, and control strategies. Classified publications such as the AFTTP 3-1, Vol. II, Threat Reference Guide and Countertactics (U) and the Missile & Space Intelligence Center’s World Wide Threat Handbook (U) are excellent resources for such specifics. Open-source references include books such as the Jane’s Information Group series.

Integrated Air Defense System

The most significant threat to MAGTF aircraft is an organized, proficient IADS capable of correlating information from a host of long range, active and passive detection and cueing sources that employ systems capable of multiple engagements. The MAGTF will probably not be able nor required to suppress an entire IADS. It will focus on some portion of the IADS to open an avenue to conduct its mission. Whether conducting SEAD against an IADS, a locally integrated air defense system or an autonomous air defense unit, the MAGTF mission planner must organize his SEAD to subdue the threat and ensure the supported mission’s success. IADS, regardless of complexity, equipment or type, consists of four components: the command element (CE), sensors, weapons systems, and C2 network.
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Command Element

The CE exercises control over all other IADS components. Responsibility for the defense of a designated vital area rests with this organization. It possesses the authority to identify contacts and commit weapons against air targets in its AOR.

Sensors

Active and/or passive sensors allow the CE to detect, identify, and correlate(track aircraft and airborne weapons within its AOR. Sensors are normally positioned to detect hostile targets at as great a distance from the defended vital area as possible, and present the information in a usable manner to the IADS. The primary purpose of these sensors is to provide data for the IADS to establish a recognized air picture for the CE, via the C2 network.

Weapons Systems

The IADS will have some combination of interceptor aircraft, SAM systems, antiaircraft artillery (AAA), and jammers available to harass and destroy inbound aircraft and missiles. Actual composition ratios between different weapons system types vary greatly from country to country, and even within a single country depending on the criticality of specific vital areas. The IADS aims to overwhelm attacking aircraft with these complementary systems. Weapons systems are located in such a manner as to ensure mutual support is attained.
C2 Network

The command post, sensors, and weapons systems must be linked, providing the controlling agency with the ability to see detected aircraft, and effectively coordinate an economic yet sufficient response with available weapons. The effectiveness of an IADS hinges on the C2 network’s speed and reliability for components to receive, evaluate, and forward information. In the most developed IADS, individual sensors and weapon systems are capable of autonomous operations, should they lose connectivity with adjacent and higher components. The C2 network is the critical element of an IADS. It is the means by which sensors, weapons, and the CE are integrated. Without the C2 network, there exists only an air defense, which is neither integrated nor a system.

Engagement Sequence

Every IADS should in most cases accomplish the following five tasks to engage enemy aircraft:

- Detect.
- Identify.
- Correlate/track.
- Target assignment.
- Weapons control.

If operating autonomously, these tasks may be completed organically, which may or may not increase air defense reaction time. If integrated into an IADS network, many of these tasks
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may be performed by designated agencies, resulting in dissemination to other parts of the IADS. This process of integrating and correlating IADS is designed to have a synergistic effect, thus reducing the time required to complete the engagement sequence. This in theory makes the capability of a truly integrated air defense system much greater than the capability of the sum of its components. The rules of engagement (ROE) and C2 architecture are key to ensuring an IADS provides more efficient and responsive air defense coverage.

Detect

This is the first task completed in the engagement sequence. Without detection information, the engagement sequence cannot proceed. Target detection may be accomplished by a variety of different sensors, including EW radars, passive detection devices, signals intelligence (SIGINT), aircraft, and visual observation human intelligence (HUMINT).

Identify

Once a target has been detected, its identity must be established. The primary objective of identification is to definitively determine whether an aircraft is friendly or hostile. Detection sensors can help correlate air tracks with identification, friend or foe (IFF) responses, electronics intelligence (ELINT) analysis or visual observations.

Correlate/Track

Correlation involves the fusion of detection data from various sensors to establish the three-dimensional position of an
inbound target (range, azimuth, altitude). Correlation is required to focus weapons control systems in a particular area, minimizing the amount of time required to bring weapons to bear on the target.

Target Assignment

The target assignment is the handoff or designation of identified target(s) to a specific weapons system.

Weapons Control

Once a target is designated to an individual fire control/weapons system, the target must continue to be tracked for the duration of the engagement to guide munitions to impact.

Concept of Employment

The enemy deploys sensors and weapons to provide the earliest possible detection and engagement of attacking aircraft. The enemy organizes and conducts comprehensive radar, visual, and electronic surveillance of surrounding airspace. Coverage is emphasized across major avenues of aerial approach, and focuses on the protection of critical targets. Air defense weapons are specifically placed to achieve surprise, optimize individual strengths, and offset weaknesses. To protect critical assets, the enemy places air defense weapons to maintain mutual, overlapping fire support and employ multiple engagement zones. The enemy’s objective is to interfere with attacking aircraft to the extent that it will prohibit the MAGTF in accomplishing its
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mission. The two most important concepts in enemy air defense employment are:

- **Mutual support** or the ability to engage high priority targets with multiple weapons systems.

- **Economy of force** or the ability to avoid multiple, unwanted engagements on the same target.

The enemy uses his air defense weapons to protect his forces by denying the MAGTF the ability to conduct effective air operations. This does not require the enemy to destroy every aircraft. The enemy air defense system can achieve this by—

- Adversely influencing friendly aircrews’ ability to conduct their mission effectively (causing mission aborts).

- Destroying aircraft when they come within effective range of enemy air defense weapons.

Achieving these goals permit the enemy to continue to protect designated vital areas. There are two types of air defense operations the MAGTF can expect to encounter: centralized and autonomous. Each threat environment is unique and requires a different level of effort to either disrupt or destroy.

**Centralized IADS Engagement**

In an IADS, the engagement sequence is carried out through its CE, sensors, weapons systems, and C2 network physically spread across the defended area. The following text illustrates how an IADS processes information using its four components through the five tasks of the engagement sequence.
An IADS must develop and maintain a recognized air picture reflecting all aircraft operating within or approaching its area of responsibility. Each sensor may only be able to detect and identify aircraft in a small portion of the airspace for which the IADS is responsible. Each sensor provides only a portion of the information required to develop a complete aircraft track. Filter centers within the IADS process track data from the various detection assets, correlate the data, and resolve multiple inputs of a single aircraft into a track. These filter centers distribute this correlated data throughout the IADS.

Identification results are forwarded up to the (senior) controlling agency. Accurate identification of all air targets within the defended airspace is critical if friendly air operations are being conducted simultaneously, to preclude fratricide. Data correlation and identification provides the air defense commander and his staff with the recognized air picture requisite to effective air defense. Dissemination of this data provides all elements of the IADS the current recognized air picture, increasing their situational awareness.

Target assignment is the decisionmaking process employed by the air defense commander. Basically, this is how and when the air defense commander decides which aircraft are to be engaged with particular air defense assets. In an IADS, filter centers feed their consolidated air pictures into a centralized command post (CCP), also known as the controlling agency, where authority exists to commit air defense weapon systems. It is through this task of the engagement sequence that the air defense commander ensures that the principles of mutual support and economy of force are applied. Air defense weapons continually provide their status, weapons state, and functionality to the CCP. With this information, augmented with standard operating responses and rules of engagement, the air defense commander determines
which aircraft pose the greatest threat to vital areas and how that threat is to be neutralized. It is critical that the air defense commander have continual access to an accurate, recognized air picture and constant access to subordinate weapons status.

Once targets are designated for engagement, the controlling agency issues appropriate orders to fire control units. Normally targets are assigned by the CCP to a specific fighter/interceptor, SAM or AAA headquarters unit. This headquarters coordinates target engagement within its individual fire units, and returns engagement results and updated equipment status to the CCP. In centralized control operations, the CCP may assign specific target tracks to a particular fire unit or weapon.

**Autonomous Engagement**

Forcing the components of an IADS to operate without cuing from centralized command and control stations will have the following effects:

- Individual weapons must detect air targets with organic sensors. Most visual and IR systems are denied the benefit of radar cueing information. Weapons systems with integrated organic radars must emit radar energy, making them vulnerable to detection, location, and attack by ARMs or other weapons. Additionally this radiation provides advanced warning to ingressing aircraft.

- When an antiaircraft weapon is operating autonomously, tracking data from outside sources is not available to it. Track information would have enabled the weapon system to employ its weapon much sooner than if the individual weapon system had to create a track on its own.
Individual weapons rely on organic means for aircraft identification. Because this increases the chance of fratricide and greatly limits the ability of friendly aircraft to operate in the vicinity, it can force operators into restrictive firing conditions, such as the requirement to visually identify targets before engaging. Every delay increases the probability of MAGTF aircraft survival.

Economy of force is nearly impossible to achieve. Targets may be engaged by many individual weapon systems within the local area. Missiles and aircraft may engage lower priority threats, depleting supplies available for higher threats to the vital area. An IADS can be classified as either territorial or tactical, depending on the type of areas they are designed to protect. Each will have unique equipment, command structures, capabilities, and limitations.

**Territorial IADS**

Territorial IADS are designed to protect large, fixed airspace such as defined borders or coastlines. They also defend vital areas within a country such as critical military, industrial, and population centers. Territorial IADS are widely used, and most likely encountered when conducting air operations within the boundaries of a hostile nation. Territorial IADS have the following characteristics:

- SAM and AAA sites are well prepared, and protected with both physical structures (bunkers, revetments, decoys) and other point defense SAM and AAA systems.

- SAMs and AAA pieces are normally longer range, fixed sites. Their relatively static nature is due to the size and extensive power requirements of associated equipment, and the volume of information required to/from supporting C2 network(s).
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- Territorial IADS normally employ air-to-air interceptors to complement both strategic and tactical surface-to-air weapons, and extend the destructive engagement zones as far from defended vital areas as possible.

- Because component sites are normally fixed, C2 functions are primarily conducted via rigid media (e.g., telephone lines, fiber-optic cables, and land line data links). These media will be protected through burying and/or “hardening” to prevent disruption or damage. Such C2 networks are generally impervious to all but the most direct, destructive means of attack. Primary networks may have redundant connectivity, including laser and RF data links and voice communications.

- Territorial IADS normally have rigid, centralized command structures, including air defense districts (geographically designated areas of responsibilities), air defense zones, and CCPs to control each functional area.

Tactical IADS

Tactical air defense systems are designed to protect maneuvering forces, major headquarters, and logistic areas, etc., from air attack. Linked, local area defenses (i.e., an integrated threat) may also be considered a tactical IADS. Tactical IADS are most likely encountered when conducting MAGTF operations against maneuvering forces in the field. Tactical IADS have the following characteristics:

- Often employ mobile SAMs/AAA. Other air defense assets (other than small arms) do not normally defend these.

- SAMs/AAA pieces are normally short to medium range. A wide variety of aircraft may be employed to augment surface-based weapons. Examples include fixed-wing fighters, ground attack aircraft, and rotary-wing aircraft.
C2 functions are normally conducted via less rigid media including RF voice communications, data link, and cellular telephone. Mobile systems will endeavor to hardwire their C2 work if given the opportunity (ground forces have paused momentarily to regroup or are in a defensive posture).

Tactical IADS normally have less rigid, more decentralized command structures.

MAGTF air operations may face both types of IADS, either sequentially (flying over engaged ground forces to strike an industrial complex deeper within a hostile country’s borders) or simultaneously (striking a maneuver force headquarters that is defended not only by its organic air defenses but falls within the coverage of the country’s territorial defenses). The underlying tenet of successful SEAD against an IADS is to deny or delay the engagement sequence for as long as possible, allowing MAGTF aircraft the greatest opportunity to complete their mission.

Air defense command posts are the heart of the IADS. Their destruction or disruption provides the best chance of catastrophically affecting the IADS. Degrading the enemy’s air defense C2 system will limit effective air defense coverage and reduce EW. Loss of these command posts breaks an IADS into individual components and destroys system integration. Loss of integration allows the MAGTF to attack and defeat individual components in detail.

An IADS as a whole uses three types of control—centralized, decentralized, and autonomous—to maximize its ability to rapidly engage hostile aircraft. The type of control exercised determines an IADS’ flexibility in dealing with late-breaking or “pop-up” targets. The type of control implemented is dependent on the country’s political-military relationship, equipment sophistication, the vital area to be defended, and personnel training levels.
Centralized Control

Also known as “top-down” control, the senior controlling agency directs target engagement. Before a firing unit can engage other targets, it must request permission from the controlling agency. Centralized control is used to minimize the likelihood of engaging friendly aircraft.

Advantages

- Minimizes the likelihood of engaging friendly aircraft.
- Individual operators focus on a single or a few actions with each target before advancing to the next.
- Individual radar and fire control operators require only basic training in specific system operations to fulfill their mission.

Disadvantages

- Senior controlling agency is susceptible to over-tasking, resulting in a failure of the entire system.
- Susceptible to slow decision processing, information overloading, and a lack of independent capability.
- Requires a high degree of training and operator proficiency at higher echelons of the IADS
- Difficult for operators accustomed to working within centralized control structure to perform well in an autonomous role.
- Centralized control relies on consistent, reliable information both to and from the senior controlling agency on which to base engagement decisions.
Decentralized Control

To prevent over-tasking critical elements within the IADS, decentralized control can be used by an IADS. This is the preferred control method within the MACCS. Controlling agencies monitor unit actions and make direct target assignments to units only when necessary to ensure proper fire distribution, prevent engagement of friendly aircraft or prevent simultaneous engagements of hostile targets. Decentralized control is only possible if intermediate echelon command posts are prepared and capable to operate without the direction of senior commanders. Today, technology advances have made decentralized control more feasible because of hardware component reliability and software simplicity. With such advances, operators with a more basic level of proficiency are capable of conducting complex and detailed engagements. However, decentralized control requires a high level of confidence in subordinate element commanders, and a great deal of individual operator training and proficiency at every level within the IADS. Relative advantages of centralized control become the ‘friction areas’ of decentralized control architectures; the vulnerabilities of centralized control become the strengths of decentralized control.

Autonomous Control

Individual air defense elements operate without direction from higher authority. Autonomous control is normally utilized only when communication links are disrupted, saturated or destroyed. Aircraft, SAM or AAA unit commanders assume full responsibility for the entire engagement sequence, without information from the rest of the IADS.
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Capabilities

Enemy air defense capabilities greatly influence the timing and duration of SEAD, MAGTF tactics, and airspace coordination. SEAD delivered at the wrong time or for an inadequate duration will be ineffective. Aircrews may be able to fly over, under or around the air defense coverage to reduce the SEAD requirement. Planners consider the threat engagement envelope and aircraft maneuverability when designing airspace control measures. From the previous discussions, MAGTF SEAD mission planners can expect air defenses to incorporate the following capabilities.

Sensors

A wide variety of redundant, multispectral sensors will be employed by an IADS, to include the use of electro-optical (EO), infrared (IR), laser, and radio frequency (RF) systems. Both active sensors (radars) and passive sensors (electronic warfare support (ES) assets) will be employed. Aircraft will be used to extend the range of sensor systems. Acquisition and tracking sources will be capable of “handing off” data to guidance mechanisms in another spectrum (e.g., night vision goggle (NVG) acquisition to an IR or imaging guidance).

Weapons Systems

A variety of weapons systems (i.e., SAMs, AAA, aircraft) use multispectral guidance—including EO, IR, RF, millimeter wave, lasers, and radio electronic combat (REC) assets—that targets MAGTF radars, communications, and global positioning system (GPS) receivers with EA. In the near future, destructive
firepower will include advanced explosives, directed energy (such as RF and laser), and electromagnetic pulse weapons. These advances complicate our ability to effectively counter and suppress such threats.

**C2 Network**

Technological advances have increased the efficiency of C2 networks, which makes them increasingly more difficult to disrupt and destroy and rapidly decreases network reaction time. C2 networks often use buried hard wire links to ensure connectivity.

**Redundancy**

Redundancy allows commanders to use the most effective sensors, weapons systems, and C2 networks to conduct the engagement sequence. Redundancy provides multiple opportunities for successful completion of the five tasks of the IADS engagement sequence and guarantees continued effectiveness as IADS components are degraded or destroyed. Multiple sensors (e.g., ground based and airborne radars) may be used to cover the same sector of airspace. Several weapons systems may be able to target aircraft in a likely avenue of approach (SAMs and AAA). A C2 network may employ a hard wire data link, a hard wire voice link (telephone), radio voice communication, radio data link communication, and cellular telephone communication to pass the same information to various components of the IADS. Technological advances allow redundancy to be built into current and future IADS components, as well as within existing systems. This greatly complicates the SEAD effort required to suppress the variety of alternative sensor, weapons system, and C2 network resources.
Surprise, Mobility, and Deception

Surprise allows commanders to optimize air defense strengths and offset weaknesses. Using the precepts of mobility and deception, commanders can conduct coordinated, concentrated air defense at critical places and times in the battle. Commanders can provide air defense coverage at critical terrain features such as barriers or river crossing sites. Since the enemy cannot be strong everywhere, economy of force must apply. Therefore the enemy can certainly be expected to employ surprise tactics, using a combination of stationary and mobile systems and an effective deception plan to surprise our aircrews, maximizing destructive capability and negating MAGTF SEAD efforts. Advanced, mobile air defense systems greatly complicate the MAGTF’s ability to detect, track, and destroy these elements with existing SEAD weapons, complementing both the enemy’s deception and surprise plans.

Aggressive Action, Initiative, and Originality

Like all effective military leaders, air defense unit commanders employ aggressive action, initiative, and originality to exploit inherent capabilities of their equipment. They must be responsive to changes in the tactical situation as well. When the supported unit’s mission changes, the air defense commander must reevaluate his unit’s deployment. He must be aware of changes in the tactics and weapons employed by opposing aircrews.

Coordinated Action

Coordinated action between supported and supporting units and among air defense units emphasizes combined arms. Air defense
operations are not a series of separate and distinct actions unrelated to each other or to the conduct of the supported mission.

All-Around Security

An air defense system must provide all-around security not only for forward combat units but also to logistics units, lines of communications, and reserves. An air defense unit must provide security from attacks in any direction.

Radio Electronic Combat

The enemy uses REC to complement his ground-based air defense capability. REC integrates EW, physical destruction, SIGINT, and radio electronic concealment and deception. REC expands the IADS’ detection, identification, and tracking abilities.

The enemy integrates the REC effort with other tactical actions. The enemy uses REC at critical moments to disrupt the C2, coordination, and execution of SEAD missions. If REC activities succeed, the attack on an IADS may degenerate from a coordinated operation to individual, ineffective attacks. The enemy will most likely use REC to—

- Provide an IADS with attack warning. This information allows air defense units to set the proper emission control posture to prevent SEAD targeting.
- Jam or deceive navigation equipment, air control, air-to-air and air-to-ground radars, and communications.
- Direct supporting arms against targets located by radio direction finding to suppress direct and indirect fire weapons performing SEAD.
Suppression of Enemy Air Defenses

Vulnerabilities

An enemy air defense system may be a complex, mutually supporting system with overlapping coverage. While it is a formidable system, it has vulnerabilities that the MAGTF can exploit.

Centralized Control

The complex nature of an enemy air defense system operating under centralized control is potentially its greatest weakness. While centralized control allows individual components to support each other, it may increase reaction time and information processing requirements of the engagement sequence for many of its air defense units. The mobility of air defense components also creates problems with centralized control. Fixed air defense systems usually have unchanging areas of responsibility and a reliable, redundant C2 network. When air defense systems move, surveillance and engagement zones can become confused, sectors of responsibility can vary, and C2 functions can become unreliable.

Autonomous Control

Autonomous control can present significant difficulties to an IADS. Individual weapons must detect air targets with organic sensors. Visual and IR systems are denied the benefit of radar cueing information. Organic radar/weapon systems must radiate sensors, making them vulnerable to detection, location, and hostile ARMs. This additional radiation provides advanced warning to ingressing aircraft.

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Tracking data from outside sources is not available. Track information would have enabled the weapon system component to employ its weapon much sooner than if the individual weapon system component had to create a track on its own.

Individual weapons rely on organic means for aircraft identification. This increases the chance of fratricide and greatly limits the ability of friendly aircraft to operate in the vicinity. This may force operators into restrictive firing conditions, such as the requirement to visually identify targets before engaging. Every delay increases the probability of MAGTF aircraft survival.

Economy of force is nearly impossible to achieve. Targets may be engaged by many individual weapon systems within the local area. Missiles and aircraft may engage lower priority threats, depleting supplies available for greater threats to the vital area.

**Misemployment**

Enemy commanders sometimes fail to use air defense weapons as an integral part of combined arms operations. They may not recognize the full capability of the air threat. They may not correctly anticipate likely enemy COAs, opening gaps in the air defense coverage that the MAGTF can exploit.

Even the most sophisticated IADS is vulnerable to misemployment because of lack of operator training, skill or experience. Unfamiliarity with system operation can significantly reduce air defense system effectiveness.

Unfamiliarity with SOPs and rules of engagement can lead to fratricide or failure to engage a hostile aircraft.
Logistic Support

Sustainment of an IADS depends on logistics support. Surface-to-air weapons are particularly logistics dependent. Sensors, weapons systems, and C2 networks often require large amounts of electrical power over long periods of time to ensure around the clock coverage. All IADS components require frequent maintenance to ensure full mission capability. Weapons systems have a high rate of fire and limited stores of ammunition. If logistical support is denied, IADS operations will quickly degrade.

Trends

From World War I through Operations Desert Storm and Decisive Edge, air defense systems have continually influenced aviation employment.

Enemy sensors and weapons systems are becoming more lethal and capable as they make greater use of the electromagnetic spectrum. “Smart” weapons that utilize RF, IR or laser energy for targeting continue to become more prevalent. In addition to surface-to-air weapon systems, new technology is being applied to surface-to-surface, air-to-surface, air-to-air, and command, control, communications, computers, and intelligence (C4I). These air defense systems continue to be produced in large numbers and are often mobile, and thus harder to locate and destroy. Additionally, older weapon systems, once easily countered with onboard self-protection equipment, are being upgraded with new technologies to increase their lethality. Recent technology updates include modifications to tracking and guidance radars to prevent and delay RWR cueing, and the use of multiple guidance methods (RF and IR) that reduce the effectiveness of aircraft countermeasures.
These trends indicate that—regardless of the spectrum of conflict (low, medium or high)—any potential adversary may be armed with relatively inexpensive, easily obtainable, and extremely lethal, surface-to-air, air-to-air, air-to-surface, and surface-to-surface weapons systems. These weapons could be integrated into C2 networks and take advantage of advancing technology.

These trends, left unchallenged, are particularly threatening to the MAGTF. It is therefore imperative that the MAGTF be able to conduct effective SEAD operations.