A JOINT APPROACH TO AIR SUPERIORITY

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ABSTRACT

A JOINT APPROACH TO AIR SUPERIORITY, by MAJ David S. Nahom, USAF, 82 pages.

Air superiority will continue to be a prerequisite to military operations in future battle. Air superiority includes not only dominance over manned vehicles (fixed-wing and rotary aircraft), but unmanned threats as well (Theater Ballistic Missiles (TBMs), Unmanned Aerial Vehicles (UAVs), and cruise missiles). As in past conflicts, defending a joint force against a full array of potential threats will require the services of both Air Force fighter aircraft and Army surface-to-air missiles, working alongside joint C4 ISR assets. With enemy airpower becoming more diverse and lethal, Army and Air Force counterair units must become more interoperable, if they expect success in the next conflict.

Current counterair forces suffer from interoperability challenges relating to systems integration and joint training difficulties. Cooperation among DCA systems within the Army and Air Force is hampered by different doctrine, priorities, and even visions concerning counterair. Better interoperability will be necessary in the future, if DCA forces are to maximize their weapons capabilities, while reducing the possibility of a fratricide incident.

PREFACE

The author is currently completing this study while assigned to the Command and General Staff College (CGSC) at Fort Leavenworth, Kansas. Major Nahom is an F-15C Instructor Pilot, and has flown over 2200 hours during twelve years in the F-111 A/F and the F-15 A/B/C/D. He has served at operational flying assignments with the 492nd and 493rd Fighter Squadrons at RAF Lakenheath, United Kingdom, the 71st Fighter Squadron at Langley AFB, Virginia, and the 95th Fighter Squadron at Tyndall AFB, Florida.

Starting out as an F-111 Weapons Systems Officer, Major Nahom's CA experience began during Operation DESERT STORM, flying missions shutting down Iraqi airfields, and in search of hidden SCUD facilities. Following pilot training, Major Nahom has spent the past six years as an F-15C Aircraft Commander and Instructor Pilot. The F-15C is currently world's premier air superiority aircraft, used extensively in the DCA role. The author has deployed several times in support of Operation SOUTHERN WATCH, performing DCA throughout Iraqi no-fly zone. Major Nahom has also participated in several CA exercises, including RED FLAG, and ROVING SANDS.

Major Nahom is a graduate of Specialized Undergraduate Navigator Training, Euro-NATO Joint Jet Pilot Training, and Squadron Officer's School. He holds a bachelor's degree in economics from the University of Colorado, and is currently completing his master's degree in military arts and science from CGSC.

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ACRONYMS

AADC	Area Air Defense Commander
ABL	Airborne Laser
ACA	Airspace Control Authority
ACO	Airspace Control Order
ACP	Airspace Control Plan
ADA	Air Defense Artillery
AIM	Air Intercept Missile
AMRAAM	Advanced Medium Range Air-to-Air Missile
AO	Area of Operations
AWACS	Airborne Warning and Control System
BMD	Ballistic Missile Defense
BVR	Beyond-Visual-Range
CA	Counterair
CAP	Combat Air Patrol
C2	Command and Control
C4 ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CCD	Camouflage, Concealment, and Deception
CEP	Circular Error Probable
CGSC	Command and General Staff College
CRC	Control and Reporting Center
CRE	Control and Reporting Element

DCA	Defensive Counterair
DSP	Defense Support Program
EA	Electronic Attack
EMP	Electromagnetic Pulse
EW	Electronic Warfare
FDL	Fighter Data Link
FEZ	Fighter Engagement Zone
FM	Field Manual
GAO	Government Accounting Office
GPS	Global Positioning Satellite
HIMAD	High-to-Medium-Altitude Air Defense
HVAA	High Value Airborne Asset
ID	Identification
IW	Information Warfare
JACC	Joint Airspace Control Center
JAOC	Joint Air Operations Center
JEZ	Joint Engagement Zone
JFACC	Joint Forces Air Component Commander
JFC	Joint Forces Commander
JOA	Joint Operations Area
JP	Joint Publication
JSTARS	Joint Surveillance Target Attack Radar System
LFE	Large Enforce Employment

MEADS	Medium Extended Air Defense System
MEZ	Missile Engagement Zone
NBC	Nuclear, Biological, Chemical
NCA	National Command Authority
OCA	Offensive Counterair
OPFOR	Opposing Force
PAC	Patriot Advanced Capability
RCS	Radar Cross Section
RJ	Rivet Joint
ROE	Rules of Engagement
SAM	Surface-to-Air Missile
SEAD	Suppression of Enemy Air Defenses
SHORAD	Short Range Air Defense
SOF	Special Operations Forces
TACS	Theater Air Control System
TAGS	Theater Air-Ground System
TBM	Theater Ballistic Missile
THAAD	Theater High Altitude Area Defense
THEL	Tactical High Energy Laser
TMD	Theater Missile Defense
UAV	Unmanned Aerial Vehicle
UHF	Ultrahigh Frequency
WMD	Weapons of Mass Destruction

WSMR	White Sands Missile Range

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CHAPTER 1

AIR SUPERIORITY: THE DIFFICULTIES OF A JOINT APPROACH

If we lose the war in the air, we lose the war, and we lose it quickly.[1]

Field Marshal Bernard Montgomery
Joint Doctrine for Countering Air and Missile Threats

One of the primary objectives U.S. military forces expect to accomplish in future conflicts is air superiority. Achieving air superiority will permit operations in the air and on land and sea without prohibitive interference from an enemy's air force, cruise missiles, and theater ballistic missiles (TBMs).[2] Air superiority is rarely an end in itself but rather a means to the end of attaining military objectives.[3]

During the Cold War, the major opposition to U.S. and NATO[4] air superiority was the Soviet fighter force. Today's threat emanates not from a single country with a large and advanced air force, but rather several smaller threat nations. Although fixed-wing and rotary aircraft can be the most deadly to friendly forces, these smaller nations may opt for less expensive unmanned vehicles. Various types of ballistic and cruise missiles may offer resource-constrained states a cost-effective (asymmetric) alternative to fielding large manned air forces.[5]

Air superiority includes not only dominance over manned aircraft, but unmanned vehicles as well. A recent trend in threats to air superiority has been the increasing numbers and accuracy of these unmanned vehicles. A "worst case" for friendly forces in future conflicts is an adversary with the ability to employ lethal combinations of fighters, helicopters, unmanned aerial vehicles (UAVs), TBMs, and even cruise missiles. Recognizing the success of U.S. and NATO forces in employing integrated aircraft and

cruise missile attacks in the Balkans, a potential enemy may attempt to mirror this successful tactic.[6]

The Mission of Counterair

According to Joint Publication 3-01, *Joint Doctrine for Countering Air and Missile Threats*, "air superiority is achieved through the counterair (CA) mission, by integrating both offensive and defensive operations from all components to counter the air and missile threat. Joint forces must be fully integrated to exploit the mutually beneficial effects of offensive and defensive operations to destroy, neutralize, or minimize air and missile threats, both before and after launch."[7] The CA mission is the instrument the joint force commander (JFC) uses to secure air superiority within an operation.

CA is divided into two major categories, offensive counterair (OCA), and defensive counterair (DCA). OCA consists of attack operations on airfields, missile sites, command and control (C2) capabilities and infrastructure. OCA also includes fighter sweeps, suppression of enemy air defenses (SEAD), and electronic warfare (EW).[8] OCA is essentially the targeting of an enemy's airpower before it becomes a threat to friendly forces.

The other portion of CA is DCA, consisting of both active and passive defense. Active DCA is the interception of airborne TBMs, cruise missiles, and aircraft, while passive DCA is camouflage, deception, hardened shelters, detection and warning, and dispersal.[9] DCA is the actual defense of friendly forces that are under attack from enemy airpower.

As in past conflicts, containing enemy airpower will require a coordinated and integrated OCA and DCA effort. Although U.S. OCA and DCA forces currently enjoy a technical dominance over all potential opponents, a JFC may soon find a foe with the equipment, training, and desire to challenge our air superiority. As threats become more sophisticated, achieving air superiority may not be as effortless as in past conflicts.

Threats to Air Superiority

Prior to a detailed discussion on CA, a study of present and emerging threats is important, and will highlight the need for a joint and integrated approach to CA. Arguably the most dangerous type of threat to joint force operations is conventional fixed-wing aircraft. There are presently more than 40,000 operational military fixed-wing aircraft today, with nearly 10,000 in Third World inventories. In total, forty-five countries have an aviation industry of some kind, with twenty-one countries designing their own aircraft.[10] Enemy fixed-wing aircraft are highly flexible and can employ a variety of munitions, including guns, rockets, cruise missiles, and tactical air-to-surface missiles.

An additional danger of enemy fixed-wing aircraft is the large-scale proliferation of throughout the world, increasing the probability that opposing forces may employ the same type of aircraft against one another. This aspect further complicates the DCA effort due to threat identification difficulties.[11] During Operation DESERT STORM, Kuwait's air force placed a large number of French built Mirage F-1 fighters in the coalition force opposing Iraq. Unfortunately Iraq also employed the F-1 against the coalition, and in significant numbers. Having the same type of fighter on both sides of a large air battle could confuse friendly DCA forces, and lead to a fratricide incident.[12]

Rotary aircraft are survivable, versatile, and ideal for use in most combat areas. The ability to hover and fly low makes helicopters difficult to acquire and very challenging for DCA forces to identify and engage. Enemy helicopters have greatly increased their capabilities and firepower in recent years, including improvements in night and all-weather attack capability.[13] While fixed-wing and rotary manned aircraft remain a formidable threat, the proliferation trend in the twenty-first century is toward unmanned threats: TBMs, UAVs, and cruise missiles.[14]

An enemy's use of the unmanned vehicle is not a new concept in warfare, and has always posed a challenge for CA forces. Adolph Hitler's V-1 and V-2 missiles, as well as Saddam Hussein's SCUD ballistic missiles are examples of the damaging potential of the unmanned threat. As the history of the V-1, V-2, and SCUD reveal, regardless of U.S. dominance over an enemy air force, air superiority may not always be guaranteed.

A few days following D day, Hitler began his attack on England using V-1 cruise missiles from occupied France and Holland. Despite control of the skies over the Luftwaffe at that point in the war, the Allies were seemingly helpless to stop these unmanned weapons from reaching the English soil. The V-1 was a ground-launched jet engine powered cruise missile, approximately twenty-five feet in length. Carrying 2,000 pounds of explosive, it flew in excess of 400 miles-per-hour to a range of nearly 200 miles. When the fuel supply was exhausted, the V-1 crashed and indiscriminately destroyed whatever was unfortunately in its path. Despite fighters and antiaircraft artillery destroying a large percentage of the nearly 9,000 V-1s launched, over 24,000 Britons were injured or killed by this weapon. Hitler was also successful using V-1s against targets on the European continent, killing over 10,000 Allied soldiers.[15]

Months later, London was attacked by the first use of ballistic missiles in history, the V-2 rocket. Unlike the V-1 missile, the V-2 was able to reach its target with little to no warning.[16] The V-2 was a liquid-fueled rocket-powered ballistic missile, again carrying a 2,000-pound warhead. The V-2 rose to an altitude of sixty miles, then descended to its target at nearly 3,500 miles per hour.[17] Due to the V-2's speed, there was no defense against this missile after launch. With his V-2 rockets, Hitler was able to cause more than 20,000 civilian casualties in southern England.[18]

In comparison to other forms of airpower during World War II, both the V-1 and V-2 were extremely inaccurate weapons. Their circular error probable (CEP)[19] was in excess of seventeen kilometers, making the weapons tactically "insignificant" to fielded forces of the time. Yet the attacks were able to kill thousands of English civilians, and ultimately dampen Allied morale.[20]

Hitler's commitment to the V-1 and V-2 attacks contributed to the Allied decision to launch Operation MARKET GARGEN, the largest airborne operation in history, as well as Operation CROSSBOW. CROSSBOW was the Allied OCA attempt to eliminate the missile launch sites in France and Holland. In spite of the Allies' best efforts, the Germans were still able to launch over 15,000 V-1 and V-2 missiles between June 1944 and March 1945.[21]

When Hitler began V-2 attacks in September 1944, General Eisenhower was forced to give CROSSBOW the highest priority of Allied air operations, including those supporting the Normandy beachhead. Operation CROSSBOW resulted in the loss of 450 Allied aircraft, and over 2,900 aircrews. Despite CROSSBOW, the V-1 and V-2 attacks continued until the spring of 1945, when Allies were finally able to capture all the launch

sites. The Germans succeeded in creating a major diversion to offensive air operations ongoing in Europe.[22]

During Operation DESERT STORM, Saddam Hussein continued SCUD missile attacks against the Arabian Peninsula and Israel throughout the conflict. Hussein regarded the SCUD strategy as constructive, since it had helped him secure favorable peace accords during the Iran Iraq war years earlier.[23] Despite the apparent control of the skies, coalition forces could merely reduce the numbers, but never completely stop Hussein's attacks. As in CROSSBOW, the coalition responded by diverting many resources away from other areas, in favor of OCA attacks on SCUD launch sites.

Coalition DCA efforts against SCUD attacks consisted of an early warning network and Patriot missiles. Although Patriots were frequently effective in destroying inbound missiles (or at least altering their course), SCUDs were still able to cause unwanted destruction. In large populated areas, lethal pieces of the intercepted missiles often led to military and civilian casualties.

Hitler and Hussein effectively tied up hundreds of aircraft and thousands of sorties with relatively small numbers of launchers and missiles, while retaining the capability to threaten allied unity and strategy.[24] General Norman H. Schwarzkopf, JFC for Operation DESERT STORM commented shortly after the conflict:

> The SCUD was a clumsy, obsolete Soviet missile, which had been originally designed to lob a half-ton warhead 190 miles and be able to hit within a half mile of its target--close enough for Soviet purposes because the SCUDs could carry nuclear warheads. The Iraqis had learned to roughly double the missile's range by welding two SCUDs end to end, or adding a section to the original framework, but in doing so they had to drastically reduce the payload. So in essence what they had was a weapon that could fly 300 miles and miss the target by a couple of miles with a warhead of only 160 pounds. Militarily, that was the equivalent of a single airplane flying over, haphazardly dropping one small bomb, and flying

> away--terrible for anyone it happened to land on, but in the grand scheme of warfare, a mosquito. However, the SCUD was effective as a terror weapon against civilian populations: in the Iran-Iraq war, the Iraqis had fired Scuds at Tehran in much the same way the Nazis had showered London with V-2s.[25]

TBMs include short-range unmanned ballistic missiles with ranges up to 1,000 kilometers, and medium-range ballistic missiles with ranges from 1,000 to 3,000 kilometers. TBMs are surface launched with ballistic trajectories. They are often launched from highly mobile, difficult to detect launchers, and are capable of carrying nuclear, biological, or chemical (NBC) warheads, creating a weapon of mass destruction (WMD). Though not always a precision weapon, the potential for an NBC payload make the TBM threat a potent weapon for any user nation. Table 1 below indicates the countries that posses WMD capabilities, and what types as of 1998.[26]

TABLE 1. THE SPREAD OF WMD

Country	Nuclear	Biological	Chemical
China	X	X	X
Iran	X	X	X
Iraq	X	X	X
Israel	X	X	X
Russia	X	X	X
North Korea	X	X	X
United States	X	X	X
United Kingdom	X	X	X
France	X		X
India	X		X
Algeria	X		
Pakistan	X		
Egypt		X	X
Libya		X	X
Syria		X	X
Burma			X
Germany			X
Italy			X
Japan			X
Laos			X
Vietnam			X
Taiwan		X	

Source: "Asymmetric Threats," *1998 Strategic Assessment: Engaging Power for Peace*, Chap. 11.

TBMs begin their flight in the boost phase. As a result of time and distance factors, destruction during this early phase of flight requires near-real-time missile launch information, and an immediate delivery of destructive capability. Interception early in the boost phase offers the greatest potential for eliminating problems associated with WMD payloads, since the missile will be destroyed over enemy territory.[27]

As the missile enters the ascent and midcourse phases, the weapon is at its highest altitude, and is often outside the earth's atmosphere. As opposed to the boost phase of flight, a missile in this phase may be easier to engage, since there is more time to alert appropriate DCA forces, and cue systems. A missile's trajectory is evaluated constantly during flight, and if it is determined to land a remote area, and therefore not threaten friendly forces, DCA weapons may not be "wasted" on the intercept.

During the terminal phase of a TBM's trajectory, incoming missiles are destroyed a few seconds from impact, primarily by surface-to-air missiles or gun systems. Destruction during the terminal phase is the tactic employed by Patriot systems during Operation DESERT STORM. Although active DCA systems may successfully intercept the missile at the terminal phase, the missile's warhead may still pose a danger to friendly forces. A SCUD missile "breaking up" over Dhahran during DESERT STORM was able to kill twenty-seven U.S. soldiers, the most costly coalition incident of the Gulf War.[28]

Due to a small radar cross section (RCS), high velocity, short launch notification time, and all-weather capability, TBMs pose a formidable threat to modern CA systems. TBMs are beginning to see great improvements in their accuracy, with CEPs now within fifty meters (due to such innovations as global positioning satellite (GPS) navigation).[29] With this new precision, the TBM may no longer be tactically "insignificant," as was the case in World War II and even DESERT STORM.

A new and rapidly evolving capability is the UAV. Threat experts project more than fifty developer, and seventy-five user countries of UAVs by 2005.[30] In future conflicts, UAVs will be employed in several missions, including information gathering, electronic combat, decoy, ground attack, and SEAD. UAVs have a relatively small RCS, low speed, and low thermal signature, thus making them difficult to detect, track, and engage.[31]

The cruise missile is an unmanned, self-guided vehicle that sustains flight through aerodynamic lift at a predetermined, constant (cruise) altitude, while carrying a warhead of any type (conventional or NBC).[32] Cruise missiles can be air-, land-, or sea-launched and normally fly to their target at low altitude, thus creating acquisition difficulties. Often they follow an unpredictable trajectory making them difficult to determine a point of launch or even predict an exact impact point. The mobility of cruise missile launch platforms, the small launch signature of the missiles, and their reduced RCS also complicates CA operations. Stealth technologies can also be incorporated into cruise missiles, making them an even more challenging threat.[33]

Counterair in Future Operations

U.S. airpower has the ability to completely dominate any of the world's air forces well into the foreseeable future. By attacking C2 nodes, enemy airfields, and early warning networks, the U.S. maintains ample firepower to keep a majority of enemy airpower grounded. Threat aircraft that do actually launch become quick prey to Air Force fighters performing DCA duties. Likewise, U.S. Army Air Defense Artillery (ADA) units maintain a redundant air defense capability against all fixed-wing and rotary aircraft, providing a layered defense for joint forces.

With present advantages enjoyed by the U.S. fighters and ADA units, it may initially appear fixed-wing and rotary-manned aircraft no longer pose a danger to friendly forces, with unmanned vehicles being the sole threat. In truth, future enemies will not only poses a formidable manned threat, but will likely combine UAVs, TBMs, and cruise missiles into their arsenal, severely complicating the air defense picture.

Current Army and Air Force doctrine both agree on the joint nature of CA. Army ADA doctrine states, "CA is achieved through the unity of effort, integration, and coordination of service component CA and TMD operations by the JFC."[34] Likewise, Air Force doctrine also focuses on a requirement for a joint approach to CA. The Air Force describes CA as "more than just airpower. Counterair is a joint team effort, gained and maintained by a combination of command and control systems, intelligence, surveillance, and reconnaissance platforms, air-to-air and air-to-ground aircraft and missiles as well as air defense weapons."[35] Although the Air Force and Army discuss the joint solution to air superiority in doctrine, the execution of CA may not be as "joint" as required by future threats.

How "Joint" Is Counterair Operations?

As both services understand, neither has the capability to achieve air superiority alone. Unity of effort is vital, requiring component systems not only to integrate, but also become interoperable.[36] By deploying Air Force fighters, Army ADA, and joint command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4 ISR) assets into theater, the JFC has all the necessary parts, but at a tactical level these units may not adequately function as a team. Joint doctrine defines the tactical level of war as the maneuver of units in relation to each other and or the

enemy in order to utilize their full potential.[37] To guarantee air superiority in a future joint operation, a critical question must be addressed: Do the two services effectively integrate on a tactical level to accomplish active DCA? Presently, joint DCA forces display difficulties with interoperability attributed to technical limitations, fratricide concerns, and training issues.[38]

With Army and Air Force units both possessing unique and complementary capabilities to the DCA mission, units from both services will be required in future operations. During Operation DESERT STORM, Patriot batteries were used primarily in the TBM defense role, while Air Force, Navy, and coalition fighters were used to defend Saudi Arabia against fixed-wing and rotary aircraft. With Iraq presenting a limited air threat to Saudi Arabia, direct integration between ADA and fighters was not essential. Future adversaries may provide a more aggressive approach, with coordinated and simultaneous manned and unmanned attacks. A future conflict may require better tactical integration to successfully accomplish the CA mission.

In past conflicts, DCA forces were able to perform their duties sufficiently with a very limited tactical link between the Army and Air Force units. If a tactical link is necessary in future operations, interoperability among Air Force and Army assets will become an issue in how well DCA units can integrate. Interoperability among participating assets includes not only systems integration, but unit training as well.

Systems Integration in Counterair

A majority of current Air Force F-15Cs has no direct link to ADA batteries, making integration difficult. Airborne warning and control system (AWACS) aircraft,

control and reporting element (CRE) ground radar stations, and Control and Reporting Center (CRC) stations offer the only link between fighters and ADA assets. Time-critical threat information passed between a Patriot battery commander and an F-15 mission commander may have to be channeled through a "second party." Is systems integration between Army and Air Force assets adequate to support the joint CA mission?

Counterair Training

If Army and Air Force assets can be expected to perform CA together, it would be reasonable to expect a joint training effort. Presently Air Force fighter and C2 assets do a majority of their air-to-air exercises without Army ADA present. These exercises involve dozens of friendly fighters, bombers, SEAD assets, and C2 units facing an overwhelming opposing force (OPFOR). Air Force fighters defend primarily against enemy aircraft; there are rarely TBM, UAV, or cruise missile threats, and seldom an Army ADA unit.

An exercise that brings Air Force units and Army ADA together is ROVING SANDS, conducted in the White Sands Missile Range (north of Fort Bliss, TX). Although the scenario is more realistic, with OPFOR simulating both cruise missiles and enemy aircraft, there is very little direct integration of DCA forces, and air-to-air training extremely limited. If integration is to be important to the DCA mission in future conflicts, do Army and Air Force units integrate effectively within current training scenarios?

Other Joint Assets and Active Defensive Counterair

Though each makes an immense contribution to CA, the introduction of Navy and Marine Corps forces will not be necessary in this discussion of joint CA. Centering on

the Air Force and Army integration will address the required issues, and the conclusions will ultimately be applicable to all services. Certain naval platforms will enter into the argument as necessary, to offer a complete look at air superiority. Additionally, this paper will not address the subject of national missile defense. Although crucial to the U.S. defense in coming years, this discussion will limit itself to theater CA. Furthermore, although the passive side of DCA is an indispensable part of CA, it will unnecessarily lengthen this discussion, and will not enter into the dialogue.

Active DCA is the central theme of this debate on joint CA. The primary focus will discuss successful defense against cruise missiles, TBMs, and air-breathing threat aircraft after launch. Though OCA is a critical partner to DCA in achieving air superiority, the debate will only address OCA as it directly integrates with the active DCA force.

Counterair Structure

At the top in the CA hierarchy is the JFC, who is a commander authorized to exercise combatant command (command authority) or operational control over a joint force.[39] Directly subordinate to the JFC is the joint forces air component commander (JFACC), who is the commander with operational control over airborne assets in a theater. The JFC selects the JFACC from the force with the majority of air assets in theater.[40] The JFC will also designate an airspace control authority (ACA), who has the responsibility on coordinating, integrating, and regulating the use of the assigned airspace. The area air defense commander (AADC) is responsible for the conduct and integration of air defense operations.[41] Because of the close relationship in

responsibilities, the JFACC, ACA, and AADC the jobs normally fall under the same commander.[42]

The Joint Airspace Control Center (JACC) is the element under the ACA (JFACC) that centrally plans, coordinates, integrates, and regulates the airspace control functions.[43] The Joint Air Operations Center (JAOC) is essentially the JFACC's staff, and is the planning and execution focal point for all air assets in theater.[44] The CRC is directly subordinate to the JAOC, and functions as the primary radar element charged with decentralized execution of air defense functions.[45] The CRE is a mobile radar unit, and normally subordinate to the CRC. The CRE is used to extend the radar coverage of the CRC to provide aircraft control and monitoring for offensive and defensive missions. The AWACS is an airborne radar control element, and subordinate to the CRC. AWACS aircraft or CRE ground radar stations are normally the controlling elements in direct contact with DCA assets.

Defensive Counterair Assets

Air Force fighter assets for the DCA mission are the F-15C, the F-15E, the F-16C, and soon the F-22A. The F-15C is the primary DCA aircraft for the U.S., with the F-22A eventually replacing it as the air superiority fighter of the future. The F-15C and F-22A employ the advanced medium range air to air missile (AMRAAM) as its primary DCA weapon; this combination of F-15C and AMRAAM being far superior to any current adversary. The Air Force will soon field an airborne laser (ABL) platform to counter TBMs. The ABL employs a chemical oxygen iodine laser on board a modified 747-400 aircraft. This laser is designed to engage TBMs in the boost phase of flight, by heating up the rocket body to the point that the internal pressure breaks apart the missile's skin.[46]

Current Army ADA assets include the Patriot PAC-3 and the Stinger missile-based short range air defense (SHORAD) systems. The Patriot PAC-3 is the improved version of the original Patriot system designed to intercept TBMs and aircraft after launch. The Stinger missile SHORAD systems employ a short range, infrared-guided missile and are designed against fixed-wing and rotary aircraft, as well as cruise missiles in close proximity to friendly troops.

In the Army's future, the theater high-altitude area defense (THAAD) system will soon enter service, designed to complement Patriot by engaging TBMs at a greater range and altitude. The THAAD is designed to intercept TBMs in the terminal and mid-course phases of flight and will cover a much greater area than Patriot.[47] The Army is also planning to add the medium extended air defense system (MEADS) to the joint CA forces. MEADS is designed against all manned and unmanned threats and will be able to rapidly deploy and provide a mobile defense for maneuver forces. Additionally, in conjunction with the Israeli Army the U.S. Army is currently testing a ground-based version of ABL. The tactical high energy laser (THEL) is designed against all manned and unmanned threats and may someday replace or complement current SHORAD units.[48]

A Joint Approach to Air Superiority

The primary discussion will center on the tactical integration of the F-15C, Patriot PAC-3, and various C4 ISR units. Although other systems (and even other services) are capable of engaging enemy airpower in flight, the F-15C and Patriot will provide the "backbone" of the active DCA capabilities for the U.S. over the next several years. When future systems (F-22A, THAAD, ABL, and others) enter in to operational service,

this dialogue will remain relevant, and the joint CA team will be enhanced by their presence.

The nature of modern warfare demands that the Air Force and Army fight as a joint team in all aspects of combat, with the mission of CA being no exception. This was important yesterday, it is essential today, and it will be imperative tomorrow.[49] While Army and Air Force units possess many redundant CA capabilities, they maintain several unique abilities as well. A joint approach will be unavoidable when executing the DCA mission for a future joint force. Joint, Army, and Air Force doctrine all recognize the need for cooperation and integration with regards to CA, and on an operational level this may be the case. What follows is a detailed depiction of how forces actually integrate on a tactical level, and what improvements may be necessary in future conflicts.

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[1]U.S. Department of Defense, Joint Publication (JP) 3-01, *Joint Doctrine for Countering Air and Missile Threats* (Washington, DC: Joint Chiefs of Staff, 19 October 1999) (hereafter cited as JP 3-01).

[2]U.S. Department of the Air Force, AFDD 1, *Air Force Basic Doctrine* (Washington, DC: Headquarters, Department of the Air Force, September 1997), 50 (hereafter cited as AFDD 1).

[3]Ibid., 46.

[4]Denotes the countries of the North Atlantic Treaty Organization.

[5]AFDD 1.

[6]Herbert C. Kaler, Robert Riche, and Timothy B. Hassell, "A Vision for Joint Theater Air and Missile Defense," *Joint Forces Quarterly* 23 (autumn-winter 1999-2000): 66.

[7]JP 3-01.

[8]U.S. Department of the Air Force, AFDD 2-1.1, *Counterair* (Washington, DC: Headquarters, Department of the Air Force, 6 May 1998) (hereafter cited as AFDD 2-2.1).

[9]Ibid.

[10]U.S. Department of the Army, FM 44-100, *US Army Air Defense Operations* (Washington, DC: Headquarters, Department of the Army, 15 June 1995), 2-11 (hereafter cited as FM 44-100).

[11]Ibid., 2-11.

[12]Fratricide is when friendly forces accidentally employ firepower against other friendly forces ("blue on blue").

[13]Ibid., 2-10.

[14]Ibid., 2-2.

[15]Larry H. Addington, *The Patterns of War Since the Eighteenth Century*, 2d ed., (Washington, DC: The Library of Congress Cataloging-in-Publishing Data, 19944), 225.

[16]The British early warning network often picked up inbound V-1 missiles, leading to an "air raid" warning in London. The V-1 also was preceded by an audible "buzz", giving it the nickname "buzz-bomb." The V-2 was virtually undetectable, and first sign of an attack was normally the explosion of the weapon. Michael Tronolone, "More than 50 Years of Terror, A History of the Ballistic Missile Threat," *ADA Magazine*, August 2000, 2.

[17]Addington, 226.

[18] FM 44-100.

[19]Circular Error Probable (CEP) is the diameter of a circle within which one-half the missiles fired would land.

[20]Tronolone.

[21]FM 44-100.

[22]Mark Kipphut, "Theater Missile Defense," *Airpower Journal* 10, no. 4 (winter 1996): 2.

[23]Tronolone.

[24]Kipphut, 3.

[25]Remarks by General Norman H. Schwarzkopf in 1992, published in Joint Publication 3-01.5, *Joint Doctrine for Joint Theater Missile Defense* (Washington, DC: Joint Chiefs of Staff, 22 February 1996), III-8 (hereafter cited as JP 3-01.5).

[26]Institute for National Strategic Studies, "Asymmetric Threats," *1998 Strategic Assessment: Engaging Power for Peace*, Chapter 11, Available from www.ndu. edu/inss/as98; Internet; accessed on 5 January 2001.

[27]JP 3-01.5, III-8.

[28]Tronolone, 7.

[29]FM 44-100.

[30]Ibid., 2-3.

[31]Ibid., 2-8.

[32]Ibid., 2-7.

[33]JP 3-01.5, III-9.

[34]FM 44-100.

[35]AFDD 2-1.1.

[36]JP 3-01, I-1.

[37]Ibid.

[38]Kaler, 66.

[39]AFDD 1.

[40]Ibid.

[41]Ibid., 1-3.

[42]U.S. Department of Defense, Theater Air-Ground System, *Multiservice Procedures for the Theater Air-Ground System*, (Washington, DC: Government Printing Office, July 1998), 1-3.

[43]Ibid., 1-4.

[44]Ibid.

[45]Ibid., III-14

[46]"Airborne Laser (ABL) is Crucial to the Theater Missile Defense," Available from www.afa.org.library/issues/abl.html; Internet; accessed on 5 January 2001.

[47]U.S. Department of the Army, ADA Weapon Systems Factsheet, "THAAD System," Available from www.airdefenseartillery.com; Internet; accessed on 5 January 2001.

[48]"THEL Shoots Down Two Rockets," *Aerospace Daily*, 30 August 2000: Available from www.ebird.dtic.mil/Aug2000; Internet; accessed on 5 January 2001.

[49]Joint Chiefs of Staff, *Joint Vision 2010*, (Washington, DC).

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CHAPTER 2

PUBLICATIONS PERTAINING TO AIR SUPERIORITY

The future threats facing the JFC will be even more diverse, more lethal, and more difficult to detect and kill than we face today. And they will include manned and unmanned, stealthy and non-stealthy vehicles, TBMs, and cruise missiles.[1]

General Ronald R. Fogleman
"On Target for Joint Theater Air Defense"

Does the Air Force and Army effectively integrate on a tactical level to assure air superiority for the JFC? Air superiority is crucial to all military operations, which is appropriately reflected in both Air Force and Army doctrine. Both services not only address the need for air superiority as a prelude to operations, but also reference integration and the requirement of a joint approach. In addition to service specific doctrine, current joint publications reinforce many concepts outlined by the Air Force and Army, emphasizing the importance of force integration within CA units. Doctrine is a starting point, where the two services continually discus the importance of a joint vision. Yet there is evidence that Air Force and Army CA units are not "joint" enough with respect to a changing threat.

As the Cold War ended, the nature of air superiority began to evolve. A powerful enemy air force no longer existed, leaving a new and potentially more lethal style of adversary to oppose friendly forces. The Gulf War echoed this change, as displayed by Iraq's credible use of TBMs to pressure coalition forces. With the potential for a more

lethal and multidimensional enemy air force, several studies have emerged recently, very critical of current CA practices. These discussions affirm that merely arriving in theater with an Air Force fighter squadron will no longer ensure a safe haven for friendly forces. Likewise, future Army ADA units will have difficulty defending maneuver forces without assistance from other services.

Since emerging threats are becoming increasingly more accurate and deadly, a combination of Air Force and Army assets will be crucial to successful CA operations. How to efficiently integrate these assets remains a difficult issue for military planners. Though the Air Force and Army both discuss their "joint" intentions in the latest doctrine, recent articles, publications, and speeches tend to dispute their effectiveness. Current service specific and joint doctrine, combined with these recent studies, will help draw the appropriate conclusions as to the effectiveness of the CA force, as well as solutions to future air superiority challenges.

Air Force Doctrine

CA is described by the Air Force in several volumes of their doctrine, offering a detailed view of air superiority from the airmen's perspective. The AFDD 1, *Air Force Basic Doctrine*,[2] establishes overriding doctrinal guidance across the full spectrum of air operations. The AFDD 1 places air superiority and CA in context of the overall theater objectives. It addresses air and space superiority, the important first step in any military operation, by stating "control of air and space certainly enhances, and may even secure, freedom of action for friendly forces in all geographical environments--land and sea as well as air and space."[3] The AFDD 1 sets a foundation for all Air Force operations and displays how the CA mission integrates within a joint operation.

The AFDD 2-1, *Air Warfare*,[4] establishes the initial guidance for conducting air operations and establishes operational doctrine for air warfare. The AFDD 2-1 establishes the basis for the importance of air superiority in military operations.[5] Taking the Air Force argument further, the AFDD 2-1.1, *Counterair*,[6] establishes specific doctrine for CA operations. The AFDD 2-1.1 identifies the need for all components under the JFC to combine in support of theater CA efforts. Air and space superiority is identified in this document as a crucial part to any military operation and a necessity for the American way of war.[7]

Detailing procedures for conducting control of CA forces in a combat zone is outlined in the AFDD 2-1.7, *Airspace Control in the Combat Zone*.[8] It discusses the need for common interoperability among all joint CA forces. The AFDD 2-1.7 outlines the relationships of the JFC, JFACC, AADC, and ACA. The AFDD 2-1.7 outlines how Air Force units relate with other services to accomplish all military operations, including CA.[9]

Army Doctrine

The Army Field Manual (FM) 100-5, *Operations*,[10] is the keystone war-fighting doctrine document for the Army. It describes to Army commanders how to think about campaigns, major operations, battles, engagements, and operations other than war. The FM 100-5 discusses the importance of airpower in that it allows "freedom to conduct successful attacks that can neutralize or destroy an enemy's war-fighting potential."[11] The Army states that CA is inherently "joint", with Army ADA contributing to the capabilities of the other services. The FM 100-5 states, "Without control (of the skies), tactical flexibility is lessened."[12] Soon replacing FM 100-5 is FM 3-0, still in draft form

at the date of this study. Significant differences as they relate to air superiority will be highlighted as appropriate.

The Army outlines air defense operations in the FM 44-100, *U.S. Army Air Defense Operations*.[13] This manual explains the Army's contributions to joint and multinational CA and theater missile defense operations.[14] The FM 44-100 states that air defense operations exist to free the ground forces from the threat of enemy airpower, allowing the commander to fully synchronize maneuver and firepower. It identifies how Army ADA will operate as a part of a joint CA team in order to achieve its objectives.[15]

Joint Doctrine

Complementing both the Army and Air Force perspective on CA, joint doctrine issues additional guidance to CA forces. Overriding guidance and thoughts on air superiority are put forth within the joint publication (JP) series. The JP 3-0, D*octrine for Joint Operations*,[16] provides fundamentals and doctrine for the conduct of joint and multi-national operations, identifying the authority for combatant commanders and other joint commanders to coordinate operations.[17] The JP 3-0 offers an overall insight to the required command and control, as well as the organization of a joint force.

The joint publication dealing directly with air superiority is the JP 3-01, *Joint Doctrine for Countering Air and Missile Threats*.[18] It provides the guidance necessary to conceptualize, plan, coordinate, and conduct successful joint operations to counter air and missile threats in the full range of military operations.[19] The JP-3-01 is critical to this debate as it identifies how specific forces are utilized within the CA mission. Sections in chapter five of this publication focuses on joint active DCA, the focal point of this discussion.

A more detailed discussion on TBM defense is outlined in the JP 3-01.5, *Joint Doctrine for Theater Missile Defense*.[20] In difference to the JP 3-01, the JP 3-01.5 centers solely on the particulars of defending the joint force from theater missiles.[21]

The *Theater Air-Ground System (TAGS)*[22] manual is a joint publication that identifies the integration of air operations and ground combat operations. The TAGS manual complements the JP 3-0 and the JP 3-01 to identify the command and control procedures and practices required within the DCA mission.[23]

Critical Writings on Joint Counterair

Although service and joint doctrine clearly depict how CA operations are to function, other sources are necessary to ensure a critical look into this vital mission. *Joint Forces Quarterly* magazine published an article several months ago providing an insight to CA operations of the future. Titled "A Vision for Joint and Theater Air and Missile Defense," this article identifies difficulties of current CA practices relating largely to interoperability.[24] Difficulties with interoperability and fear of fratricide have led to CA forces to not take advantage of the full potential of available weapons. Though not critical in past conflicts, in future battlefields the maximum capabilities of all CA weapons may be necessary to counter deadly combinations of manned and unmanned threats. The interoperability difficulties in today's CA assets may greatly contribute to challenges to air superiority in the future.[25]

Out of the *Naval Institute Proceedings*, an article titled "Counterair Is Still Dis-jointed," outlines how separate services lack a central vision for joint CA.[26] This study recommends an increase in joint doctrine awareness and an emphasis on joint CA

training. Training deficiencies will severely limit the ability of CA forces to assure air superiority in future conflicts.[27]

The *Airpower Journal* published "Preparing for Theater Air Defense as an Airland Team" several years ago.[28] This article takes a critical look at the difficulties of ADA and fighter interoperability, since assets come from different services with different priorities and visions on the employment of CA.[29] This article creates a detailed examination of current CA training practices, by reviewing the actual CA training exercises and how the featured training is not always done on a joint basis.

Another *Airpower Journal* article, "Theater Missile Defense: Reflections for the Future,"[30] outlines the emergence of theater missile defense as a leading doctrinal issue resulting from Saddam Hussein's short-range ballistic missile capability during the Gulf War. This article offers a unique perspective, in that it compares the SCUD problem to the V-1/V-2 missiles during World War II, indicating that the TBM threat has existed for some time.[31]

From the Army perspective, the August 2000 issue of *ADA Magazine* published an article titled "More Than 50 Years of Terror, A History of the Ballistic Missile Threat."[32] This study shows the progression of the TBM threat, from Hitler's use of the V-1/V-2 rockets to Saddam Hussein's SCUD missiles, and into the future. The analysis indicates how the successful use of this unmanned asset is able to "baffle" even a superior foe.[33]

Remarks spoken by retired General Ronald R. Fogleman to the National Fire Control Symposium several years ago offers an insight to CA from the perspective of U.S. senior military leadership. General Fogleman, a former Air Force Chief of Staff,

discusses the importance of improved integration within joint battle management. He advocates the continued approach of attacking the threat before launch, OCA. By improving the battle management function, he asserts joint assets will be better able to maximize their destructive power.[34]

A very critical view to future U.S. air superiority emerged from a Government Accounting Office (GAO) report published in 1997. The report titled "Combat Air Power: Joint Assessment of Air Superiority Can Be Improved,"[35] not only discusses "holes" in the CA mission, but unnecessary "overlaps" in coverage by Air Force and Army assets. According to the GAO, with limited budgets in the coming years, services will have to better allocate their resources to the CA mission.[36]

The Eaker Institute published an article in 1997, "The Army-Air Force Doctrinal Disputes: Symptoms or Causes,"[37] discussing the problems of each service tending to only its own interests, not that of the joint effort. According to this study, not only will doctrinal adjustments become necessary, but also services will need to become more "joint" when purchasing new equipment for the CA mission.[38]

Background Data

A recent book titled *Every Man a Tiger* offers a JFACC view to air superiority during joint operations.[39] Written by Tom Clancy and General Charles Horner (JFACC during operation DESERT STORM), this book offers a "first-hand" view of difficulties the Iraqi SCUD missiles posed for coalition forces in Saudi Arabia and Israel. General Horner goes into extensive detail on the fairly unsuccessful efforts to neutralize this TBM threat. Two sections that offer some insight to future joint CA operations are "Control of

the Air," and "The Great SCUD Hunt." These sections indicate how important a coordinated and joint CA effort will be to operations in the next conflict.[40]

In their 1998 Strategic Assessment, the Institute for National Strategic Studies (INSS) detailed a current assessment of worldwide weapons proliferation.[41] The chapter on "Asymmetric Threats" offers useful, and fairly current data on TBM dangers worldwide.

Several years ago, Colonel John A. Warden III wrote *The Air Campaign, Planning for Combat*,[42] offering insights on how to organize and employ forces for all air combat, including the CA mission. Colonel Warden emphasizes the importance of air superiority in all operations, stating that air superiority has been a prerequisite to victory in every conflict since 1939.[43] The section on air superiority details how CA assets must integrate to ensure freedom of operations in future conflicts.

A book titled *The Patterns of War Since the Eighteenth Century*[44] is part of the current Command and General Staff College (CGSC) curriculum and offers background to Germany's use of unmanned vehicles during World War II. The author, Larry H. Addington, outlines a detailed account of the destruction and political advantage Hitler was able to achieve with this tactically "insignificant" weapon.[45]

Unclassified specifics on various Air Force CA platforms are available through the "USAF Fact Sheets," available via the Internet.[46] Fact Sheets referencing the E-3 Sentry (AWACS), the F-15C Eagle, and the Defense Support Program (DSP) satellites provide useful and unclassified data on how various joint assets integrate in combat. Unclassified information on the Army's Patriot platform is available in a *The Wirlwind War*,[47] a book documenting Army contributions during Operation DESERT STORM.

The author, Frank N. Schubert, details the history and specifics of the Patriot system and its employment during the conflict.[48]

Some of the most important data pertaining to CA originates from current Army ADA and Air Force officers. Army Patriot units, Air Force F-15C squadrons, AWACS squadrons, and others combine to form the joint CA team, currently assuring air superiority for today's military. Data from these individuals is often the most current and can highlight challenges to air superiority presently, also in the future.

Is Doctrine Enough?

Tomorrow's enemy will present different problems to air superiority than did the Soviet Air Force present ten years ago. New threat nations will present lethal combinations of manned and unmanned aircraft, complicating the job of a joint CA force. Regardless that Air Force, Army, and joint doctrine all address the need for cooperation among CA assets, studies written since the Gulf War indicate that CA is not "joint" enough for current and future conflicts. These studies have addressed integration difficulties, training deficiencies, technology shortfalls, and doctrinal problems. An examination of the ability of current Army and Air Force CA assets to assure air superiority is important. If deficiencies in joint CA do exist, possible solutions must be addressed.

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[1]General (Ret.) Ronald R. Fogleman, "On Target for Joint Theater Air Defense" (Remarks to the National Fire Control Symposium, Eglin Air Force Base, FL, 30 July 1996).

[2]U.S. Department of the Air Force, AFDD 1, *Air Force Basic Doctrine* (Washington, DC: Headquarters, Department of the Air Force, September 1997).

[3]Ibid.

[4]U.S. Department of the Air Force, AFDD 2-1, *Air Warfare* (Washington, DC: Headquarters, Department of the Air Force, 22 January 2000).

[5]Ibid.

[6]U.S. Department of the Air Force, AFDD 2-1.1, *Counterair* (Washington, DC: Headquarters, Department of the Air Force, 6 May 1998).

[7]Ibid.

[8] U.S. Department of the Air Force, AFDD 2-1.7, *Airspace Control in a Combat Zone* (Washington, DC: Headquarters, Department of the Air Force, 4 June 1998).

[9]Ibid.

[10]U.S. Department of the Army, FM 100-5, *Operations* (Washington, DC: Headquarters, Department of the Army, June 1993).

[11]Ibid.

[12]Ibid.

[13]U.S. Department of the Army, FM 44-100, *U.S. Army Air Defense Operations* (Washington, DC: Headquarters, Department of the Army, 15 June 1995).

[14]Ibid.

[15]Ibid.

[16]U.S. Department of Defense, Joint Publication 3-0, *Joint Doctrine* (Washington, DC: Joint Chiefs of Staff, October 1999).

[17]Ibid.

[18]U.S. Department of Defense, Joint Publication 3-01, *Joint Doctrine for Countering Air and Missile Threats* (Washington, DC: Joint Chiefs of Staff, 19 October 1999).

[19]Ibid.

[20]U.S. Department of Defense, Joint Publication 3-01.5, *Joint Doctrine for Theater Missile Defense* (Washington, DC: Joint Chiefs of Staff, 22 February 1996).

[21]Ibid.

[22]U.S. Department of Defense, Theater Air Grounds System, *Multiservice Procedures for the Theater Air-Ground System* (Washington, DC: Government Printing Office, July 1998).

[23]Ibid.

[24]Herbert C. Kaler, Robert Riche, and Timothy B. Hassell, "A Vision for Joint Theater Air and Missile Defense," *Joint Forces Quarterly* 23 (autumn-winter 1999-2000): 65-70.

[25]Ibid.

[26]Lieutenant Commander W. Beaumont, U.S. Navy, "Counterair Is Still Disjointed," *Naval Institute Proceedings* 123/1/1,127 (January 1997).

[27]Ibid.

[28] Michael L. Straight, "Preparing for the Theater Air Defenses as an Airland Team," *Airpower Journal* 5, no. 1 (spring 1991): 41-46.

[29]Ibid.

[30]Mark Kipphut, "Theater Missile Defense," *Airpower Journal* 10, no. 4 (winter 1996): 1-15.

[31]Ibid.

[32]Captain Michael Tronolone, U.S. Army, "More Than 50 Years of Terror, A History of the Ballistic Missile Threat," *ADA Magazine,* 20 August 2000, 1-15.

[33]Ibid.

[34]Fogleman.

[35]United States Government Accounting Office, *Combat Air Power: Joint Assessment of Air Superiority,* 26 February 1997, GAO/SNIAD, 97-77.

[36]Ibid.

[37]Gene Meyers, "The Army-Air Force Doctrinal Disputes: Symptoms or Causes" (The Eaker Institute, September 1997).

[38]Ibid.

[39]General Chuck Horner, USAF (Ret.), and Tom Clancy, *Every Man a Tiger: The Gulf War Air Campaign,* (New York: Berkley Publishing Group, 1999).

[40]Ibid.

[41]Institute for National Strategic Studies, "Asymmetric Threats," *1998 Strategic Assessment*: *Engaging Power for Peace*, Chapter 11, Available from www.ndu. edu/inss.as98; Internet; accessed on 5 January 2000.

[42]John A. Warden, *The Air Campaign, Planning For Combat,* (Washington, DC: National Defense University Press, 1988).

[43]Ibid.

[44]Larry H. Addington, *The Patterns of War Since the Eighteenth Century*, 2d ed., (Washington, DC: The Library of Congress Cataloging-in-Publishing Data, 19944).

[45]Ibid.

[46]U.S. Department of the Air Force, USAF Fact Sheets, Available from www.af.mil/factsheets.html, Internet accessed on 5 January 2001.

[47]Frank N. Schubert and Theresa L. Kraus, *The Wirlwind War,* Appendix A, "The Patriot Air Defense System," Available from www.army.mil/cmh-pg/books; Internet; accessed on 10 January 2001.

[48]Ibid.

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CHAPTER 3

COUNTERAIR EXPLAINED

> ***Separate ground, sea, and air warfare is gone forever. If ever again we should be involved in war, we will fight in all elements, with all services, as one single concentrated effort. Peacetime preparatory and organizational activity must conform to this fact.***[1]
>
> President Dwight D. Eisenhower, *Operations*

Future military operations will likely involve forces from several services, and possibly several countries; the mission of CA is no exception. As stated, Air Force, Army, and joint doctrine reflect the necessity of a combined CA effort to ensure air superiority within a joint operations area (JOA). While the Army and Air Force both emphasize the need for a joint approach to CA, the interoperability between the two services at the tactical level of war may actually be insufficient. Interoperability among the DCA forces includes not only integration and operability of Air Force and Army systems, but also how effectively the two services in fact train as a combined DCA team.

The Levels of War

Levels of war are doctrinal perspectives that clarify the links between our National objectives and tactical actions. The three levels, "strategic," "operational," and "tactical," are distinct, though there are no finite limits or boundaries between them. The strategic level of war is that level at which a nation, often as a member of a group of nations, determines national or multinational strategic security objectives and guidance, then develops and uses national resources to accomplish these objectives.[2] The strategic level includes decisions on the amount, and what type of CA assets to place in theater. The decision from the National Command Authority (NCA) to limit the CA campaign over North Vietnam prior to 1972 was a strategic decision.[3]

The operational level of war links the tactical employment of forces to strategic objectives. The focus at this level is the orchestration of military forces to achieve strategic goals through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles.[4] At this level, commanders must decide how to achieve the strategic ends, with the forces allotted.[5]

At the tactical level of war, units are placed in ordered arrangement, and maneuver in relation to each other and or to the enemy to exploit their full potential.[6] The tactical level for CA is where ADA systems, fighters, and supporting units operate together to achieve a clear objective, usually to establish air superiority for friendly forces. This study's focus is on this tactical level of war, where an F-15 mission commander and a Patriot battery commander work in unison with the C4 ISR assets to maintain friendly air superiority.

Air Superiority versus Air Supremacy

Control of the air medium is an essential prerequisite for maneuver forces in a JOA. Control of the air and space provides freedom to attack as well as freedom from attack.[7] There are two degrees of air and space control: "superiority" and "supremacy." Air superiority is the degree of dominance that permits friendly land, sea, and air forces to operate at a given time and place without prohibitive interference from the enemy. Air supremacy, a higher degree of superiority, is where the enemy air force is made incapable of effective interference to friendly forces at any point in a JOA.[8] While supremacy is often desirable, it may be difficult to achieve (likely unattainable), making air superiority a more realistic goal for the JFC. When air superiority is achieved, enemy aircraft and missiles may still launch, but will offer limited interference to friendly operations. During Operation DESERT STORM, coalition aircraft dominated the Iraqi manned air force, achieving perceived air superiority within hours of the conflict's start. Since CA forces could never control Hussein's SCUD attacks, it can be argued that the coalition never actually achieved air superiority.

In the history of air warfare, no state has lost a war while it maintained air superiority over an opponent, and attainment of air superiority has consistently been a prelude to military victory.[9] CA is the mission assigned by the JFC for the objective of attaining and maintaining air superiority for the joint force.

Counterair Defined

As discussed, CA is broken into two major subcategories, OCA and DCA. Air Force doctrine outlines OCA as offensive operations (attacks) to destroy, disrupt, or limit the enemy air and missile threat to friendly forces. OCA will seek out and destroy an adversary's airpower before it has the opportunity to threaten friendly forces, or as a reactive measure to reduce the effectiveness of an enemy attack.[10] OCA is essentially the targeting of enemy manned and unmanned aircraft, prior to these weapons being brought to bear on friendly forces.

OCA resources include fighters, bombers, and helicopters, which are used to directly target enemy aircraft and missiles (surface-to-surface and surface-to-air missiles) prior to launch. Fighters can also be utilized in a sweep mode, where they enter enemy territory to engage airborne enemy aircraft before they are able to threaten friendly forces.

Surface-to-surface missiles, cruise missiles, and artillery are additional assets used to directly attack airpower prior to launch. Friendly UAVs also support OCA by performing surveillance, reconnaissance, deception, jamming, and decoy operations against enemy air defense systems. In addition to the "traditional" CA units, Special Operations Forces (SOF) can conduct surveillance, direct attacks, and also terminally guide ordinance to enemy aircraft and missiles. SOF forces were used extensively during Operation DESERT STORM to search out and destroy SCUD missiles, as well as pass target locations to orbiting aircraft.[11]

Another indispensable piece of the OCA force are the C4 ISR Systems. These assets include early warning and surveillance networks, satellites, radar and other sensors, identification systems, communications systems, and computer systems. These forces enhance OCA operations by providing vital warning, intelligence, and targeting data, as well as C2 to friendly forces.[12]

A significant additional aspect of OCA (and DCA as well) is Information Warfare (IW). Many OCA targets, such as enemy C4 ISR, TBMs and their support infrastructure, airfields, and operating bases can be affected by various IW techniques such as malicious codes, electronic warfare, or Electromagnetic Pulse (EMP) generators. IW can be extremely valuable, as it may render enemy systems incapable of engaging aircraft, saving the JFACC valuable aircraft sorties for other missions.[13]

Defensive Counterair

DCA complements OCA, and consists of both "passive" and "active" defense. Passive defense (passive DCA), a critical and often overlooked portion of CA, includes detection and warning, hardened shelters, camouflage, concealment, deception, reconstitution, dispersal, and mobility. Active defense (active DCA) is the interception of manned and unmanned aircraft after they have launched and become a threat to friendly forces.[14]

Passive DCA begins with the tactical warning of friendly forces of an impending attack by enemy airpower. Tactical warning initiates many of the other passive defense (and active defense) measures taken by friendly forces. Warnings are categorized as general or specific. General warnings will indicate that attacks on a joint force are imminent, or may have even occurred. Where as specific warnings signify that particular units or areas within a JOA are in danger of attack.[15]

Passive DCA is not the active employment of any lethal weapons, but is designed to improve survivability of friendly forces by reducing the potential effects of enemy attacks. One form of passive defense is to harden shelters, which can protect valuable assets from aerial attack. Camouflage, concealment, and deception (CCD) are the

passive techniques that deny accurate location and targeting of friendly forces by feeding false information to the enemy. Reconstitution is the repairing of assets, such as airfields and communications infrastructure following an enemy attack, in order that these resources can once again be used in battle. The NBC defensive equipment and facilities allow the joint force protection from WMD by providing contamination detection and avoidance, identification, and decontamination. Passive defense also includes the redundancy of critical systems, which is dual, contingency, or even backup capabilities of primary systems. Two additional aspects of passive defense are the dispersal of assets, and maintaining of mobility of forces, enabling units to better avoid enemy attack from the air.[16]

Active Defensive Counterair

Active DCA is the action to detect, identify, and engage airborne hostile air and missile threats with the goal of destroying or reducing their effectiveness against friendly forces and assets.[17] Active DCA includes the integrated employment of air-to-air and surface-to-air systems through coordinated detection, identification, assessment, and engagement of hostile aircraft.[18] This integrated employment of Army and Air Force assets is the aspect of active DCA that is the focus of this study.

Active DCA includes “area defense,” “point defense,” “self-defense,” and “high value airborne asset” (HVAA) protection. Area defense is the use of a combination of weapon systems to defend a broad area. An example would be the employment of Patriot missiles and F-15Cs to defend a large JOA, as in the defense of Saudi Arabia during the Gulf War. Point defense is designed to protect a small and limited area, such as the use of a SHORAD battery to defend a specific airbase.

Self-defense is the use of a weapon system by an individual unit in defense of that unit. A Stinger battery within an Armor brigade, there to defend the unit from enemy airpower is a self-defense use of CA forces. If an enemy aircraft fires at a friendly fighter, that fighter will employ counterfire in self-defense.

HVAA protection is the defense of airborne national assets, which are so important that the loss of even one could seriously impact U.S. war-fighting capabilities. AWACS, Rivet Joint (RJ), Joint Surveillance Target Attack Radar System (JSTARS), air-refueling aircraft, and the U-2 are just a few examples of HVAA. Using a Combat Air Patrol (CAP) of F-15Cs to guard an orbiting AWACS aircraft is an example of HVAA protection.[19] HVAA protection may not only include active DCA, but passive techniques as well. Directing an AWACS to "retrograde" away from attacking enemy airpower is an effective passive defense measure for HVAA aircraft.

Command and Control of Counterair Assets

A JFC will normally assign the JFACC the duty of integrating the C2 of joint CA assets in theater. The AADC is designated by the JFC to coordinate the overall joint DCA force. Additionally, the JFC designates an ACA, who is given overall responsibility for establishing and operating the airspace control system within the JOA. As stated, the responsibilities of the JFACC, the AADC, and the ACA are interrelated, and therefore normally assigned to one individual.[20]

The JFACC, in the role of the ACA, establishes an airspace control system for the JFC, integrates the airspace control system with that of the host nation, and then coordinates all users. The ACA develops these procedures into an Airspace Control Plan (ACP), and after JFC approval, disseminates it throughout the theater. The ACP is then

implemented in an Airspace Control Order (ACO).[21] The JFACC, in the role of the AADC, is also tasked with the development of a JFC approved joint area air defense plan. The plan should be closely integrated with the ACP, and the AADC will additionally establish weapons control procedures for all the DCA forces within this plan.[22]

The JFACC uses the Theater Air Control System (TACS) to control and communicate with DCA forces, providing centralized control and decentralized execution of air operations.[23] Working under the JFACC/AADC/ACA (within the TACS) is the JAOC, which is the focal point of the planning and execution of all air and space operations. The JAOC is the principal air operations installation from which aircraft and air-warning functions of combat air operations are directed, controlled, and executed. It is the senior element of the TACS and the senior agency from which command and control of air operations are coordinated with other services and components.[24] Directly subordinate to the JAOC is the CRC, a radar element assigned to a geographic control and surveillance Area of Operations (AO), and charged with the decentralized execution of air defense within that AO (the CRC also contains several other airspace control functions).[25] The CRC is the senior control and surveillance radar facility within an assigned AO, which implements theater mission control through employment of the C2 elements of the TACS. The CRC's primary mission is to provide airspace management and airspace control to include: air traffic detection, tracking and identification, scramble or airborne orders, data link management, and management of air defense activities within its AO.[26]

Supporting the CRC are the CRE and the AWACS. The CRE is a mobile ground radar unit capable of providing early warning, surveillance, weapons control, and identification (ID) to CA forces, essentially extending the surveillance coverage of the CRC. The CRE can also function as a CRC when required, and if directed to do so reports directly to the JAOC. AWACS is an airborne radar element providing weapons control, early warning, surveillance, battle management, and ID to CA forces. Due to its operating altitude, mobility, and advanced capabilities, AWACS can provide surveillance coverage far beyond any of the ground-based systems.

Feeding into the air defense picture, are the JSTARS and RJ aircraft. JSTARS is a long-range, airborne sensor system, which provides real time radar surveillance information on moving and stationary surface targets via secure data links to other CA forces. JSTARS has been used in past conflicts to locate mobile missiles and launchers, convoys, trucks, tanks, surface-to-air missile (SAM) sites, and artillery pieces. RJ is an airborne signals intelligence collection and reporting aircraft. Working in concert with the AWACS and JSTARS, RJ provides an assessment of hostile electronic emitters by correlating location, emitter type, and mode signals emitted by enemy forces.[27] Figure 1 offers a depiction of the relationship of various CA assets within the TACS.[28]

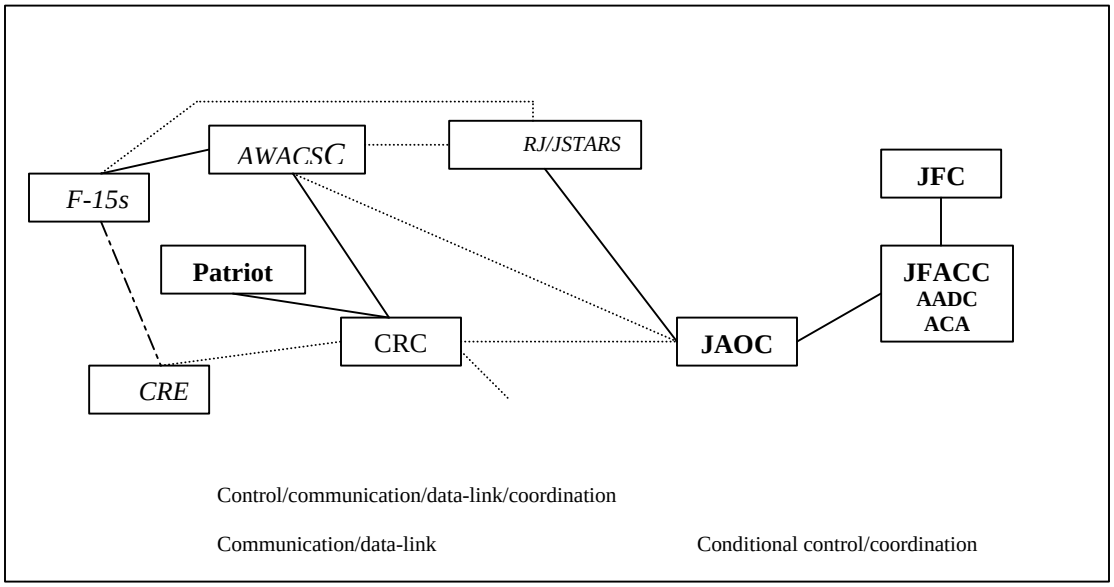

Figure 1. Theater Air Control System

The Air Force and Counterair

Beyond the C3 elements, fighters make up the majority of Air Force assets contributing to joint DCA. Air Force units field the F-15C Eagle as the primary weapon in the DCA role. Other multi-role fighters often used in the DCA mission are the F-16 Falcon and F-15E Strike Eagle. Future JFCs will have the F-22A, anticipated to replace aging F-15Cs as the primary DCA aircraft within 10 years. The Air Force also plans the addition of an ABL platform to the DCA force in coming years. This laser weapon system is designed to shoot down TBMs while still in the launch area, while in the boost phase of flight. Table 2 below outlines the CA assets, their capabilities, and mission.

TABLE 2. DCS WEAPONS PLATFORMS

System	**Service**	Fixed & Rotary Intercept?	TBM Intercept?	UAV Intercept?	Cruise Missile Intercept ?	Primary Mission
Patriot PAC3	Army	X	X	X	X	HIMAD[29]
THAAD*	Army		X			HIMAD
Stinger based systems	Army	X		X		SHORAD
THEL*	Army	X		X		SHORAD
MEADS *	Army	X	X	X	X	All Intercept
F-15C	Air Force	X		X	X	DCA
F-16/F15E	Air Force	X		X	X	Multi-role
F-22A*	Air Force	X		X	X	DCA
ABL*	Air Force	X	X	X	X	DCA
AWACS RIVET JOINT Joint STARS	Joint					C4ISR

Source: United States Government Accounting Office, *Combat Air Power: Joint Assessment of Air Superiority*. Note: * Future DCA System

F-15Cs work directly with AWACS, CRE, and RJ crews to carryout active DCA for the joint force. The F-15C will normally set up in a CAP in front of the area, point, or HVAA to be defended. Using a combination of on-board systems, and those on AWACS, CRE, and RJ, the F-15Cs locate, identify, and engage airborne enemy aircraft with a mixture of firepower.

A distinct advantage fighter's offer over SAM systems is the ability to engage hostile manned and unmanned aircraft significantly further from friendly forces. Given their mobility, F-15s can also cover a much larger area than the Patriot system, though posses no capability against TBMs, requiring augmentation from Army CA forces.

The Army and Counterair

The Army currently fields two missile systems: The Patriot missile system and the Stinger missile-based systems (see table-2). Patriot is a long-range, all-altitude, all-weather SAM missile system, designed to counter TBMs, cruise missiles and all aircraft. Patriot has a self-contained surveillance and tracking radar, and also connects into the air defense system through the CRC.[30]

Although Patriot is effective against all manned and unmanned threats, the U.S. only possesses limited systems, making their exclusive use for area defense over a large JOA prohibitive. During Operation DESERT STORM, Patriot was in very limited numbers, and was therefore used primarily for Ballistic Missile Defense (BMD) of various points in Saudi Arabia and Israel.[31] Since Hussein's SCUD missiles were not accurate enough to pose a credible risk to maneuver forces, Air Force fighters were sufficient to ensure their protection. With the improving accuracy of current TBM's, this arrangement may not be possible in future conflicts.

Army SHORAD units are all based on the Stinger missile. The Stinger is an advanced short-range infrared missile, designed primarily to defend army maneuver units. Stingers can be found in the Avenger launch system; a modified high mobility multipurpose wheeled vehicle (HMMWV) with eight missiles and a .50 caliber machine gun loaded in the back. They may also be employed from the Linebacker system; a modified Bradley fighting vehicle with four Stingers and a twenty-five millimeter cannon mounted on top. Stingers are also employed in the man-portable (MANPAD) configuration. All three styles of Stinger can be linked into the air defense picture (CRC) through the Forward Area Air Defense (FAAD) C3 system, and may be employed with a Sentinel AN/MPQ-64 surveillance and target tracking radar. Stingers are capable of engaging fixed and rotary aircraft, UAVs, and cruise missiles, although only at a very short range, giving the system limited utility to the active DCA team.[32]

JFCs will soon employ the THAAD system, which is designed to engage TBMs in the upper tier of the Army's two-tiered TBM defense concept (mid-course phase of flight).[33] THAAD will engage the missiles at a greater range, minimizing post-intercept debris over friendly assets.[34] Future maneuver forces will also employ the MEADS, designed to be rapidly deployable and highly mobile. MEADS will give maneuver forces a TBM defense, designed to engage the missiles in a similar manner as Patriot, in the terminal phase of flight. MEADS is also effective against cruise missiles, UAVs, and fixed and rotary manned aircraft. Additionally, future JFCs may someday posses the THEL system, which employs a ground based laser (similar to that on the ABL).[35]

Identification and Rules of Engagement

In future conflicts, components must work together, employing a mix of dedicated weapon systems, in order to maximize the effectiveness of air defense operations. By working in unison, the limitations of some surveillance, control, and weapon systems may be balanced by the advantages of other systems.[36] Coalescing the AWACS, RJ, CRE, CRC, F-15s, and Patriots will offer the best chance of engaging a combination of enemy manned and unmanned threats, and defending the joint force.

Prior to engaging threatening aircraft, CA players must follow an unambiguous set of rules of engagement (ROE). ROE will allow enemy aircraft to be engaged, while protecting friendly assets from fratricide incidents. If joint DCA assets are to successfully work together, clear ROE will be a crucial part of the area air defense plan.

When deciding whether to engage an aircraft or missile, a difficult task is the ID of the threat. Two possible methods of ID are "positive" and "procedural." Both are intended to effectively provide safe and flexible use of the airspace for friendly forces. Positive identification relies on a high confidence ID derived from visual observation, radar tracking from the point of origin, and or electronic means. Procedural control relies on a combination of airspace control measures documented in the ACP or ACO. For most scenarios, combinations of positive and procedural ID techniques are used to identify friendly forces, neutrals, and foes. An example of positive ID would be an AWACS aircraft (or an F-15C) electronically identifying an airborne aircraft. An example of procedural ID would be an aircraft flying along a minimum risk routing, a corridor established to allow aircraft to pass through an AO without being engaged.

For DCA forces to engage and destroy an enemy manned or unmanned vehicle, theater ROE will have to be satisfied. ROE is the authority given to DCA forces, which delineates the circumstance and limitations under which they can engage other forces, and with what amount of force.[37] Establishing ROE is the responsibility of the JFC, who takes the recommendation from the JFACC-AADC-ACA. After identifying an enemy aircraft, it must then be determined whether is has committed a "hostile act" or has "hostile intent" in order to satisfy the theater ROE (and thus be engaged). In some operations, an enemy aircraft simply launching will constitute a hostile act and can therefore be engaged immediately; other theaters may not have such a "liberal" ROE. In Operation SOUTHERN WATCH, Iraqi fighters can fly, and are not classified as hostile until crossing into one of the "no-fly" zones.

Early identification of hostile aircraft will allow for maximum Beyond-Visual-Range (BVR) engagement while minimizing fratricide incidents. Just as importantly, self-defense ROE related to air-to-surface and surface-to-surface threats for both OCA and DCA situations must be developed and understood.[38]

DCA assets will be given a weapon control status: "Weapons free," "weapons tight," or "weapons hold." Weapons free is a weapon control order imposing a status whereby weapon systems may be fired at any target not positively identified as friendly. Weapons tight is a control order restricting systems to fire only at targets not positively identified as friendly and recognized as hostile. Weapons hold is a control order imposing a status whereby a system may only be fired in self-defense or in response to a formal order.[39]

If Air Force fighters were to operate without the help of Army ADA, a Fighter Engagement Zone (FEZ) would be used to outline the area where no SAM capability exists. A Missile Engagement Zone (MEZ) is an area where friendly SAM systems engage hostile aircraft without assistance from friendly fighters. Friendly aircraft will not normally enter or engage enemy aircraft in a MEZ without prior coordination.

In a Joint Engagement Zone (JEZ), ADA and fighters work in unison to defend against hostile attack. In a JEZ, positive and procedural ID techniques are used to identify all airborne objects. Only those objects confidently identified as hostile will be targeted and engaged, and by the most efficient air defense asset available. The use of a JEZ is the preferable method of airspace control since it maximizes weapon system capabilities, helps reduce fratricide incidents, and works to minimize overly restrictive airspace control procedures.[40]

An enemy aircraft (manned or unmanned) is engaged only after it is identified, and theater ROE are satisfied. Despite hostile aircraft inside the range of friendly weapons, engagements can often be delayed due to identification difficulties. Additionally, although AWACS may be able to identify an aircraft as hostile, that information is not always passed to F-15s and Patriots in a timely manner. Evidence shows that current DCA fighters, SAM systems, and C4 ISR assets are not sufficiently interoperable to take advantage of their respective potential weapons ranges and lethality. Information on the detecting, tracking, and identifying of targets cannot consistently transferred among current DCA systems.[41]

Defensive Counterair in a Joint Operation

Air superiority is an absolute requirement for success in any future operation, as it has in every conflict since World War II. In the past, enemy airpower has challenged friendly forces with a robust manned threat, and a tactically "insignificant" unmanned capability. Future enemy airpower will now approach friendly DCA forces with the same credible manned force, combined with a much more accurate and lethal cruise missile, UAV, and TBM threat. To oppose this threat to air superiority, DCA forces will require a coordinated and interoperable fighter, SAM, and C4 ISR force.

Fighters operating in a FEZ will not have the capability to defend TBMs and will struggle with the UAV and cruise missiles threat. Patriot batteries operating a MEZ will have limited ranges (and flexibility) against UAVs, aircraft, and cruise missiles. Future conflicts will not only require a JEZ for area defense, but detailed coordination among all players in the active DCA force. A robust passive DCA effort, along with concentrated OCA, will also be necessary if air superiority is to be assured in the future JOA.

Current Army inventories contain the Patriot PAC-3 and Stinger-based SAM systems, while current Air Force units employ the AWACS and RJ team controlling F-15C aircraft. The JFC will designate the JFACC/AADC to organize this team into a coordinated air defense force. Current doctrine organizes the DCA units into a cohesive entity on an operational level, but with this difficult and complex mission, organization alone may not be enough.

Can U.S. DCA forces effectively integrate on a tactical level to accomplish active DCA? With the potential deadly combination of manned and unmanned threats, air superiority will depend on the successful interoperability of participating joint CA forces.

Interoperability in this discussion includes not only "systems integration" among the two services, but "joint training" programs as well. The following two chapters examine these two aspects of current and future DCA forces in the Army and Air Force.

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[3]John A. Warden, *The Air Campaign Planning for Combat* (Washington, DC: National Defense University Press Publication, 1991).

[4]JP 3-0, II-3.

[5]Warden.

[6]JP 3-0, II-3.

[7]U.S. Department of the Air Force, AFDD 1, *Air Force Basic Doctrine* (Washington, DC: Headquarters, Department of the Air Force, September 1997), 29 (hereafter cited as AFDD 1).

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[9]Warden.

[10]U.S. Department of the Air Force, AFDD 2-1.1, *Counterair* (Washington, DC: Headquarters, Department of the Air Force, 6 May 1998), 3 (hereafter cited as AFDD 2-1.1).

[11]General Chuck Horner, USAF (Ret.), and Tom Clancy, *Every Man a Tiger: The Gulf War Air Campaign* (New York: Berkley Publishing Group, 1999).

[12]AFDD 2-1-1, 24.

[13]Ibid., 24.

[14]Ibid., 32.

[15]Ibid., 32.

[16]Ibid., 33.

[17]Ibid., 29.

[18]U.S. Department of the Army, FM 44-100, *US Army Air Defense Operations* (Washington, DC: Headquarters, Department of the Army, 15 June 1995), 3-5.

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[20]Ibid., II-6.

[21]AFDD 2-1-1, 10.

[22]JP 3-01, II-6.

[23]AFDD 2-1-1, 10.

[24]Ibid., 11.

[25]U.S. Department of Defense, Theater Air-Ground System, *Multiservice Procedures for the Theater Air-Ground System*, (Washington, DC: Government Printing Office, July 1998), III-14.

[26]AFDD 2-1-1, 11.

[27]Ibid.

[28]Links drawn from TAGS, VII-2, and experience.

[29]High-Medium Air Defense.

[30]U.S. Department of the Army, Air and Missile Defense Program Executive Office Information, Available from www.peoamd.redstone.army.mil/tmd/require/ index.htm (January 2001); Internet; accessed on 5 January 2001.

[31]Horner.

[32]U.S. Department of the Army, Air Defense Artillery Fact Sheet, Available from www.airdefenseartillery.com/fact_sheets (2 April 2001); Internet; accessed on 10 January 2001.

[33]Upper-tier intercepts are in the endo-atmospheric or exo-atmospheric, where the missile is in the ascent or mid-course phase of flight. The lower-tier is where the missile is in the terminal phase of flight.

[34]Ibid.

[35]"Laser Knocks Down Two Rockets," Available from www.147.210.21/adamag/August312000/THEL (31 August 2000); Internet; accessed on 5 January 2001.

[36]JP 3-01, V4.

[37]Ibid.

[38]AFDD 2-1-1, 13.

[39]Ibid., 46.

[40]AFDD 2-1.1, 38.

[41]Herbert C. Kaler, Robert Riche, and Timothy B. Hassell, "A Vision for Joint Theater Air and Missile Defense," *Joint Forces Quarterly* 23 (autumn-winter 1999-2000): 1-15.
1

CHAPTER 4

CAPABILITIES AND INTEGRATION OF COUNTERAIR SYSTEMS

> Air power is indivisible. If you split it up into compartments,
> you merely pull it to pieces and destroy its greatest asset--its flexibility.[2]
>
> Field Marshall Bernard Montgomery, *Counterair*

An enemy able to saturate the JOA with combinations of manned and unmanned aircraft will offer a difficult and unique problem to the future JFC. In recent conflicts, adversaries have opposed friendly CA forces with a relatively limited level of airpower. In the next war, an enemy may present not only a more credible manned air force than past foes, but also a robust unmanned threat. Assuring air superiority in upcoming operations will require a proactive OCA effort coinciding with a coordinated and joint DCA plan, in order to successfully defend the JOA from enemy aircraft and missiles.

By systematically destroying C2 nodes, airfields, and missile launchers, OCA forces have the ability to reduce enemy airpower to a controllable size. Likewise, passive DCA measures will serve to reduce the effectiveness, as well as make predicable enemy airborne attempts at friendly joint forces. OCA and passive DCA measures reduce the amount (and intensity) of hostile enemy airpower, allowing the active DCA forces (Patriot missiles and F-15C fighters) a manageable-sized threat in which to engage. Although both the Patriot and F-15C are employed simultaneously in the DCA mission, and have some "overlapping" capabilities, each system contains unique advantages, making both systems indispensable to the JFC.

Advantages and Disadvantages of the Patriot System

Development of the Patriot missile system began in 1967 by the Massachusetts-based Raytheon Company, initially called the Surface-to-Air Missile-Developmental (SAM-D) program. With small post-Vietnam military budgets, the system was "shelved" until 1976. When revived, it was re-named "Patriot" in response to the bicentennial celebration, and as a political ploy by the then Speaker of the House of Representatives, Massachusetts's congressman Thomas O'Neil. Patriot was fielded in Europe in 1985, then only possessing capability against aircraft (including helicopters).[3]

In 1988 Patriot was given a software upgrade, Patriot Advanced Capability-1 (PAC-1), to give the system a BMD capability. In testing, PAC-1 was only successful in altering the course of incoming missiles (a "mission kill"), but not achieving a "warhead kill." The next upgrade, PAC-2, was first fielded in 1990, containing a more advanced capability against TBMs. At the beginning of Operation DESERT SHIELD only three PAC-2 missiles were in existence, and not ready for operational use. By the time Operation DESERT STORM began, hundreds of PAC-2s were deployed to defend Saudi Arabia and Israel.[4]

DESERT STORM presented significant challenges to all DCA assets, Patriot was no exception. Saudi Arabia and Israel offered large areas to be defended, and Iraq was very close, possessing TBMs with the potential of a chemical or biological payload. With defense of Army maneuver units, as well as BMD of Saudi Arabia both a requirement, the limited Patriot batteries would be scattered too thin to be effective for both duties. The U.S. Central Command Army service (ARCENT) commander General

Yeosock and the Air Force service (AFCENT) commander General Horner agreed that Patriot missiles would be used primarily in the counter-missile role, and Air Force fighters would suppress the Iraqi Air Force, protecting Army maneuver units.[5] The Iraqi air force proved a very limited threat, allowing Patriot to concentrate primarily on the TBMs.

Patriot units are currently upgrading to a PAC-3 capability, giving the system a much-improved BMD capability. PAC-3 will not rely on a blast fragmentation warhead, but rather a kinetic kill vehicle that destroys targets by colliding with them, called "hit-to-kill" technology.[6] This "hit-to-kill" feature will completely destroy the warhead in flight, reducing the damage from possible WMD "fallout."[7]

Although Patriot retains the capability to target every type of manned and unmanned threat, the system is limited due to poor mobility and short weapons and sensor range (compared to that of an airborne system). The Patriot phased array radar is somewhat restricted due to its position on the ground, allowing the potential for ingressing aircraft to flow "underneath" its coverage. Rotary aircraft are especially difficult for Patriot to engage due to their ability to fly very low, using terrain features for cover.

For system cueing of incoming aircraft, Patriot relies on AWACS aircraft and others to pass information to the CRC, then through several links to the battery engagement control station. Without the external sources, Patriot would have difficulties detecting, identifying, and engaging all inbound vehicles.

Due to the speed of TBMs, Patriot relies on DSP satellites for missile warning and cueing to the incoming missiles. The DSP satellites were originally designed to track

Intercontinental Ballistic Missiles (ICBMs) during the Cold War by detecting the heat of their rocket plume during liftoff. This data can be fed to the CRC as discussed, but due to the time sensitive nature a TBM intercept,[8] the information can also be relayed directly from the DSP ground station, to a communication satellite, and directly to the Patriot control station.[9]

In addition to its sensors, Patriot is limited by a lack of mobility. Whereas a fighter can move the CAP easily with regard to the threat, a Patriot battery does not enjoy this flexibility, making it less suitable for an area defense. Patriot batteries employ their assets in one general direction, towards the expected enemy avenue of approach. To change the missiles orientation can take an extended period of time, a much more difficult task than simply moving a fighter CAP. Furthermore, Patriot normally engages aircraft and missiles closer to friendly forces than do the F-15Cs, allowing the potential for WMD fallout near friendly troops.

Advantages and Disadvantages of the F-15

The McDonell Douglass Corporation first flew the F-15A in 1972. This advanced aircraft was originally designed to match the latest Soviet fighter designs, specifically the Mig 25 Foxbat. The F-15C is an improvement on the original design, with advances in avionics, and slight airframe modifications. The F-15C carries up to eight air-to-air missiles, a combination of AIM-7s, AIM-9s, and AIM-120s,[10] and employs a pulse-doppler radar system with an internal electronic identification system.[11]

To extend the F-15Cs sensor coverage, the AWACS and RJ aircraft can work in direct contact with the pilot. The F-15C has two Ultrahigh frequency (UHF) radios, and often maintains contact with both AWACS and RJ to optimize the CAP locations, and

intercept parameters. A small number of F-15C units are outfitted with a fighter data link (FDL) system, which allows the F-15 to share sensor data with other platforms, via a secure link. The F-15 mission commander has no direct link with the CRC, requiring all information (data or voice) to be passed through the AWACS for dissemination.

A distinct advantage the F-15C enjoys over a Patriot battery is its mobility, flexibility, and range. Future JOAs will likely encompass large areas, requiring air superiority over a vast region (area defense). F-15Cs can set up their CAPs, and with the help of C2 assets, make quick adjustment with regard to the threat. F-15Cs are able to employ weapons at significantly greater ranges from friendly forces than is possible with Patriot, minimizing fallout damage. If enemy aircraft do "leak" through the F-15C screen, there will often be time for additional engagements by other fighters, or often Patriots.

Due to fuel and crew limitations, fighters can only stay on station for a finite amount of time, making Patriot a more constant form of protection. To extend CAP times will require a large amount of support from aerial refueling aircraft. Although the F-15C is an excellent platform against all fixed-wing and rotary aircraft, it has no capability against TBMs, and limited capability against cruise missiles and UAVs. With their small RCS, and unpredictable flight path, detecting and engaging these unmanned threats will often require assistance from off-board sources (AWACS, etc.). Even with external help, engaging a well-coordinated manned and unmanned attack will be difficult (impossible if TBMs are involved), making coordination with Patriot batteries critical.

Intercepting Fixed and Rotary Winged Aircraft

With potentially fewer F-15Cs and Patriots available to the AADC than desired, their efficient use will be imperative. To defend a JOA, the AADC will position available Patriots around critical locations (airfields, headquarters, maneuver forces, etc.) for BMD, as well as to engage aircraft that "leak" through the fighter screen. The F-15Cs will be in CAPs positioned not only defending the entire joint force from enemy fixed and rotary aircraft, but in a position to defend friendly HVAA. The CAPs will be between enemy likely avenues of approach and the defended areas. Supporting the fighters and Patriots, DSP satellites will be in geosynchronous orbit,[12] with AWACS, RJ, JSTARS, and the CRC/CRE in appropriate locations to maximize their sensors.

Attacking enemy aircraft are usually detected first by AWACS, with that information passed to the F-15Cs. The fighters and AWACS work together to identify the aircraft, evaluate the ROE, and optimize the intercept. If an enemy attacks with overwhelming numbers, there is potential for an attacking aircraft to leak through the fighter screen. Patriot batteries would then continue the intercept, yet since they have no direct link to the F-15Cs, will likely spend valuable time re-evaluating ROE on the approaching enemy aircraft. With a well-coordinated enemy attack, this time may not exist.

Data-linked information through the F-15Cs FDL is improving this data sharing, but is yet to be fielded in sufficient numbers. With FDL, target data can be passed through AWACS to the CRC, and then through various levels to the Patriot battery.

Intercepting Theater Ballistic Missiles

Enemy TBM launch is normally first detected by the DSP satellite system by sensing the missile heat and booster plume against the earth's background. The

information is passed from the DSP Command Center in Cheyenne Mountain, Colorado, via communications satellite to the CRC. The CRC issues missile warning to initiate passive DCA measures, and passes information to the appropriate Patriot battery control center for cueing. The Patriot then engages the incoming TBMs in the terminal phase of flight. The satellites' information may also be passed directly to the Patriot battery when needed for faster cueing. Missile launch information is also passed via AWACS to OCA forces, for follow-on attacks on the TBM launch site.[13]

Current TBM defense relies heavily on a successful OCA effort, since the only defensive platform (Patriot) engages TBMs in the terminal phase of flight, in the vicinity of friendly forces. As discussed, missile intercept in this phase may endanger the joint force by WMD fallout. The Army is currently testing the THAAD system, designed to engage TBMs in the ascent and midcourse phases of flight. THAAD will take cueing from DSP systems as well, but also maintains sensors able to track TBMs over a larger area than Patriot. THAAD will engage the TBM at much longer ranges, and at a very high altitude (outside the atmosphere), assess the intercept, and if necessary reengage the TBM. If THAAD misses the second intercept, it will pass the cueing data off to the appropriate Patriot system, thereby killing the TBM in the terminal phase. THAAD works similarly to the Navy Theater-Wide Defense system designed for AEGIS cruisers and destroyers.[14]

Air Force DCA forces will soon possess a BMD capability with the ABL platform. The ABL will take information from the DSP systems, and from on-board sensors, to cue a laser to the TBM in its boost phase. In this phase, the TBM is very vulnerable since it is slow, following a predicable path, and has a large heat signature.

The ABL will be able to fire a laser from great distances, destroying the TBM seconds after launch. Although ABL and THAAD will greatly strengthen the U.S. BMD force, Patriot will remain crucial since it will remain the only "close-in" defense available.

Intercepting Cruise Missiles and Unmanned Aerial Vehicles

Cruise missiles and UAVs offer a difficult problem to DCA forces since they are difficult to detect, track, and engage. Detection can come from any one of the C4 ISR systems, or from the F-15C or Patriot sensors. The information is then passed to the fighters or Patriot most appropriate for the intercept. Due to their small RCS, low altitude profile, and unpredictable flight path, cruise missile detection may be delayed, requiring rapid and efficient sharing of data to successfully engage. Direct coordination from all systems will be absolutely essential for the enemy with a well-coordinated cruise missile attack.

Capabilities and Integration Difficulties

An enemy that presents a lethal combination of manned and unmanned attacks will pose a potentially deadly threat to friendly forces. Without THAAD, ABL, or some other method to engage TBMs earlier in their flight path, Patriot will continue to be employed primarily for TBM protection, mostly in the JOA rear areas. This could potentially leave maneuver commanders without the advantages of a dedicated Patriot battery. As TBMs become more accurate and lethal ("tactically significant"), a dedicated missile defense will become more than a luxury for maneuver units, but a requirement for all forces throughout the JOA. Additional Patriot units or an improved system, such as MEADS, will be mandatory to adequately defend joint forces in the next battle.

Air Force fighters and Army SHORAD units accomplish a significant portion of the DCA mission for the JFC. Although the F-15C and Stinger can adequately defend against air breathing threats (ABTs), they have no capability to counter TBMs, and may struggle to engage a dangerous impending type of threat: the cruise missile and UAV. The overlapping coverage Patriots and F-15Cs provide against this new threat will be crucial to assure continued air superiority.

Within a JEZ, the fighters will likely be the first line of defense, with Patriots not only engaging inbound TBMs, but other vehicles that "leak through" the fighter CAPs (a layered defense). Better systems integration will allow Patriot operators to efficiently engage enemy aircraft that pass through the fighter defenses, while rapidly differentiating between friendly and enemy manned and unmanned vehicles (preventing fratricide).

With overwhelming numbers of manned and unmanned threats, DCA assets will need to rapidly share threat data, to successfully defend the entire joint force. Existing integration between the fighters, Patriot, and C4 ISR systems is currently too inefficient for this rapid sharing of information.[15] Future upgrades (data linking and radar improvements) are crucial, and will allow the F-15C to better engage the entire array of threats. As the F-22A replaces the F-15C, the Air Force will have a system that is better integrated with C4 ISR platforms, increasing capabilities of the entire DCA force.

During Operation DESERT STORM, coalition forces successfully used F-15Cs and SHORAD units to defend against all rotary and fixed wing aircraft, while Patriots were used primarily in the TBM defense role. With the exception of fighters avoiding Patriot MEZs, coordination between F-15Cs and Patriots was minimal. Although this relationship between SAMs and fighters worked in the past, future conflicts with a more

sophisticated adversary may not allow such a simple air defense plan. The next conflict will likely require more use of the JEZ to handle the potential mix of manned and unmanned threats, with all systems efficiently operating throughout. Although improving systems integration among DCA forces is critical, an examination of CA training scenarios will be equally important.

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[2]U.S. Department of the Air Force, AFDD 2-1.1, *Counterair* (Washington, DC: Headquarters, Department of the Air Force, 6 May 1998).

[3]Frank N. Schubert and Theresa L. Kraus, *The Wirlwind War*. Appendix A, "The Patriot Air Defense System," Available from www.army.mil/cmh-pg/books; Internet; accessed on 10 January 2001.

[4]Ibid.

[5]General Chuck Horner, USAF (Ret.), and Tom Clancy, *Every Man a Tiger: The Gulf War Air Campaign* (New York: The Berkley Publishing Group, 1999), 241.

[6]Hit-to-kill technology is preferable to a proximity fuse, in that when the Patriot missile strikes the incoming TBM, the impact maximizes the missiles destruction. This limits the amount of potential "fall-out" damage from the missile's warhead. Hit-to-kill systems deliver the most possible destructive energy, much greater than even the most efficient blast-fragmentation warhead. Available from www.army.technology. com/project and peoamd.redstone.army.mil/tmd/require/index.htm

[7]Schubert and Kraus.

[8]During Operation DESERT STORM, SCUD missiles had approximately a seven seconds time of flight from launch to impact. Schubert.

[9]U.S. Deparment of the Air Force, USAF Fact Sheet. *Defense Support Program Satellit,* Available from www.af.mil/news/factsheets/Defense_Support_Program_ Satel.htm; Internet; accessed on 5 January 2001.

[10]Air Intercept Missile 7 (AIM 7) is a medium-range semiactive radar homing missile. The AIM 9 is a short-range infrared guided missile. The AIM 120 (also know as

the advanced medium range air-to-air missile or AMRAAM) is a medium-range active-radar missile.

[11]U.S. Department of the Air Force, USAF Fact Sheet, *F-15 Eagle*, Available from www.af.mil/news/factsheet/F_15_Eagle.html; Internet; accessed on 5 January 2001.

[12]Geosynchonous orbits are those that place a satellite stationary over a desired point. USAF Fact Sheet.

[13]U.S. Department of the Air Force, USAF Fact Sheet.

[14]U.S. Department of the Army, ADA Weapon Systems Fact Sheet, "THAAD System," Available from www.AirDefenseArtillery.com; Internet; accessed on January 5, 2001.

[15]Herbert C. Kaler, Robert Riche, and Timothy B. Hassell, "A Vision for Joint Theater Air and Missile Defense," *Joint Forces Quarterly* 23 (autumn-winter 1999-2000): 1-15.

CHAPTER 5

COUNTERAIR TRAINING

If something is going to be done in war, it ought to be practiced in peace. If it has not been practiced, losses are likely to be high and the plan is unlikely to go as expected.[1]

Colonel John A. Warden III, *Air Campaign Planning for Combat*

A measure of interoperability among Army and Air Force CA forces includes not only the systems integration aspects, but also the effectiveness of CA training within the joint force. In the next conflict, there is a potential for an enemy to present a well-coordinated manned and unmanned attack against friendly forces, increasing the need for joint interoperability between the two services. Although it will be imperative for Army Patriots, Air Force F-15Cs, and C4 ISR assets to efficiently operate together, it will be equally important for Army and Air Force personnel to function as a team. Future training exercises will not only have to "test" Air Force and Army systems integration, but must also allow a realistic look at the actual coordination required between the two services to meet a potential adversary.

Current Joint Counterair Training

Operational F-15C squadrons train almost exclusively against a manned fixed-winged type threat. Training scenarios normally employ two or four F-15Cs against an equal (or outnumbered) OPFOR simulating the most advanced potential adversary. The OPFOR may use similar airframes (other F-15Cs) to simulate the threat, or may employ

dis-similar types (F-16s, F-14s, F-18s, etc.). Engagements often include AWACS or Ground Control Intercept (GCI) assistance, and may include some type of Electronic Attack (EA). Most squadron members train to this scenario once or twice weekly, unless deployed to a contingency, in which the frequency can be much lower. Squadron's infrequently employ against rotary aircraft, since most helicopter assets are in Army inventories, and not usually co-located with Air Force squadrons, and maintain other training priorities. Additionally, Air Force squadrons rarely employ against assets simulating cruise missiles and cruise missile type tactics. Most importantly, squadrons seldom employ their assets with a coordinated Army ADA force.

F-15C pilots may only see large-force employment $(LFE)^2$ training at home station a few times yearly, with several opportunities during various exercises. The most noted air-to-air LFE training being the Red Flag and Green Flag exercises held periodically at Nellis Air Force Base in Nevada. Both exercises pit several fighters, bombers, and support aircraft against an overwhelming OPFOR, with scenarios usually including enemy ADA assets, as well as EA. F-15Cs often employ at Nellis in support of OCA scenarios, but may occasionally work in the DCA role. The DCA training that does take place normally does not include Patriots, and seldom focuses against UAV or cruise missile threats.

There are several other air-to-air exercises (Maple Flag in Canada, Bright Star in Egypt, etc.), most of which rarely employ fighters in a DCA role in conjunction with ADA assets. One of the few exercises that regularly put F-15Cs, AWACS, and Patriots together is Roving Sands, held in the White Sands Missile Range (WSMR) north of Fort Bliss, Texas. Roving Sands places the DCA team against fighter aircraft, aircraft

simulating cruise missiles, and even simulated TBM launches. Though Roving Sands appears to offer an excellent DCA training opportunity, in actuality the exercise is of limited value for Air Force units, especially with regard to joint coordination. The Army has the "lead" on Roving Sands, and concentrates on the coordination and employment of their ADA systems against manned and unmanned threats, and has little interest in direct integration with Air Force fighters. Additionally, WSMR is not optimal for air-to-air training, leading to many fighter squadrons to avoid this exercise in favor of Red Flag and Green Flag. The Nellis ranges have a state-of-the-art debriefing system, allowing units to accurately recreate aerial engagements from a co-located facility. Nellis offers the F-15C units better air-to-air training opportunities than available in the WSMR, but valuable opportunities to integrate with Patriot crews is lost.

With the high operational deployment rate of F-15C pilots in the past ten years, the amount and quality of training has been severely reduced. Deployments such as Operation SOUTHERN WATCH and Operation NORTHERN WATCH strictly reduce the times pilots spend on LFE training, and greatly limit the opportunities to practice integration with not only Patriots, but C4 ISR assets as well.

Army ADA units suffer the same training shortfalls and difficulties in terms of joint integration as do their Air Force counterparts. Patriot batteries also have the same problems with high operations tempo as Air Force units, further evaporating training opportunities. Most Army training scenarios rarely take advantage of Air Force command and control and fighter assets.

Training Improvements

Exercises similar to Roving Sands will be required to properly train future integrated CA forces. When exercises such as Red Flag were designed years ago, the major threat to U.S. air superiority was the Soviet fighter force. An OPFOR consisting of a robust and overwhelming manned threat was realistic, and was considered to be the most dangerous scenario friendly air forces would face.

In the last ten years, the most realistic threat to air superiority has been a "Soviet style" fighter force working alongside a limited and inaccurate (as well as tactically "insignificant") unmanned threat. Conflicts against Iraq and Serbia mirrored this style of threat, where the greatest threat to friendly air superiority was small numbers of Mig 29 Fulcrum fighters. Training scenarios such as those offered at the Nellis ranges, although designed for the Cold War, sufficiently prepared units for DCA in recent conflicts.

As unmanned vehicles are becoming increasingly more accurate (due to such innovations as GPS navigation), an enhanced DCA force is necessary, requiring improved DCA training exercises. Realistic scenarios for training will need to include threats beyond a "manned" OPFOR. Transforming Roving Sands into a truly integrated and "joint" exercise will help further develop necessary tactics, techniques, and procedures for future conflicts. Integrating Army ADA units and OCA forces into LFE training when possible, as well as including unmanned threats into the scenarios will also aid CA forces to better integrate.

Army units will soon possess the THAAD system, MEADS, as well as improvements in sensors and data sharing. Likewise, the Air Force will add the ABL, the F-22A, and several improvements to the F-15C into the CA force. These new DCA

systems (as well as emerging OCA systems) will greatly enhance the CA forces ability detect, identify, and engage enemy aircraft and missiles both before and after launch. With the new capabilities, and increased lethality of both friendly and enemy systems, a well-designed joint training plan is necessary to guarantee air superiority, and avoid fratricide incidents.

Joint Training

Interoperability among Patriot batteries, F-15Cs, and C4 ISR asset will be absolutely imperative if friendly forces are to remain dominant in the battle for air superiority. Just as systems need to integrate in order to share time-sensitive data, the operators of the equipment need to be well trained in joint employment. The next enemy will likely present CA forces a much more complicated threat than did Saddam Hussein ten years ago, requiring forces to utilize all the maximum capabilities of their assets. Setting up deliberate joint training scenarios will not only find "holes" in various weapon systems (as well as their integration with other joint assets), but will guide Army and Air Force units on the correct manner in which to synergistically employ these systems.
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[1]John A. Warden, *The Air Campaign, Planning for Combat* (Washington, DC: National Defense University Press, 1988), 81.

[2]For this discussion, "large-force" denotes employment of greater than four F-15s in one scenario. LFE scenarios usually include AWACS aircraft, and may integrate air-to-ground platforms as well.
[3]

CHAPTER 6

A JOINT APPROACH TO AIR SUPERIORITY

If you don't control the air, you'd better not go to war.[1]

General Charles Horner *Counterair*

Since World War II, no country has won a war in the face of enemy air superiority, no major offensive has succeeded against an opponent who controlled the air, and no defense has sustained itself against an adversary who possessed air superiority.[2] As in past conflicts, a future JFC will require control of the air environment as quickly as possible in order to allow component commanders freedom to operate their forces.[3]

Joint doctrine defines air superiority as the degree of control over an opponent's military, permitting all operations (air, land, and sea) without prohibitive interference from opposing airpower.[4] Air superiority includes not only dominance over manned vehicles (fixed-wing and rotary aircraft), but unmanned threats as well (TBMs, UAVs, and cruise missiles). Ensuring complete protection from enemy aircraft and missiles requires the participation of all CA assets: Air Force fighter aircraft, Army ADA units, and joint C4 ISR systems.

As threat nations acquire more potent and complex systems, the participating CA forces will likely need improvements in unity of effort and integration to assure complete air superiority coverage. During Operation DESERT STORM, coalition CA units successfully maintained a defense of Saudi Arabia and coalition areas using fighters and SHORAD units, while Patriots employed primarily in the TBM defense role. Iraq presented a limited air threat, allowing friendly air superiority with minimal coordination

between fighter CAPs and Patriot batteries. Although this relationship was feasible in the past, future conflicts with a more sophisticated adversary may not allow such a straightforward employment of assets. A future enemy may have the capacity to overwhelm air defense units with multiple combinations of manned and unmanned vehicles, requiring improved interoperability among CA units.

Taking into account this changing threat environment, is current interoperability between Air Force and Army assets adequate for their integration? Interoperability includes not only systems integration, but joint training issues as well. Evidence shows that current fighters, SAM systems, and C4 ISR assets are not sufficiently interoperable to take advantage of their respective potential weapons ranges and lethality.[5] With a more capable threat, and CA forces unable to maximize their full potential, air superiority might be compromised in future conflicts. The relationship between Air Force fighters and Army ADA units will likely need improvements to assure our continued dominance over tomorrow's threat.

Emerging Threat Trends

Although enemy fixed-wing and rotary aircraft can provide the most danger to friendly forces, the proliferation trend in the 21st century is towards unmanned vehicles (TBMs, UAVs, and cruise missiles). These unmanned threats can offer resource-constrained states a cost-effective (asymmetric) alternative to fielding large manned air forces. This is not to say that manned vehicles no longer pose a risk, but that they may be augmented with an overwhelming, and deadly mix of unmanned threats.

The unmanned threat is not a new occurrence in warfare, as demonstrated by the credible use of V-1 and V-2 missiles in World War II, and SCUD missiles in the Gulf

War. Although these weapons were relatively inaccurate, making them tactically insignificant, they caused friendly commanders to expend unprecedented numbers of assets countering them.

A recent and alarming trend in unmanned vehicles has been improvements in the guidance systems. Hitler's V-2 rockets had a CEP[6] in excess of seventeen kilometers,[7] whereas today's TBMs are beginning to see accuracy's within 50 meters.[8] With this new accuracy, the TBM is no longer tactically insignificant, as was the case in World War II, and even DESERT STORM.

Another emerging threat to air superiority is the cruise missile. Although few countries currently posses cruise missiles, it is becoming the latest trend, with Russia, France, Germany, Italy, South Africa, and China aggressively developing programs.[9] Likewise, UAVs are becoming very popular among several nations. Although Air Force fighters and Army SAM systems maintain a redundant capability to engage both cruise missiles and UAVs, it is very challenging for each, since both threats have a small RCS, and can fly at very low-altitudes following an unpredictable profile.

Air Superiority and Counterair

Air superiority is achieved through the counterair mission, by integrating both offensive and defensive operations from all components to counter the air and missile threat.[10] The CA mission is the instrument the JFC uses to secure air superiority in a joint operation. CA is divided into two major categories, OCA, and DCA. OCA is operations (attacks) to destroy, disrupt, or limit the enemy air and missile assaults on friendly forces. OCA is the targeting of an enemy's airpower before it becomes a threat to friendly forces.

DCA, consisting of both active and passive defense, is the actual defense of friendly forces that are under attack from enemy airpower.[11]

As in past conflicts, OCA forces will target as much of the enemy airpower as possible before it is able to threaten friendly forces. DCA forces are necessary to defend the joint force from the elements of enemy airpower that are able to continue attacks, despite OCA efforts. The current DCA force consists of Army Patriot PAC-3 units and Air Force F-15C squadrons, positioned to defend critical areas from enemy aircraft and missiles.

Although U.S. OCA and DCA forces currently enjoy a technical dominance over all potential opponents, a JFC may soon find a foe with the equipment, training, and desire to challenge air superiority. As threats become more sophisticated, achieving air superiority may not be as effortless as in previous conflicts.

Current and Future Defensive Counterair Forces

Currently the DCA mission is carried out by Air Force F-15Cs working in conjunction with Patriot batteries, both functioning alongside various C4 ISR assets. Additional Air Force aircraft also possess an air-to-air capability, but are primarily used for other essential missions (strategic attack, air interdiction, close air support, OCA, etc.), leaving DCA duties primarily to the F-15C squadrons. Likewise, although the Patriot is the Army's primary DCA asset, maneuver units maintain a SHORAD systems for self-defense operations. Additionally the Navy and Marine Corps maintain several CA assets available to the JFC, although the DCA mission within an AO is normally assigned to designated F-15C, Patriot, and joint C4 ISR units.

In the future, U.S. forces are likely to employ the THAAD system, ABL, MEADS, and the F-22A fighter. THAAD is designed to engage TBMs in the upper tier of the Army's two-tiered TBM defense concept (midcourse phase of flight).[12] THAAD will engage the missiles at a greater range than Patriot, covering a larger area, and thereby minimizing post-intercept debris over friendly assets.[13] MEADS is a highly mobile SAM system, designed to give maneuver forces a more easily deployable and flexible air defense system than that of Patriot.

The Air Force is currently testing the ABL, a high-energy laser system designed to engage TBMs while still in the launch area, in the boost phase of flight. The Air Force is also replacing current F-15Cs with the F-22A. The F-22A will offer greater range, speed, and interoperability with joint systems.

Interoperability in Counterair Forces

Although Air Force fighters possess a lethal and flexible capability against manned vehicles, they are unable to engage TBMs, and will often require assistance to efficiently acquire and engage UAVs and cruise missiles. Army SAMs (specifically the Patriot missile system) do maintain the ability to target all manned and unmanned threats, but have smaller employment ranges and less mobility than the fighters. Both systems are required to completely defend an entire joint force from an enemy capable of both manned and unmanned vehicles.

During Operation DESERT STORM, coalition forces successfully used F-15Cs and SHORAD units to defend against all fixed-wing and rotary aircraft, while Patriots were used primarily in the TBM defense role. With the exception of fighters avoiding Patriot MEZs, coordination between F-15Cs and Patriots was minimal. Although this

relationship between SAMs and fighters worked in the past, future conflicts with a more advanced adversary may not allow such a simple air defense plan.

An enemy with the ability to present lethal combinations of manned and unmanned attacks will pose a potentially serious threat to friendly forces under our current structure. Without THAAD, ABL, or some other method to engage TBMs earlier in their flight path, Patriot will continue to be employed largely for TBM protection, and primarily in JOA rear areas. This could potentially leave maneuver commanders without the advantages of a dedicated Patriot battery, relying Air Force fighters and SHORAD units for DCA coverage. As TBMs become more accurate and lethal, a dedicated TBM defense will become more than just a luxury for commanders, but a requirement for all forces throughout the JOA.

Fighters will not have the capability to defend TBMs, and will struggle with the UAV and cruise missiles threat. Patriot batteries can engage all threats, but will have limited engagement ranges and flexibility. Future conflicts will require both Patriots and fighters, and better coordination among all players. DCA players must establish several layers of defense, to assure no enemy aircraft or missiles can penetrate friendly defenses. This layered defense will require a rapid sharing of data among a well-coordinated fighter, SAM, and C4 ISR force.

Current Army inventories contain the Patriot PAC-3 and Stinger-based SAM systems, while current Air Force units employ the AWACS and RJ team controlling F-15C aircraft. Existing doctrine organizes the DCA units into a cohesive entity on an operational level, but with this difficult and complex mission, organization alone may not be enough. With the potential of deadly combinations of manned and unmanned threats,

air superiority will depend on the successful interoperability (systems integration and joint training) of all participating joint CA forces.

A Joint Approach to Air Superiority

If the F-15C and the Patriot remain the sole U.S. DCA weapon systems, improvements in interoperability will be imperative, if air superiority is to be guaranteed with regard to emerging threat systems. The F-15C and Patriot may possess limited capabilities against the full array of potential threats in the future, and additionally are only available in limited numbers. With the up-and-coming risks to air superiority, the F-15C and Patriot could have difficulty maintaining air superiority in the next conflict. By improving systems integration and joint training, many "short term" difficulties may be overcome. As THAAD, ABL, MEADS, and F-22A are potentially added to the DCA force, this interoperability will still remain crucial to not only assure air superiority, but prevent fratricide incidents.

Performing an area defense against manned and unmanned threats will require a JEZ employing F-15C CAPs and well-placed Patriot batteries, providing the JFC a layered defense. Within a JEZ, the unique capabilities of the fighters and SAMs can be used to efficiently engage all enemy missiles and aircraft. To adequately defend a JOA, the fighters, SAMs, and C4ISR systems within this JEZ will need the capability to instantly share information on inbound threats. The F-15C mission commander, the Patriot battery commander, and the AWACS controller should be viewing the same "common" picture, and have secure voice contact with all players. If an F-15C is engaging an inbound aircraft, the Patriot operator should be instantly aware of this, so as to not "waste" additional assets on that threat, or spend time tracking it. The F-15C pilot

should have the ability to verify ROE data through voice contact if necessary. The AWACS controller should be in a position to share data and voice information with all applicable fighters and SAMs, to integrate the assets, validate ROE, and engage applicable threats. This technology is available to both Patriots and F-15Cs, but is not employed in all front-line units. Additionally, the organization of the Patriot batteries do not allow for the battery commander to have a direct link to AWACS, or the F-15Cs.

In addition to improvements in systems integration, improvements in joint training are necessary if Patriot and F-15C units are to maintain air superiority in future conflicts. Exercises similar to Roving Sands will have to be developed and improved to train this crucial joint force. Red Flag, Maple Flag, Bright Star, and others will all require a more developed threat scenario, and feature a joint CA force. The simulated threat will need to employ a combination of manned and unmanned vehicles, including UAVs, and even simulated TBM launches. The F-15Cs and Patriots will have to be forced to integrate their systems with each other, joint C4ISR systems, and with the joint OCA platforms.

Air Force Air Defense Artillery?

Forcing two separate services to integrate more efficiently may continue to be difficult. During an operational deployment ("wartime"), all assets fall under the control of the JFC. The JFC then appoints a JFACC, who plans, tasks, and controls joint air operations. The JFC also appoints an AADC, with the responsibility of coordinating the air defense plan within the AO. Since the duties of JFACC and AADC are interrelated, they normally fall under the same individual, usually an Air Force officer.[14] The JFACC-AADC essentially has the duty of organizing the fighters, ADA assets, and C4 ISR

capabilities into a coherent air defense team, to maintain air superiority for the joint force. In contrast, during peacetime operations the separate DCA assets fall under different services, with different doctrine, priorities, and even visions concerning CA.

With Patriot and F-15C units falling under the same command structure in wartime, with a duty that requires a high amount of integration and cooperation, placing some Patriots within the Air Force structure is a possible alternative to current organization. Patriot and F-15C forces within the same peacetime command may be better able to integrate systems, as well as training and doctrine, offering a more coherent team during hostilities. With this change, the DCA doctrine and training could ultimately concentrate more on tactics, techniques, and procedures, with less effort placed on the integration difficulties between the two separate services.

Army maneuver units will always need a dedicated Patriot system (or equivalent asset) for unit self-protection. As unmanned threats become more accurate and deadly, maneuver units will eventually require a more flexible and mobile capability than is offered by Patriot and current SHORAD components. A system similar to MEADS will allow a rapidly deploying Army a more mobile and complete self-protection air defense capability. As long as the Army can maintain self-protection means against manned and unmanned threats, some Patriot units (and ultimately THAAD) may be better employed under the supervision of one service. One day possibly F-22As, ABL, AWACS, and some THAAD and Patriot units could remain in one coherent CA force, in peacetime and in war.

Final Thoughts

Air superiority is an absolute requirement for success in any future operation, as it has been in every conflict since World War II. In the past, enemy airpower has challenged friendly forces with a robust manned threat, and a tactically "insignificant" unmanned capability. Future enemy airpower will now approach friendly forces with the same credible manned force, combined with a lethal cruise missile, UAV, and TBM threat. To oppose this threat to air superiority, DCA forces will require a coordinated and interoperable fighter, SAM, and C4 ISR force.

Systems integration and joint training will have to improve to where future DCA forces will be able to seamlessly share critical information. Currently the Army and Air Force are not producing systems that easily integrate with each other, and are not training to a necessary "joint" level. With the changing nature of tomorrow's threat, a concerted joint effort in systems integration and training will be necessary to assure air superiority in the future.

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[1]U.S. Department of the Air Force, AFDD 2-1.1, *Counterair* (Washington, DC: Headquarters, Department of the Air Force, 6 May 1998) (hereafter cited as AFDD 2-1.1).

[2]John A. Warden, *The Air Campaign: Planning for Combat* (Washington, DC: National Defense University Press, 1988) 13.

[3]U.S. Department of Defense, Joint Publication 3-01, *Joint Doctrine for Countering Air and Missile Threats* (Washington, DC: Joint Chiefs of Staff, 19 October 1999), I-1 (hereafter cited as JP 3-01).

[4]Ibid., GL-3.

[5]Herbert C. Kaler, Robert Riche, and Timothy B.Hassell, "A Vision for Joint Theater Air and Missile Defense," *Joint Forces Quarterly* 23 (autumn-winter 1999-2000): 1-15.

[6]Circular Error Probable (CEP) is the diameter of a circle within which one-half the missiles fired would land.

[7]Michael Tronolone, "More than 50 Years of Terror, A History of the Ballistic Missile Threat," *ADA Magazine*, August 2000, 1-15.

[8]U.S. Department of the Army, FM 44-100, *US Army Air Defense Operations* (Washington, DC: Headquarters, Department of the Army, 15 June 1995).

[9]Ibid.

[10]JP 3-01.

[11]AFDD 2-1-1, 24.

[12]Upper-tier intercepts are in the endo-atmospheric or exo-atmospheric, where the missile is in the ascent or mid-course phase of flight. The lower tier is where the missile is in the terminal phase of flight.

[13]U.S. Department of the Army, ADA Weappons Systems Factsheet, Available from www.airdefenseartillery.com/fact_sheets; Internet; accessed on 5 January 2001.

[14]U.S. Department of Defense, Theater Air-Ground System, *Multiservice Procedures for the Theater Air-Ground System* (Washington, DC: Government Printing Office, July 1998): I-5.

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GLOSSARY

Airspace Control Authority (ACA): The commander who has the responsibility of coordinating, integrating, and regulating the use of the assigned airspace. (TAGS).

Area of Operations (AO): A geographical area, including the airspace above, usually defined by lateral, forward, and rear boundaries assigned to a commander, by a higher commander, in which he has responsibility and the authority to conduct military operations. (FM 101-5).

Area of Responsibilities (AOR): The geographical area associated with a combatant command within he has the authority to plan and conduct operation. (FM 101-5).

Counterair (CA): Air operations conducted to attain and maintain a desired degree of air superiority by the destruction or neutralization of enemy forces. (AFDD 1).

Circular Error Probable (CEP): The diameter of a circle within which half the missiles fired would land (Tronolone).

Defensive Counterair (DCA): Operations to detect, identify, intercept, and destroy enemy air and missile forces attempting to attack or penetrate the friendly air environment. (AFDD 1).

Joint Forces Air Component Commander (JFACC): The commander with operational control over airborne assets in a theater (AFDD 1).

Joint Forces Commander (JFC): Commander authorized to exercise combatant command (command authority) or operational control over a joint force. (AFDD 1).

Offensive Counterair (OCA): Operations mounted to destroy, disrupt, or limit enemy airpower as close to its source as possible. (AFDD 1).

Rules Of Engagement (ROE): Directives issued by competent military authority that delineate the circumstances and limitations under which forces can initiate/continue a combat engagement. (JP 3-01).

Suppression of Enemy Air Defenses (SEAD): Activity to neutralize, destroy, or temporarily degrade surface-based enemy air defenses by destructive and/or disruptive means. (AFDD 1).

Theater Missile Defense (TMD): The identification, integration, and employment of forces to detect, identify, locate, track, minimize the effects of, or destroy enemy theater missiles. (FM 101-5-1).

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