AEROSPACE POWER IN URBAN WARFARE: BEWARE THE HORNET'S NEST

Peter C. Hunt

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Comments pertaining to this paper are invited; please forward to:

Director, USAF Institute for National Security Studies
HQ USAFA/DFES
2354 Fairchild Drive, Suite 5L27
USAF Academy, CO 80840
phone: 719-333-2717
fax: 719-333-2716
email: james.smith@usafa.af.mil

Visit the Institute for National Security Studies home page at
http://www.usafa.af.mil/inss

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FOREWORD

We are pleased to publish this thirtieth-ninth volume in the *Occasional Paper* series of the US Air Force Institute for National Security Studies (INSS). Aerospace power has emerged as a primary military instrument of choice in pursuing national objectives within the complex international security environment entering the 21st century. Changes in the security landscape, the dynamics of sub-theater conflicts, and coalition imperatives combine to place new requirements on aerospace operational planning and the conduct of aerospace operations themselves. Occasional Papers 38 and 39 address, in turn, both political and operational dimensions of aerospace power application today. They are presented both for informational and educational purposes to offer informed perspectives on important aspects of contemporary aerospace operations, to generate informed discussion and to bound productive debate on aerospace power in both supported and supporting roles. In Occasional Paper 38, *Constraints, Restraints, and the Role of Aerospace Power in the 21st Century*, Jeffrey Beene presents a comprehensive examination of the use of aerospace power within tightly restrained conflicts and suggests improvements in doctrine, training, and tools to more effectively employ such power within that environment. Then in Occasional Paper 39, *Aerospace Power in Urban Warfare: Beware the Hornet's Nest*, Peter Hunt examines the employment of aerospace power in the increasingly important urban operational environment. Aerospace technologies and systems offer alternatives and important adjuncts to surface forces in the urban arena, but significant obstacles and critical considerations must be brought into planning for such operations. Each of these aspects of aerospace power demands greater thought and analysis, and these two occasional papers are presented to help focus that attention.

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JAMES M. SMITH
Director

EXECUTIVE SUMMARY

Interservice debates concerning urban warfare diverge along two paths. One approach emphasizes the role of infantry, whereas the second approach seeks ways to achieve operational and strategic objectives without large numbers of ground forces. This alternative approach relies on aerospace power to provide commanders with better intelligence, which they can use to analyze and target entities valued by the enemy.

Aerospace power should emphasize those tasks that best support the joint force. The urban area provides aerospace power with advantages over surface-based counterparts, yet it introduces variables affecting the offense-defense relationship that should not be overlooked. The compression of time, space and levels of war in an urban environment threatens to reduce aerospace power effectiveness, much as it degrades the fire and maneuver of surface forces.

Little evidence or doctrine exists concerning offensive aerospace power against modern, well-equipped urban defenders. An operational-level strategy that isolates the enemy optimizes aerospace power with minimum risk, but requires accurate intelligence and specialized munitions. The strength of urban aerospace defenses and the time required to achieve objectives should not be underestimated. Enemies defending the terrain on which they live and work tend to devise workarounds to defeat the most militarily capable attackers.

ACKNOWLEDGMENTS

This paper could not have been accomplished without the support and encouragement of my colleagues and family. I would like to thank the leadership of the 23rd Fighter Group "Flying Tigers," Colonel Joe Wood and Lieutenant Colonel Robert Brown, for their encouragement and understanding as I devoted time to this project. The rare opportunity to conduct research while assigned to an operational flying unit enabled me to reach out and build bridges with a dedicated group of active duty, retired and contractor personnel who are addressing the difficult challenges of urban operations. Thanks also to another Flying Tiger, Lieutenant Colonel Henry Fisher, with whom I debated many of the issues in this paper. Finally, I thank my wife, Debbie and my children, Rachel, Kristen, Abby and Ryan, for their love and patience as I completed this paper.

Aerospace Power in Urban Warfare: Beware the Hornet's Nest

INTRODUCTION

As the U.S. Armed Forces continue to debate post-Cold War roles and missions, a significant intellectual divide has developed concerning the approach to operations in urban environments. The bulk of professional literature on this subject deals with methods to improve the capabilities of the infantryman, around whom an urban force would best be structured. New technologies and experiments seek to provide the foot soldier with better communications, improved ability to fire and maneuver through the urban jungle, and protection from a variety of threats.

An alternative approach to the challenge of urban environments emphasizes joint operational concepts that achieve operational and strategic objectives with minimum risk to friendly forces. This perspective "steps back" from a pure infantry fight and seeks the best means to influence the urban environment from the pre-crisis phase through conflict termination and transition.[1] New technologies and procedures provide friendly commanders with improved intelligence, enabling him to understand and shape the crisis in consonance with strategic goals. Based on the improved situational awareness, commanders can orchestrate precision strikes that use a wide variety of lethal and non-lethal munitions appropriate for the situation.

This paper acknowledges the merits of both approaches, but offers no new ideas for infantry tactics in urban areas. Instead, it analyzes alternative approaches that rely heavily on aerospace power. In general, the paper focuses on the challenges to operational-level aerospace power planners charged with developing strategies appropriate for an urban environment. Specifically, the paper highlights enemy countermeasures that could increase risk and reduce aerospace power effectiveness in urban warfare. Although an urban environment could be the locus of a range of scenarios from peacekeeping to full-scale war, this examination concentrates on small-scale contingencies that

pose a viable threat to U.S. military personnel, but involve less-than-vital national interests. Such activities referred to here as "urban warfare," encompass only a subset of possible urban operations.

Several assumptions limit the scope of this paper. First, the paper assumes the projection of U.S. military power to an urban area outside the United States. The defense of U.S. cities against foreign powers, terrorists or other non-state actors remains a concern of defense planners, but is not addressed here. Second, the U.S. mission will be to attack an urban defender in an unfriendly nation, not to defend an ally's city against an outside force. If trying to defeat an enemy who has occupied a friendly city, the mission changes little, though the following assumption would warrant increased attention. Third, the scenario assumes the establishment of rules of engagement that are significantly more complex than those expected in other types of terrain, primarily due to the presence of noncombatants and a desire to minimize collateral damage. Finally, the paper assumes the U.S. will achieve air and space superiority before conducting urban warfare.[2]

The following section explores the fundamental question of why we should plan for urban warfare. Before committing or reprioritizing assets toward this mission area, one should understand the nature of the subject area and the implications for aerospace power. The paper then discusses the levels of war and the unique characteristics of the urban environment that influence aerospace power strategies. It next analyzes the relationship between offense and defense in the urban setting, to reveal salient points of note for campaign planners. It then presents a concept for using aerospace power to isolate the urban defender, and describes challenges in applying aerospace power in urban areas. Finally, the paper draws conclusions from the theory and evidence presented that can guide aerospace power planners faced with similar challenges.

WHY SHOULD WE CARE?

U.S. Unprepared for Urban Warfare, Analysts Caution.
- Steven Willingham, *National Defense*

Bottom Line: It's Infantry.
- Scott E. Packard, *Proceedings*

Defense periodicals published during the past five years are replete with articles critical of the U.S. military capability to conduct urban warfare. Government boards and panels have identified deficiencies in several areas, including training, doctrine and technology.[3] Why has this issue generated so much attention and how have the services responded? If the "bottom line" is infantry, then what role should aerospace power have in the urban environment?

Several core arguments attempt to justify why this issue should be of interest to military planners. First, demographic shifts toward urbanization lead to governmental failures to provide for the needs of the expanded urban populace. Dissatisfaction with the status quo, potentially fueled by ethnic or religious tensions, leads to massive unrest and instability. Second, since urban areas contain key political, economic and social institutions, the U.S. and its allies naturally seek to defend such important interests. Third, the U.S. involvement in urban peace operations in the 1990's, from Somalia to Haiti to Bosnia, demonstrates a trend that may likely continue. A final argument points to the post-Cold War strategic environment dominated by the U.S. role in world politics, bolstered by a military without peer. Challengers to the U.S. military will seek to deny our technology-dependent force by "luring us into the cities in an attempt to mitigate our capabilities and make us fight where we are the least effective."[4] Such "asymmetric conflicts" challenge U.S. planners to avoid fighting the last war—commonly identified as Operation Desert Storm in 1991.

Skeptics argue that the number of urban warfare incidents in the past 500 years of Western warfare has actually decreased, not increased.[5] Since cities are valuable to someone, they prefer to avoid death and destruction in

the urban area. Only when a city became a political symbol like Stalingrad, Manila, Seoul or Grozny was urban warfare deemed necessary by both sides.[6] A second contrary view attributes U.S. military intervention in peace operations (often with urban components) to "promiscuous" foreign policy commitments of U.S. forces to regions of marginal interest.[7] This view holds that U.S. involvement in urban operations depends not just on the strategic environment, but on the willingness of political parties to employ the military instrument of power as a foreign policy tool.

Overall, however, policymakers have downplayed the skeptic's viewpoints and directed the unified commands and services to develop capabilities to conduct urban warfare.[8] Since military leaders normally cannot choose the environment in which they are ordered to operate, prudence dictates establishing strategies to achieve objectives in a variety of situations. While the joint community has made considerable progress in coordinating service urban warfare efforts, the lack of a single focal point within the Department of Defense has resulted in fragmented service programs that vary widely in scope.[9] Service initiatives reflect their beliefs on the urgency of the impending threat as well as perceptions about how the environment changes their roles and missions. Efforts devoted to three areas—training, doctrine, and technology—demonstrate how the services are addressing this challenge. The following section describes some of these areas, with emphasis on aerospace power efforts.

Training

If measured by the proportion of resources expended, the Marine Corps leads U.S. military efforts to experiment and train for urban warfare. Since the mid-1990's, a series of Advanced Warfighting Experiments directed by the Marine Corps Warfighting Laboratory—HUNTER WARRIOR, URBAN WARRIOR and PROJECT METROPOLIS—have sought to understand the urban environment and to determine requirements to improve warfighting capability. Guiding their programs is the notion of a "three block war," where ground forces conduct humanitarian assistance on one block, peacekeeping on a

second block and combat operations on a third block. Recognizing that overcoming small-unit deficiencies takes time, training and equipment, the Corps focus is admittedly tactical: "It doesn't do you any good to make the grand strategy of the Roman Empire if your legions can't fight, and we can't fight."[10]

The Marines have coordinated their experiments with Navy Fleet Battle Experiments and the U.S. Army's Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstrations (ACTDs). Under the umbrella of the Army After Next project, the Army's Dismounted Battlespace Battle Lab has led the service's MOUT efforts to identify mission needs and establish MOUT training facilities at several Army posts.

Recent U. S. Air Force experimentation with urban warfare has concentrated on the role of Close Air Support (CAS), as have Marine Corps aviation initiatives.[11] The USAF special operations community has conducted experiments applicable to urban CAS, but most USAF programs seek to raise the activity above the tactical level. For example, the recent USAF-hosted Joint Expeditionary Force Experiment (JEFX) 2000 focused on operational-level issues but included urban scenarios and MOUT ACTD activities as part of the overall environment.[12]

Doctrine

Army and Marine Corps doctrines stress that urban areas are to be bypassed when possible, to avoid risking long, costly battles.[13] The previously discussed imperatives to improve urban warfare capability have resulted in updated Marine Corps MOUT doctrine and calls for similar Army revisions. Some claim that emerging technological advances and threat capabilities outpace the ability of doctrine to adequately guide military operations.[14] A proposal to develop operational-level joint doctrine for urban operations initially encountered resistance, but should be available in the near future as Joint Publication 3-06, Joint Doctrine for Urban Operations.[15]

Air Force doctrine regards force application more from a "functional than geographic standpoint and classifies targets by the effect that destruction

has on the enemy rather than where the targets are physically located."[16] For the Air Force, urban warfare is not a new phenomenon, nor is the use of aerospace power in such twentieth-century conflicts. As a result, basic and operational-level Air Force doctrine do not address unique considerations for urban environments. At the tactical level, some aircraft-specific employment doctrine includes urban operations techniques. Additionally, emerging multiservice tactics, techniques and procedures for aviation in urban operations will provide officially sanctioned guidance for operators.[17]

To the Air Force's credit, it recently initiated two projects, which, though not published as official doctrine, indicate a desire to understand the characteristics of aerospace power in urban operations. First, the USAF-funded, Joint Chiefs of Staff (JCS) J8-sponsored *Handbook for Joint Urban Operations* represents a fast-track effort to provide a planning tool that describes the operational-level urban environment pending the publication of JP 3-06.[18] Second, a year-long RAND Corporation study culminated in the publication of *Aerospace Operations in Urban Environments: Exploring New Concepts,*[19] a comprehensive, well-balanced report on the capabilities and limitations of aerospace power in urban areas and possible tasks and concepts that can optimize aerospace power effectiveness.

Technology

Proposed technological solutions to the urban warfare dilemma abound. The JCS J8 Land and Littoral Warfare Assessment Division identified and prioritized mission needs unique to urban operations, leading to a comprehensive list of requirements. Suggested technological equipment includes through-wall sensors, non-LOS communications, sensor fusion devices, advanced vision equipment, human sensory enhancements, remote reconnaissance, non-lethal munitions and personal protection kits.[20] Tying some of these capabilities together, one Army computer and communications program, the Situational Awareness System, attempts to "link together teams of 8-12 soldiers, an ideal size for the type of widely dispersed small unit operations that will define urban operations."[21]

By their very nature, air and space-based platforms rely upon high-technology systems to perform functions such as Intelligence, Surveillance and Reconnaissance (ISR), attack and lift. Generally, aerospace technologies oriented toward urban warfare attempt to perform the same functions by extracting more information and attempting more precise strikes. The RAND study grouped enabling aerospace technologies into six areas: three-dimensional modeling, communications and navigation systems, sensor technologies, sensor fusion, air-launched sensors and limited-effects munitions.[22] Examples of such technologies include through-wall communications, seismic and acoustic sensors, laser-guided hand grenades and non-lethal weapons. Many of the proposed concepts of operations incorporate these technologies using Unmanned Aerial Vehicles (UAVs) of various sizes and networks of ground sensors.[23]

The training, doctrine and technology initiatives discussed above represent only some of the current efforts to address urban warfare challenges. One problem noted in many studies, conferences and discussions about urban warfare concerns the difficulty in distinguishing between the operational and tactical levels of war.[24] The following section defines these terms and analyzes the characteristics of urban environments that contribute to this difficulty.

AEROSPACE POWER AND THE LEVELS OF WAR

> Operational level of war: The level of war at which campaigns and major operations are planned, conducted and sustained to accomplish strategic objectives within theaters or areas of operations….
>
> - Joint Publication 1-02, *DOD Dictionary of Military and Associated Terms*

Joint doctrine defines three levels of war—strategic, operational and tactical—which are differentiated by the level of responsibility for planning, decision making and execution. The operational level links strategy to tactics, so that resource application and phasing achieves both operational and strategic

objectives. Classical military theorist Carl von Clausewitz wrote that political policy "permeates all military operations and, in so far as their violent nature will admit, it will have a continuous influence on them."[25] In short, a coherent operational-level campaign plan requires continuous coordination with echelons above and below the operational level.

Does the nature of an urban environment affect the levels of war? Certainly, tactical actions can have operational and strategic effects, particularly in urban operations. One recalls the U.S. soldier in Port Au Prince, Haiti in 1995, whose decision to withhold force against a threatening mob prevented the ignition of an already tense situation. The deaths of eighteen servicemembers on the streets of Mogadishu, Somalia in 1993 marked a turning point for U.S. policy in the area, leading to a rapid withdrawal of U.S. forces from the region. A single air-delivered bomb can have strategic implications, as demonstrated by the interruption of the Iraqi power grid during Operation Desert Storm in 1991 and by the political fallout following the mistaken strike on the Chinese Embassy in Belgrade, Yugoslavia during NATO Operation Allied Force in 1999.

The level of war at which effects are felt, however, must be distinguished from the level at which activities are planned and conducted.[26] Urban warfare creates a tension between the operational and the tactical levels due to the differences in air, space, and ground power capabilities introduced by this unique environment. In USAF doctrine, the first tenet of air and space power calls for centralized control and decentralized execution of air and space forces.[27] Furthermore, command of aerospace assets should be exercised by an airman at the theater level, normally the Joint Force Air Component Commander (JFACC). For airmen, whose operational doctrine is essentially unaffected by terrain, the capability to control aerospace power at the theater level (including strategy development, targeting recommendations and tasking order promulgation) is primarily a function of communications. The urban environment creates an imbalance between control of air and ground forces: the JFACC's capabilities are only marginally affected by terrain, but the

ground commander encounters obstacles to fire, maneuver and communications that degrade his ability to command large units.

To understand operational-level challenges for both aerospace power and ground power, the following section examines the characteristics that differentiate the urban environment from other areas. The paper then analyzes the unique attributes of aerospace power to see how the urban environment affects both aerospace and ground power.

Characteristics of the Urban Environment

Essentially, only two characteristics of urban areas differentiate them from other environments: (1) complex terrain dominated by three-dimensional manmade structures, and (2) the presence of large numbers of non-combatants. Both elements vary considerably as one spans the globe: the urban core of a developed state often contains tall skyscrapers of concrete and glass, while a sprawling urban area in a lesser-developed state may consist of wood-framed houses in irregular patterns. Additionally, the number of civilians in urban areas varies by several orders of magnitude, as does their intent and capability to resist an enemy force. The effects of these two characteristics, however, are far-reaching.

Three-dimensional terrain that includes subways, sewers, buildings and towers presents several challenges for opponents attempting to project force. First, the number and type of obstructions reduce the LOS distances in many situations. Small changes in location can drastically increase or decrease LOS ranges, since even a single structure affects the relationship. Beyond the impediments to visual sight, LOS restricts weapons and sensors that use other portions of the electromagnetic spectrum, such as radio communications, lasers, data links and infrared devices. Second, the presence of vertical terrain restricts vehicle and personnel movement. Streets and buildings that channellize surface movement form additional obstacles when damaged or rubbled by combat operations. Third, the complexity of the terrain offers numerous places to conceal personnel and equipment. Combined with reduced LOS ranges, this characteristic offers advantages to

defenders and renders ineffective the use of some weapons designed for long-range engagements.

The presence of large numbers of noncombatants also constrains military operations. To maintain domestic, international, and even target-state popular support for a small-scale contingency operation, U.S. planners must demonstrate extraordinary efforts to avoid civilian casualties. A city whose citizens evacuate becomes merely a new type of terrain, but in virtually all cases, "the people are the center of gravity."[28] Although the law of armed conflict regards noncombatants in a city no differently from those in other areas, the requirement for attacking forces to observe the principles of proportionality and discrimination dictates restraints on acceptable collateral damage. The rules of engagement (ROE) may specify additional criteria that attackers must observe prior to expending ordnance, which delays the delivery of force at many levels. Finally, the desired endstate may include a restoration of public facilities and services, which could limit short-term desires to apply overwhelming firepower.

Although an urban operation may comprise only part of a larger campaign, its political importance (perhaps a major reason it was not avoided), inherent complexity and the proportionally large amount of resources required to achieve theater objectives could lead commanders to designate the urban area itself a Joint Operations Area (JOA). As one example, the Russian victory over the German Sixth Army at Stalingrad took six months and cost over one million casualties. More recently, when combat erupted in Mogadishu, Somalia on 3 October 1993, the task force commander appropriately focused all efforts on the city fighting. The subsequent Joint Task Force (JTF) Commander devised a four-phased campaign plan that clearly defined offensive and defensive orientations with respect to tactical (Mogadishu) and operational (the hinterlands) areas.[29]

Figures 1 and 2 compare a current JOA comprised of mostly open area, Operation Southern Watch in Iraq, with a notional urban area and its

Figure 1: Operation Southern Watch JOA[30]

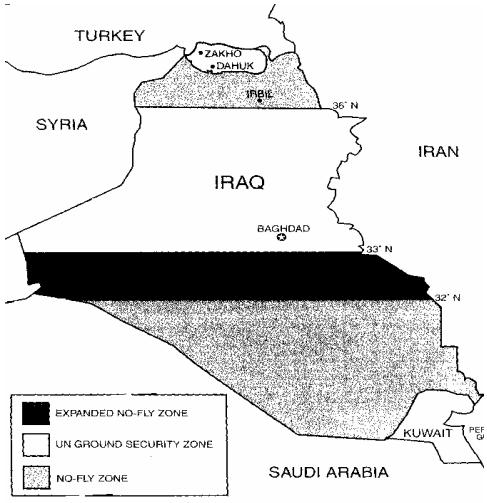
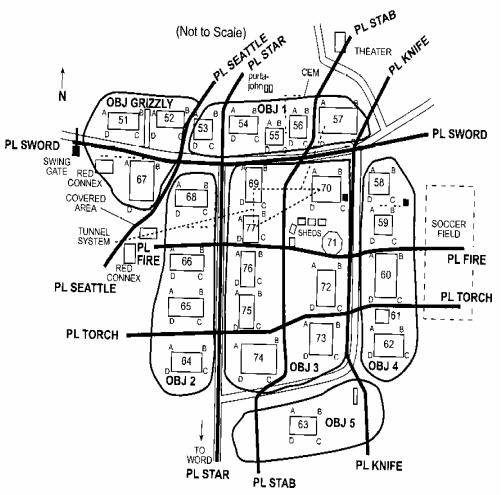


Figure 2: Urban Operations JOA[31]



overlaid ground unit control measures. As discussed above, the complex terrain and presence of noncombatants tend to slow ground force advances. If the overall objective is to capture terrain, then phase lines (PL) and ground objectives (OBJ) in urban areas become compressed because of the time required to consolidate gains. The increased target density affects aerospace power capabilities as well; the following discussion analyzes why and how this affects campaign-level planning.

Aerospace Power Attributes in Urban Warfare

Aerospace power derives many of its capabilities from three essential attributes that differ greatly from surface-based power: speed, range and perspective. The resulting capabilities include strategic airlift, precision strike and multispectral ISR. How does the urban environment affect the three essential attributes? From a tactical viewpoint, the urban environment appears to blunt aerospace power. The first attribute, speed, enables aerospace platforms to span an entire theater in just a few hours, but it provides a less obvious advantage in a small urban "theater" only ten or twenty miles across. The difference between 100-knot, 300-knot or 500-knot platforms seems largely irrelevant if each can traverse a city in a few minutes. The second attribute, aerospace power's global range, offers seemingly fewer advantages when the entire area is within range of organic artillery. From a ground commander's perspective, artillery provides reliable fires without additional coordination required to deliver bomb or missile strikes. Moreover, even a "precision" guided 2000-pound bomb may create unacceptable collateral damage. Finally, aerospace power's three-dimensional perspective cannot be fully realized due to tall buildings and hidden defenders. Reduced LOS and ability to detect enemy forces renders ISR products less valuable. Viewing these three aerospace power attributes—speed, range and perspective—from a tactical perspective, however, ignores this component's role in an operational campaign and fails to consider the *relative* characteristics of aerospace and ground power in the urban environment.

Although aerospace power capabilities may be degraded in the urban environment, such degradations need to be compared with those encountered by ground forces. First, aerospace power's speed in crossing an urban area dwarfs the rate of advance for ground units involved in house-to-house fighting. Oversimplified, an open-terrain ratio of air advance (500 miles per hour) to ground advance (50 mph) yields a 10:1 speed differential. Since aerospace power is unhindered by terrain, this ratio increases whenever a ground offense slows for any reason. Assuming that ground forces advance through a city in a day and that slow-moving aircraft cover this distance in less than an hour, this increases the ratio of airspeed to groundspeed to 24:1. While this analysis does not consider the potential objectives achieved by the advance ("controlling a sector" versus placing aerospace power overhead to "do something"), it clarifies the relative time advantage of aerospace power whenever surface obstacles impede movement.

Second, the capability of a ground commander to direct fire across the bounds of an urban "theater" is appealing, but it ignores the impact of urban terrain on weapons ranges. Vertical structures limit both the azimuth and elevation of surface fires. In fact, both Army and Marine Corps doctrine acknowledge the limitations of artillery in MOUT.[32] Aerospace power can attack urban targets from long ranges and from nearly any azimuth. As with ground-fired weapons, of course, the urban environment demands three-dimensional delivery accuracy. To dismiss airpower in general as too "blunt" is premature, since desired effects and minimal collateral damage may be achieved with a wide range of currently available guns, bombs, and rockets.

Third, the urban environment hinders aerospace power's perspective to some degree, but only for short periods of time. Space forces have the ability to provide continuous surveillance from above, while the movement of aircraft creates constantly changing angles and perspectives between the aircraft and the area of interest. Maneuvering "around" terrain is certainly easier at altitude than in urban canyons or alleyways. Among other things, an elevated perspective can provide ISR by solving the LOS problem, deliver

fires that would otherwise be blocked by obstacles, and serve as a relay for data, voice and other forms of communication between air-, ground-, sea- and space-based platforms.

Aside from understanding these three attributes that distinguish aerospace power from ground power, operational commanders must assess the risk of committing various types of forces to an operation. When less-than-vital interests are at stake, domestic support in the face of U.S. casualties remains tenuous at best. The Marine Corps recognizes both the lessons of history and the results of current experiments that confirm the high-risk nature of urban warfare. The URBAN WARRIOR series of experiments gradually reduced the rate of casualties to the urban attackers from about 46 percent to 38 percent; the follow-on PROJECT METROPOLIS seeks to apply the lessons learned and reduce casualty rates below 20 percent.[33] By defining the range of problems encountered by attackers, the Corps is focusing initially on doctrinal and tactical solutions, from which technological enhancements will follow.[34]

Commanders must also assess the risk posed by the urban environment to modern aerospace power. Absent a broad series of tactical experiments comparable to ground-based MOUT efforts, aerospace strategists must evaluate the body of knowledge resident in aerospace power theory, history and contemporary threat assessments. U.S. aerospace power's capability to locate and destroy targets has increased by orders of magnitude with the advent of space-based navigation systems and precision-guided munitions. The improvement in individual platform quality and the downsizing of the post-Cold War military results in a quantity of attack-capable aircraft only a fraction of that available in the last half of the twentieth century. Survivability of aerospace platforms becomes a critical concern, because sustained attrition would likely outpace the replenishment capability of the aerospace industry. Thus, a commander's risk-assessment concerning aerospace forces must define acceptable loss rates. The next section examines the relationship between offense and defense where aerospace forces are

engaged, and presents potential countermeasures that enemies could use to degrade U.S. aerospace power.

THE RELATIONSHIP BETWEEN OFFENSE AND DEFENSE

> The discussion of offense and defense in airpower cannot be divorced from an analysis of the circumstances postulated to exist during the employment of airpower forces.
>
> - John R. Carter, *Airpower and the Cult of the Offensive*

According to most contemporary urban warfare scholars, the defender of urban terrain maintains a distinct advantage over the attacker. In a purely surface-based campaign without reference to terrain characteristics, Clausewitz provided an explanation for the defender's advantages of *position* and *time*.[35] He maintained that defense is a stronger form of war, yet it seeks a weaker objective—often the status quo as measured by control of terrain. Over the course of a campaign, Clausewitz's proposition that "time which is allowed to pass unused accumulates to the credit of the defender" assumes, of course, that the defender is using his time wisely.[36] If an enemy is defending a city and the elements within are of value to him, one can logically assume that his time will be well spent executing a tenacious defense. However, Clausewitz's theories failed to account for either the role of revolutionary military technologies such as aerospace power or for the drastically changed strategic landscape since the eighteenth century. The inquiry into how aerospace power impacts urban warfare requires a reexamination of the nature of offense and defense with respect to aerospace power.

Defining aerospace power as defensive or offensive can be based on factors such as relative air platform position, intent to project power, or even the orientation of ground forces. For simplicity, this paper defines postures of aerospace power as follows: defensive aerospace operations are those conducted to deny an enemy's aerospace operations in a defined airspace. The defense may be active (e.g. surface-to-air missiles [SAM], antiaircraft artillery [AAA], or electronic countermeasures [ECM]), or passive (e.g. camouflage, concealment and deception [CCD], burying facilities underground, hardening

shelters). Offensive aerospace operations are those conducted to exploit air and space (such as ISR, lift and attack) as well as counterair missions such as airfield attacks. Additionally, offensive operations include measures to counter enemy defenses, which can be categorized as active (air intercepts, lethal or non-lethal suppression of enemy air defenses [SEAD], ECM) or passive (low-visibility designs that reduce radar, visual, infrared, acoustic or other signatures). Note that some measures (e.g. ECM) can be defensive or offensive, depending on whether the intent is to deny an enemy's operation or to exploit the use of the environment.[37]

Early airpower theorists like Giulio Douhet believed that aerospace power is inherently offensive because the attacker can choose the time, avenue of approach and point of attack, while the defender, "not knowing the direction of attack, is compelled to spread his forces thinly to cover all possible points of attack along his line of defense."[38] Written before the invention of radar, Douhet's assumption that defenders could not know the direction of attack downplayed the role of air defense in general and the value of cueing information in particular. The devastating effect of fighter aircraft and German flak in World War II forced airmen to reevaluate aerospace power's offense-defense relationship. While aerospace power could still mass effects from widely dispersed locations, the threat earned respect during operational and tactical planning. In the last several decades of the twentieth century, for example, fighter escort and SEAD gained prominence with the introduction of radar-guided SAMs and AAA.

The projection of (and the surface-based defense against) aerospace power differs at the tactical and operational levels. At the tactical level, attackers and defenders must detect, engage and employ assets against the enemy. Detection includes things like radar spikes, visual pickups, or moving target indications on a surveillance platform. Engagement involves the target tracking and system manipulation required to achieve weapons and sensor parameters. Employment requires the delivery of an asset—deadly weapons, non-lethal munitions, electronic jamming, paratroopers, surveillance photos,

etc—to achieve the tactical objective. At the operational level, strategists must observe the enemy, develop a campaign plan to achieve operational objectives, issue orders, and incorporate the effects of tactical actions to adjust future plans. Whereas tactical engagements take place over minutes or hours, operational planning requires both long and short-range views. The observe-orient-decide-act (OODA) model of decision making and execution applies to both tactical and operational levels, where the speed and quality of the "OODA Loop" affect success as much as the ability to "act" with superior power projection. Of the four phases, orientation is the most important but also the most complex.[39]

Many concepts for aerospace power in urban environments focus on ways to conduct offensive operations. The survivability of stealth aircraft in Operation Desert Storm seemed to swing the offense-defense pendulum back to the offense. In a sense, Iraq's inability to detect (observe) and target (orient) stealth aircraft harkened back to the pre-radar era during which Douhet authored his theories. Experience since 1991 warns us that the pendulum remains situation-dependent and should be continuously evaluated during each campaign; the downing of an F-117 stealth fighter during NATO Operation Allied Force in March 1999 confirmed that ground-based defenses have the potential to defeat even the most sophisticated aerospace assets.[40] The remainder of this section describe ways the urban warrior seeks to defend against aerospace power.

Actively Defending the Urban Airspace

Differences between defense of urban airspace and defense of open areas can be explained by the nature of the threat and illustrated by lessons of the past. Historically, states threatened by air attack established active air defense "belts" or "zones" around areas of value. The rear-area defense of military command posts requires forward observers to report surface and air threats, while a carrier battle group's defense-in-depth involves complex and redundant layers of defense against surface, subsurface and air threats. Commanders defending cities from Berlin to Baghdad established the most

effective air defenses available to them at the time. The following discussion examines active air defenses prior to and during actual force engagement.

Preengagement Relationships: The ability to observe impending air attacks aids the defense in preparing and executing the best possible response. Since World War II, early warning (EW) radar has provided defenders with the primary means to anticipate impending air attacks. However, the use of EW radar is not unique to urban air defense. An important advantage, distinct to the urban defender who knows that aerospace power is focused on his area, concerns the predictability of aerospace platform routes and destinations. By reducing the advantage of aerospace power's speed and range over a large theater, the urban defender can challenge not only air strikes, but also other missions such as aerial resupply. The German air bridge to resupply the Sixth Army at Stalingrad encountered a Russian defense that emplaced "hundreds of antiaircraft batteries…along the flight path, in direct line to the German radio beacon to Pitomnik [airfield].… In just five weeks, nearly three hundred of them [transports] were shot down."[41]

Enemies lacking EW radar to identify attackers can fuse available radar information with other indicators to provide warning. During Operation Desert Storm, F-117 stealth fighters attacked targets in Baghdad without sustaining any damage from enemy defenses. Iraqi AAA gunners anticipated the nightly attacks, but opened fire for only a few minutes after each bomb exploded. Not until several weeks into the campaign did pilots observe AAA prior to the aircraft reaching Baghdad. They attributed the preemptive AAA not to a newfound ability to observe the aircraft, but rather to Iraqi EW radar detection of air refueling aircraft. By correlating the location of the air refueling tracks with previous attacks, the Iraqis may have used timing to anticipate the F-117 strikes.[42] On a broad scale, detection includes not simply the immediate tactical engagement, but also pre-strike, enroute and even ground sortie preparation activities. If desiring to achieve surprise, operational-level considerations such as package timing and composition should avoid predictability over the course of a campaign.

When EW radar is unavailable, urban air defenders must resort to other means for defeating attacks. One system used by the Chechens during the defense of Grozny (1995-2000) demonstrates how to construct a rudimentary integrated air defense system (IADS). Though not oriented solely against air attack, the Chechens use of cellular phones and commercial scanners allowed them "to communicate easily with one another, ensured the coordination of combat operation, and allowed Chechens to listen in on Russian conversations."[43] In the first three years of the on-again, off-again battles for Grozny, the Chechens shot down three fighter aircraft and ten helicopters while damaging twenty-six aircraft. The Chechen air defenses, assessed by the Russian Air Force Chief of Staff as "very effective," operated without the support of a single surveillance radar.[44]

Force Engagement: As aerospace assets approach the urban area, the increased density of threats affects tactical and operational considerations. Even a single type of enemy countermeasure represents a potential show-stopper to aerospace power employment: "the detection and neutralization of adversary manportable surface-to-air missiles will become increasingly important …[because] these weapons could seriously impede all urban air operations, both rotary and fixed wing."[45]

The lethality of active aerospace defense increases in proportion to the time attackers spend within range of threat systems. Not only is the threat potentially more dense (if measured by the number of systems per square mile or the number of possible bullets per cubic meter), but the compression of friendly aerospace platforms into the same urban JOA further improves the defense to offense ratio. The defender's mathematical advantage increases as attackers approach the urban core, if overlapping threat rings defend key sites near the heart of a city. Particularly in this "most dangerous" urban environment, operational planners must determine the degree to which threat systems must be suppressed before tasking friendly aerospace platforms.[46]

The proximity of urban targets to threat systems may force operational planners to increase the priority of SEAD in urban campaigns. In

open terrain, targets and threats are not necessarily collocated. Fixed targets, such as electrical power stations or weapons storage sites, often lack point defenses due to the sheer number that would be required. Moving targets, such as the lead elements of a tank column, sometimes outpace their unit's air defense umbrella. To mass effects on the target, planners and attack aircrews seek to avoid known threats, suppress threats when possible and kill threats when necessary. The compressed nature of an urban environment means that targets and threats often coincide, or that targets are more likely to be located within a threat's lethal range. When threat ranges of ground defenses consistently exceed the standoff ranges of attack platforms, the importance of SEAD increases correspondingly.

Active aerospace power defenses that can be used in urban areas include conventional systems such as AAA and SAMs as well as several nontraditional means. The RAND study concluded that "the primary threats facing U.S. air assets operating over urban terrain are likely to be shoulder-launched SAMs, heavy machine guns, small arms and other infantry weapons."[47] Such threats challenged U.S. aerospace power in Panama City and Mogadishu. During Operation Just Cause in Panama (1991), small arms presented the primary threat to airpower. Thirteen fixed-wing transports received minor damage from small arms, while eighteen of twenty transport helicopters took hits.[48] Four helicopters were shot down by small arms, the largest of which were Soviet-built 14.5 millimeter AAA guns. In Mogadishu, Somalia (1993), the antiaircraft weapon of choice was the rocket-propelled grenade (RPG), which shot down two helicopters and downed two others. The downings took place during periods of prolonged overflight, during which time the increasing density of RPG fire proved too much for the vulnerable aircraft.[49] In Chechnya, Russian helicopters also proved vulnerable to RPGs; the Chechens favored RPGs because they could be used against both air and ground targets.[50]

Urban terrain limits the effectiveness of large AAA and SAM systems, but their presence drastically changes attackers' tactical

considerations. Large-caliber AAA and radar-guided SAMs suffer from urban LOS difficulties, cumbersome equipment and large crews.[51] However, the introduction of such systems, even if along the outskirts of the urban area, demands attention. During the 1982 Lebanon War, Israel employed an intense SEAD campaign against SAMs and radar-guided AAA in the Beka'a Valley, over which they flew enroute to targets around Beirut.[52] In Grozny, the Chechens placed radar-guided ZSU 23-4 AAA guns in the city, and one of the guns shot down a Su-25 fighter aircraft attacking a nearby bridge.[53]

Aside from SAMs and AAA, urban defenders may use nontraditional means to deny the attackers' use of air and space. Such countermeasures rely on low-, medium-, or high-technology devices. Low-technology items such as balloons have been employed across a wide range of urban areas. The Soviets used barrage balloons in Leningrad to interfere with attacking aircraft flight paths, while the threat of tethered balloons over Baghdad caused F-117 pilots nearly as much anxiety as the dense AAA.[54] While impractical to deploy balloons across an entire theater at all times, the enemy can anticipate the attacker's requirement to overfly the urban area to achieve his objectives. An even simpler countermeasure than balloons was the Somali use of kites to counter low-flying helicopters over Mogadishu.[55]

Intermediate technical applications include the use of lights and ECM. The sheer amount of light in urban areas may ease the general target area acquisition problem, but may also highlight aircraft that would otherwise be difficult to acquire. In World War II, defenders used searchlights to illuminate aircraft and provide cueing to air defense assets; similar techniques may be effective against platforms that are not visible on radar. Active ground-based ECM systems suffer from urban clutter and limited field of regard, but can nevertheless deny portions of the airspace, if only for limited times and sectors. False radar-threat emissions complicate a campaign-level threat analysis, and signals that reflect off urban structures could actually help the defender by obscuring the source's location. Friendly ISR capabilities have significant limitations against an enemy capable of jamming electronic links.

The RQ-1 Predator UAV, for example, relies on a single UHF radio that is not equipped with frequency-hopping or secure communications.[56] Commercial radio scanners and electronic jammers can degrade attackers' ability to coordinate attacks. Chechen rebels used some of these techniques,[57] and the capability to deny data links or any portion of the electromagnetic spectrum could reveal the Achilles heel of high-tech attackers

High technology countermeasures include systems like Global Positioning System (GPS) jammers and lasers, which are not necessarily more effective in urban areas than in open areas. While no current threat to space-based GPS satellites seems imminent, the opportunity exists for interruptions to other components of the GPS: ground stations and data links. A competent enemy may be able to reduce the satellite reception capability in a certain area, degrading platform navigation and weapon guidance for certain systems. Aside from requiring a technologically sophisticated enemy, such a strategy would likely be implemented outside the immediate urban area. The use of lasers represents another high-technology countermeasure, one designed to defeat both manned systems and weapons sensors. Aircrews attacking an urban area necessarily focus their sensors on the target area and potential threat locations. High-powered lasers, particularly if oriented toward known aircraft locations, could potentially blind or incapacitate aircrew. If located atop buildings and fired upward, lasers present minimal risk to defenders on the ground. These high-tech countermeasures, along with "traditional" urban threats of man portable air defense systems (MANPADS) and AAA represent some of the active means to deny attacks.

The ways that defenders employ countermeasures are as important as the systems themselves. For example, defensive conditioning of attackers through predictable firing patterns offers the potential to lure attackers into areas of lethal fires. Two recent enemies with Soviet-style IADS implemented their defenses in different manners. Though their IADS were degraded to different degrees, the Iraqi technique discussed above against F-117s was

primarily reactive, whereas the Serbs conserved air defense assets for employment in unexpected ways.[58]

Finally, the exploitation of the attackers' communications network offers ample opportunity to direct either active or passive defenses. The strength of U.S. ISR systems is also a vulnerability if enemy information warfare efforts yield useful information. Whether using captured U.S. equipment, organic assets or other means, the vast amount of U.S. military communications can seem like a sieve of information to a qualified interceptor. Code-breaking or monitoring nonsecure communications enables air defense cueing or passive defense preparations. The following discussion examines the often-neglected, but potentially effective passive defenses of urban airspace.

Passively Defending the Urban Airspace

While active aerospace defense projects power against attackers, passive defenses use other strategies to deny the offense. AAA and SAM effectiveness rely on the speed and quality of the defender's "OODA Loop," but passive defenses interfere with the *attacker's* decision cycle. If friendly assets can observe any point on the globe and deliver munitions precisely on those coordinates, need we consider enemy efforts to disrupt our capability? The following discussion shows that opportunities abound for passive aerospace defense of urban areas, by denying the attacker's ability to properly observe, orient, decide and act upon available information.

To deny theater-level observation altogether, enemies can exploit gaps in aerospace surveillance and reconnaissance. In the face of intense aerial interdiction efforts, the North Vietnamese used the cover of thick vegetation, night and weather to move supplies along the Ho Chi Minh Trail.[59] Similarly, during Operation Allied Force the Serbs moved most combat equipment at night or under the cover of bad weather, which denied aerospace sensors usable information in the electro-optical (visual) and infrared regions.[60] An enemy who determines the overflight window of non-geosynchronous satellites can plan activities during periods of minimum

surveillance. In short, even the most advanced ISR systems have limits that determined and capable enemies can exploit.

Another strategy to deny observation is to simply hide behind or beneath urban terrain, which offers numerous concealment opportunities. Sewers, subways and other subterranean structures present difficulties for aerospace sensors that cannot detect underground activity. To neutralize Israeli aerospace power in the Lebanon War, Palestinians maneuvered through the buildings of Beirut and also developed an extensive network of underground tunnels and trenches.[61] Burying facilities underground offers the potential to deny detection, but defenders must take care to avoid related indications of activity. In Operation Desert Storm, an F-117 strike against an underground Iraqi command post nearly failed because the pilot could not identify the target. However, a large group of vehicles near the entrance to the facility gave away its position, and the bunker was destroyed.[62] On the other hand, urban terrain may cover up such carelessness in an environment filled with vehicles, airshafts, manhole covers and the like.

When the denial of overhead observation is not possible, passive defenses can degrade observation and orientation at both the operational and tactical levels. Classic CCD techniques have proven effective in urban warfare. In World War II, Germany and Britain devised elaborate schemes to defend cities from air attack. The famous German camouflage of Hamburg Harbor used painted rafts in the harbor to replicate nearby buildings, bridges and canals. Meanwhile, the British camouflaged factories using paint, landscaping and other devices. Both sides blacked out city lights at night to complicate target acquisition. British denial of both operational-level reconnaissance and tactical-level target acquisition proved generally more effective than the German focus on denying target acquisition alone. In fact, the Hamburg Harbor effort failed partly due to German "disregard for concealing the camouflage effort from aerial reconnaissance."[63] Poor camouflage offered little protection, so the Germans also distributed war production industries throughout numerous buildings. When the allies knew

the target location, German efforts to disperse activities worked better than camouflage.[64]

Contemporary measures to degrade aerial observation and orientation must account for both visual sensors and sensors that use other portions of the electromagnetic spectrum. Visual target identification may well be required in urban environments, if ROE are designed to minimize the probability of attacking the incorrect target. Traditional battlefield smoke generators will obscure activity on streets and alleyways, but vertical terrain protruding through the smoke prevents total target area obscuration. Even primitive enemies have degraded advanced U.S. electronic intelligence (ELINT) efforts. In Mogadishu, Somalis practiced electronic emission control and used drums, written orders and messengers for communication.[65] Strategies used in non-urban settings have denied U.S. ELINT, infrared (IR) detection, and ground sensor networks. The North Vietnamese used aluminum foil to suppress electromagnetic emanations from engine ignition systems, shielded vehicle hot spots with banana leaves and bamboo and may have neutralized air-delivered ground sensors.[66] The resources available in urban areas multiply opportunities for similar tactics.

The above strategies seek to minimize observability, but an alternative strategy could *add* to large amounts of emissions inherent in urban areas. By overwhelming the data available to collection platforms, enemies can essentially "hide in the open." Simple defensive measures to increase visibility require corresponding friendly efforts to observe and analyze the behavior. Sorting the real from the false requires significant (and not necessarily foolproof) resources that tend to expand rather than contract decision cycles.[67]

We Own the Night? High technology devices expand the human capability to observe and target enemy forces during periods of darkness. The most widely used system uses helmet-mounted goggles that amplify light. Aircrew, infantrymen and other specialists wear these Night Vision Goggles (NVGs) to improve night warfighting capability. In conjunction with laser

designators, IR sensors and laser-guided munitions, NVG-equipped attackers can perform precision attack without artificial illumination. Operation Desert Storm demonstrated the effects of night-vision exploitation, but urban terrain offers defenders unique countermeasures against NVGs, laser and IR capabilities.

Target-area lighting highlights enemy positions, yet it can hinder night weapons delivery accuracy. NVGs are designed to amplify low light, so a single bright light can wash out a large portion of the field of view. Even the most advanced aviation NVGs cannot "gain down" sufficiently to distinguish targets in the vicinity of city lights.[68] Ironically, the World War II blackouts sought to deny visual acquisition, whereas illuminating city lights to full intensity might better deny NVG-equipped aircrews. Aircrews could opt to attack without NVGs, accepting reduced visual cues as the best alternative to unusable night-vision devices. The overall lighting situation—target area, moon illumination, cloud cover and ambient urban lights—could eventually work to the advantage of the defender, not the attacker.

Lasers enable precision weapons delivery by providing target identification, ballistic ranging and warhead guidance. Attackers generally minimize lase time, in part to avoid detection from laser receivers. Should a sophisticated enemy ascertain attackers' laser codes, the potential for decoy laser spots and reflections off urban structures could confuse friendly sensors and weapons. At the operational level, laser planning must be deconflicted in time and space, which is particularly challenging in limited airspace with large numbers of laser-capable platforms.

Finally, IR sensors and weapons rely on thermal contrast to distinguish targets. Just as NVGs gain down when sensing bright lights, IR sensors gain down when oriented towards structures that retain heat, such as concrete and asphalt. Depending on their locations, false heat sources can degrade IR sensors; more likely, however, is the potential to decoy IR weapons that have smaller fields of regard. Other potential countermeasures involve efforts to mask IR signatures through direct shielding or through

indirect methods such as increasing moisture in the target area, since high absolute humidity reduces IR sensor range. Clever use of thermal contrast inherent in urban structures offers natural deception with minimum effort. In a worst-case scenario, a defender equipped with NVGs or IR scanners enjoys distinct contrasts between his target (hot aircraft with some ambient lighting) and cool, dark backgrounds.

Perfect Observation and Orientation: Passive defenses against aerospace power may assume that attackers will observe activity and orient forces accordingly. In these cases, complicating attackers' decisions and actions can achieve defensive success. Somali warriors used noncombatants as shields, while infantry "hugging" tactics have denied Close Air Support in places like Stalingrad and Chechnya.[69] These techniques capitalized on attackers' desires to limit collateral damage and fratricide, respectively. To complicate decisions to strike fixed targets, relocating noncombatants or cultural items to the vicinity of potential targets forces attackers to evaluate the legal, moral and political effects of potential collateral damage.

In cases where attackers correctly observe, orient and decide to execute a plan, defenders can prevent the actions from achieving the desired effect. As discussed above, burying targets may deny observation altogether, but it has a dual purpose of protecting against most conventional aerial munitions. While collateral damage concerns of urban warfare strategists tend to dictate lower-yield weapons, buried (or hardened) targets require high-yield weapons to achieve the desired probability of kill. This inherent contradiction places aerospace planners in a dilemma not normally encountered when planning against targets in the open.

In light of the potential defensive measures available in urban areas, what concepts should aerospace strategists consider to optimize the use of aerospace power? Battlespace analysis includes a threat assessment, which commanders use to judge the risks to friendly forces. Unless the strategic urgency demands immediate intervention, an indirect approach that avoids enemy strengths offers an alternative method to achieve objectives.

A CONCEPT FOR AERIAL ISOLATION

> No single factor is more important to the attacker's success than isolation of the urban area.
>
> - MCWP 3-35.3, *Military Operations on Urbanized Terrain*

Several operational concepts guide the conduct of urban warfare. The *Handbook for Joint Urban Operations* describes five potential operational effects: Isolating (to isolate or cut off an enemy force inside an urban area from other enemy forces or allies), Containing (to prevent enemy forces from breaking out of urban areas), Reducing (to eliminate an enemy's hold over an urban area), Retaining (to prevent urban areas from falling under the political and/or military control of an adversary), and Denying (to prevent approaching enemy forces from gaining control of the urban area).[70] The first three effects are essentially offensive, while the last two are defensive. The last section examined ways defenders seek to retain and deny aerospace power in urban environments. This section considers using aerospace power for isolation, which for these purposes includes the containing of enemy forces. Finally, the paper briefly discusses concepts that use aerospace power for reducing an enemy in urban warfare.

Isolation encompasses more than simply cutting off military forces, and the concept below should be integrated with strategies that isolate an enemy both physically and psychologically using all instruments of national power. Multinational political and economic support for an isolation strategy increases its likelihood of success. Furthermore, aerospace power in a notional urban environment represents only one component of the joint force.

An Indirect Approach

When direct attack means attacking into an opponent's strength, Joint Force Commanders (JFCs) should seek an indirect approach.[71] An enemy force in an urban area likely constitutes a source of strength that for some reason cannot be bypassed. Indirect attacks include "isolating (the force) from its C2, severing its LOCs (including resupply) and defeating or degrading its air

defense and indirect fire capability."[72] Relevant aerospace power missions and target sets include: 1) strategic attacks on command posts and communications functions, 2) interdiction of roads, rails and bridges, 3) counterair strikes, and 4) destruction of artillery and weapons storage sites. A senior U.S. Army officer described an alternative to direct urban assault that would "establish a loose cordon around the city and control the surrounding countryside. The cordon would eventually result in complete isolation of the enemy from the outside world. All avenues, including air, sea and land arteries, would be blocked."[73] Complete isolation might be unnecessary and counterproductive, however, if the resulting civilian hardships exceed the coercive value of the strategy on enemy decisionmakers. An advantage of the isolation concept over direct attack is the increased ability to control LOCs and discriminate between items of value to military forces or to the population at large.

The City as an Island:[74] To help visualize the isolation concept, consider the similarity of a city to a defended island. Each has distinct physical contrasts with it surroundings and acts as a fortress that derives its importance from its inherent characteristics and its ability to project power. During the South Pacific "island-hopping" campaign in World War II, Generals MacArthur and Kenney bypassed islands of little strategic or military importance. Like cities, important islands were well defended, and challenged attackers who transitioned the surface boundaries. Most islands and cities depend on outside sources of food, fuel, raw materials, psychological security and other essentials that are extremely vulnerable to attack by forces possessing freedom of maneuver outside their boundaries.[75] General MacArthur controlled sea LOCs and weakened islands by using air, surface and subsurface craft to interdict shipping. Similarly, aerospace power's role in isolating a city requires air interdiction and air mobility to achieve the desired level of control. Unlike the World War II strategic objective of unconditional surrender, limited objectives of urban warfare in small-scale contingencies normally constrain attackers' weapons and strategies.

Learning From the Russians: Recent urban warfare in Chechnya offers an example of an attempt at isolation. The Russian strategy in Grozny shifted over the course of the war, incorporating lessons from earlier mistakes. In the 1995 campaign, a three-pronged Russian advance into the city failed to encircle and secure the area, allowing Chechen fighters to escape to the southern mountains.[76]

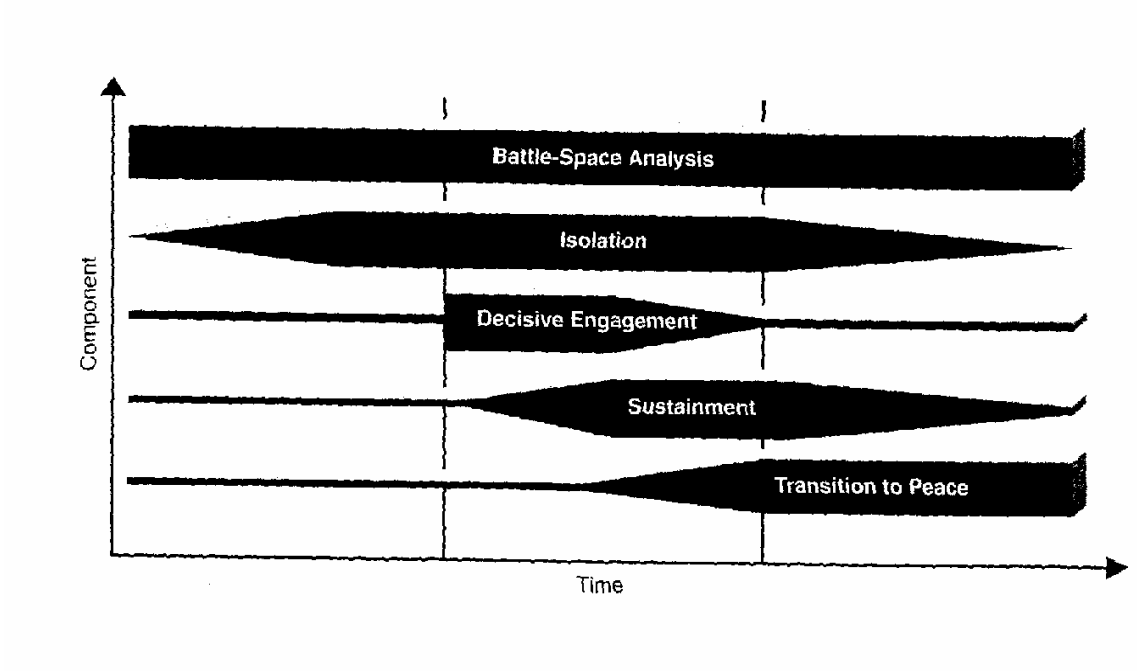
Among other errors that trapped Russian armor in the city and led to their destruction, they attacked directly into the Chechen strength. In the January 2000 campaign, however, the Russians executed an entirely different approach that "surrounded the city and used an "indirect approach" that offered success at varying levels."[77] Avoiding frontal assaults, Russian reconnaissance located resistance pockets, against which artillery or airpower was directed. The magnitude of the Russian encirclement should not be underestimated: some 50,000 soldiers eventually surrounded the city.[78]

In some ways, the Russian operation was more like a modern-day siege, which largely disregarded concerns for the lives and property of noncombatants. Collateral damage was widespread and firepower less than precise. Additionally, Russian impatience (militarily and politically) with the Chechen War reduced the time available for isolation to take effect. Such conditions of minimum ROE are unlikely to exist for US planners in small-scale contingencies.

Fundamentals of Operational Art

Joint Force Commanders (JFCs) employ operational art in developing campaigns and operations.[79] Examination of the operational art elements reveals several considerations for planners using aerospace power to isolate the enemy. First, the arrangement of operations—phases, branches and sequels—determines aerospace power's role over time. Figure 3 shows a hypothetical concept of urban operations, in which isolation plays a key role. Battle-space analysis enables isolation activities to shape enemy perception and behavior in all phases. Prior to hostilities, airborne information operations such as communications jamming, media broadcasting, leaflet drops and

Figure 3. Hypothetical Concept of Operations[80]



nonlethal weapons help achieve psychological isolation.[81] Isolation continues its importance in follow-on phases such as decisive engagement, sustainment and transition to peace, as military and political pressures are brought to bear.

Second, aerospace power's operational reach—basing and lines of operation—affects the ability to isolate an enemy. The size and scope of an urban cordon determines the resources required for its enforcement. Carrier battle groups may establish effective cordons around coastal cities, particularly when combined with disembarked Marines. Expeditionary air and ground forces could utilize an airfield in a friendly neighboring state, but operating from an airfield closer to the city offers two advantages. First, the shorter LOCs between the airfield and the city increase on-station times for aerospace power. Unlike strategic attack missions against fixed targets, isolation missions such as reconnaissance, interdiction, information operations and air mobility require persistence and near-continuous presence in time-critical situations. While the urban defender operates on interior lines, maintenance of the attacker's exterior lines requires time and logistical resupply. Second, an airfield takedown establishes a friendly LOC while denying the enemy the same, furthering the isolation effort.

Third, JFCs use leverage—exploitation of combat power—through support relationships, force interactions and force protection. If ground forces are not committed to urban combat, aerospace power may comprise the preponderance of the isolation effort. The JFACC may be the supported commander for interdiction, while the special operations commander may become supported during missions such as infiltration, exfiltration or direct attack in the city. Force interactions seek the asymmetrical application of strength against weakness; the overall isolation concept minimizes the entry of friendly forces into the city, while luring the enemy into the open countryside. Finally, a key force protection issue for aerospace assets involves the vulnerability of aerospace power while on the ground. Mortar attacks and satchel charges against friendly airfields in South Vietnam destroyed a significant number of aircraft, and the bombing of Khobar Towers in Saudi

Arabia reinforced this vulnerability while on the ground. The advantage of using airfields in close proximity to urban areas must be balanced with the risk of ground attack, particularly if little geographical buffer exists to give time for attack warning.

Fourth, the offense's culminating point—the point in time and space where the attacker's combat power no longer exceeds that of the defender—should be viewed more from a political view than from that of pure military strength. Militarily, isolation should allow unhindered friendly force buildup and gradual diminishing of enemy strength as he depletes resources. Politically, the domestic and international will to sustain an isolation strategy remains circumspect. Some argue that urban warfare creates a "time advantage reversal" which places the defender at a disadvantage because he cannot provide for his populace. This "will eventually lead to the displacement of the government leadership or hostile action on the part of the populace."[82] The mechanism by which objectives are achieved, however, depends on numerous factors unique to the target state. Saddam Hussein's grip on Iraq a full decade after the Persian Gulf War, despite wide-ranging economic sanctions, military exclusion zones and political isolation, defies the simple logic that suffering of the citizens leads to regime replacement.

Reducing the Enemy

For the aerospace power advocate who views urban warfare much as operations on any other terrain, the central elements of strategy remain unchanged. With stealth technology and precision-guided munitions, the strategist's challenge is largely in identifying and analyzing targets: "In essence, Air power is targeting, targeting is intelligence, and intelligence is analyzing the effects of air operations."[83] The difficulties of ground-based urban warfare, such as small unit operations, close-range weaponry, presence of noncombatants, defensive bias and absorption of manpower led one airman to summarize:

> Airpower, the integrated application of C4ISR and precision strike supported by other surface forces that impact the

> aerospace medium, is the only instrument of military force that can effectively prosecute urban warfare by shaping and controlling the battlespace through precise applications of lethal and nonlethal force that affect the tactical, operational and strategic levels near simultaneously. This theory encompasses every major aspect of this study and drives home the premise that airpower is the *key* to success in urban combat.[84]

Thus, aerospace power's two components for reducing the enemy are intelligence (essentially "observe-orient-decide" or "C4ISR") and targeting (the "act" or "precision strike"). This paper earlier described some technological efforts to enable urban warfare, and it also showed how urban defenders can intentionally disrupt these elements. How can we stay ahead of this thinking enemy? To improve urban intelligence, the *Handbook for Joint Urban Operations* recommends JFCs consider five essential characteristics of urban areas—physical, infrastructure, commercial, residential, and socio-economic. The handbook also describes eleven air considerations and planning factors, and devotes a large section to the importance of human intelligence.[85] To ensure intelligence for urban operations is properly oriented, the intelligence community recently formed the Defense Intelligence Support to Urban Operations Working Group. Such efforts portend great benefits for airman reliant more than most on intelligence.[86]

Targeting and munitions capabilities require adaptation for urban applications, primarily because of collateral damage concerns and the need for three-dimensional precision. Predicted Joint Munitions Effectiveness Manual (JMEM) weapons effects apply to open terrain, but urban structures introduce complicating variables. To minimize collateral damage, munitions smaller than 500-pound bombs, such as guns available on the AC-130, A-10 and AH-64 may be suitable. Additionally, the USAF is furthering development of selectable yield warheads, miniature munitions and non-lethal weapons.[87] Three-dimensional precision requires improvements to both munitions and their fuzes. The Joint Direct Attack Munition (JDAM) features "selectable impact azimuth and direction, allowing it to transit an "urban canyon" and

engage with great precision."[88] Additionally, the hard-target smart fuze allows bombs to "penetrate a structure and detonate after passing through a predetermined number of open spaces, enabling precision vertical targeting by floor."[89] In many urban situations, *both* of these related capabilities (smaller warheads and three-dimensional precision) may be required on a single munition.

The concept of aerial isolation may comprise only part of a strategy that includes aerial attacks to "reduce" the enemy. Doctrinal guidance to rapidly mass aerospace power provides a psychological advantage greater than that obtained against dispersed forces, due to the presence of noncombatants. Striking at the heart of the enemy shocks not only military forces, but also the population on whom they depend for support. Blending the notions of isolation, reduction and other concepts into a joint urban campaign requires an indepth understanding of the enemy and an appreciation for the limitations of military power in achieving friendly objectives.

CONCLUSIONS

> Finally, it must be recognized that the adversary is a thinking, adapting, often highly motivated independent actor who will do creative and surprising things to counter U.S. sensors, weapons, and concepts of operation. Concepts *of operation will have to be flexible and evolve to stay one step ahead of such a thinking adversary*.
>
> - Alan Vick, et al., *Aerospace Operations in Urban Environments: Exploring New Concepts*

Until the U.S. conducts a sustained campaign against a modern urban defender, we must rely on theory, doctrine and fragmented historical evidence to draw appropriate conclusions. This paper began by examining the relevance of urban warfare and current efforts to address U.S. preparation for its conduct. At the operational level, urban environments present more challenges for ground commanders than for aerospace commanders, and service initiatives to date reflect this belief. JFCs may elect to implement an urban isolation strategy that minimizes risk to both ground and air forces. A

review of this paper's propositions reveals the following conclusions to guide operational aerospace planners tasked to develop urban warfare strategies.

Don't Underestimate the Defense

Urban environments introduce numerous variables that complicate strategy development. Operational plans, wargames and campaign planning principles tend to focus on friendly courses of action, particularly in complex situations. This paper proposed that a well-equipped, intelligent defender enjoys increased threat system density in urban areas, along with increased opportunities for other active and passive defenses. Aerospace power faced minimal threats in Panama and Somalia, yet a single RPG triggered events that altered U.S. strategic policy.

Stronger air threats over Baghdad and Belgrade failed to deter U.S. power, which relied upon tactical surprise achieved through undetected stealth aircraft. However, Operation Allied Force offers evidence that challenges the invincibility of modern aerospace offensives: the downing of an F-117 Stealth Fighter confirmed the capability of active air defense, while the Serbian use of passive defense measures effectively avoided detection and deceived U.S. forces. A balanced strategy requires detailed planning and critical evaluation to prevent being trapped in the "cult of the offensive."[90] Attack-minded Americans ignore these recent incidents at their own peril.

Assume Imperfect Intelligence

Clausewitz's distrust of intelligence applies to aerospace power, whose capability to strike targets exceeds the ability to identify them. Referring to vast amounts of data on urban infrastructure such as streets, subways, alleys, structures and electrical power, some strategists claim that "more is known about urban areas than any other environment—and more is knowable."[91] Just as important is that which is *unknown* about an urban area. If static targets like the Chinese Embassy in Belgrade get lost in volumes of data available for analysis, then dynamic, moving, time-sensitive targets present a challenge of tremendous proportion.

Divining the capability or value of a target to enemy decisionmakers is one matter; divining enemy intent is quite another, though one toward which strategists must orient to achieve the ultimate objective, a political resolution. One turning point in U.S. operations in Somalia occurred well before the deaths of eighteen soldiers on 3-4 October 1993:

> This is the lesson of the US helicopter gunship attacks on a compound in Mogadishu on the twelfth of July 1993. The attack coincided with a meeting of some 200 leaders of the clan that was debating whether or not they could get him [Aideed] out of the country and call off the war. The political side of the UN operation understood what the meeting was about. The military side, including the United States, took the approach that said "we've got them all in one place at one time, and our mission is to get rid of the enemy. Let's see if we can do it." So, we had helicopter gunships firing missiles into this compound. Well, the result was that all those who came out alive were enemies, the moderates had disappeared, and the rest of the population that didn't like Aideed suddenly rallied to his cause. It was now Aideed and Somalia against the Americans, the outsiders. The internal divisions at that point disappeared. We became the enemy, just as we had earlier in Lebanon, without even understanding how it happened.[92]

Failure to understand the intent of influential leaders in this anarchical society backfired, and the increasing clan violence against Americans fundamentally changed Somali perceptions. Efforts to achieve "dominant battlespace knowledge" are to be applauded, but military leaders should highlight its inherent difficulty and prepare for consequences when the goal falls short.

Isolate the Enemy

Physically and psychologically separating the enemy from his sources of strength offers an indirect strategy that can precede, complement or serve as an alternative to a direct attack strategy. Complete political and economic isolation from the world community is unlikely, but a military strategy reliant upon aerospace power to enforce a "loose cordon" exploits the attackers strengths. Instead of immediately risking aerospace and ground force

engagements on urban terrain, isolation seeks to draw out the enemy where U.S. forces can employ superior firepower and maneuver. While this battle offered may not be accepted, strategists should view the target state as a whole and pressure key nodes in other areas.

A stand-alone strategy of isolation, even if well executed, competes against time. Internal workarounds, substitutes and allied support reduce reliance upon severed LOCs. True isolation requires worldwide support across all instruments of national power. As a precursor or complement to other urban strategies, however, isolation allows the attacker to shape the environment and initiate operations on his own terms.

Train For Urban CAS

This paper avoided detailed discussions of urban CAS, a mission for which the Marines train regularly and about which the USAF recently experimented in depth. The USAF study, based strictly on A/OA-10 capability to conduct CAS, concluded that current technology, weapons and tactics for urban CAS are generally sufficient, but gaps in training require attention.[93] As this paper showed, planners require an analysis of urban threats to all platforms. The balance of survivability and effectiveness determines the size and scope of SEAD efforts. Furthermore, an isolation strategy may buy time for urban CAS training in the form of mission rehearsals and terrain study. Until multiservice tactics, techniques and procedures are published and internalized, urban CAS training will be largely performed ad hoc. Even with published guidance, the capability for effective urban CAS requires a higher level of training proficiency.

Aerospace Power: The Force of Choice

Despite the challenges facing aerospace power in urban warfare, U.S. political and military leaders are likely to view the "aerospace option" as the initial force of choice, primarily to minimize risk to U.S. forces. Two militarily organizations, the U.S. Marine Corps and the Russian military, have gradually recognized the relative advantage of aerospace power in urban warfare. After extensive study and field exercises, updated Marine Corps doctrine maintains:

"In future urban warfare, aviation will be even more effective due to advances in fixed- and rotary-wing aircraft, unmanned aerial vehicles, precision guided munitions, improved munitions, communications, sensors and targeting systems. *Our battle study already indicates a trend towards more extensive aviation participation in MOUT.*"[94] After suffering high casualties from ground combat in Grozny, the third Russian battle for Grozny involved encircling the city and fewer frontal assaults. Additionally, "helicopter use and aviation assets of the air force were deployed much more widely in the 2000 battle for Grozny than earlier."[95]

As in any environment, national objectives and strategies in urban areas will drive the specific military objectives. In most cases, a strategy of aerial isolation offers JFCs a flexible, low risk option that can help the joint force achieve these military objectives. Though we may be forced to fight the battle we don't want, we should attempt to tip the playing field to our advantage.

NOTES

[1] Norton A. Schwartz and Robert B. Stephan, "Don't Go Downtown without Us: The Role of Aerospace Power in Joint Urban Operations," *Aerospace Power Journal* 14 (Spring 2000): 3-11. Additionally, the author wishes to thank Colonel Rob Owen for his challenge to examine urban operations at all levels of war, in Robert C. Owen, "Urban Warfare in the Future: The Need for Balanced Inquiry*,"* [unpublished paper dated 15 November 1999, provided to author on 25 February 2000].

[2] The definitions from *Air Force Doctrine Document 1,* (Washington, DC: Department of the Air Force, September 1997), apply to this paper. Air Superiority: That degree of dominance in the air battle of one force over another which permits the conduct of operations by the former and its related land, sea and air forces at a given time and place without prohibitive interference by the opposing force. Space Superiority: Degree of control necessary to employ, maneuver, and engage space forces while denying the same capability to an adversary. See *AFDD 1*, 79, 85. Note that air superiority refers to the "air battle," whereas space superiority does not limit itself to a "space battle." This paper assumes that air superiority (against aircraft) has been achieved and maintained through missions such as air-to-air engagements, airfield attacks and strikes on command centers . The remaining threat to air superiority in the urban environment consists of surface-based air

defenses. This paper presents considerations for operational-level commanders who must determine when urban air defenses create "prohibitive interference."

[3] Notable government critiques include *Report of the Defense Science Board Task Force on Military Operations in Built-Up Areas (MOBA),"* (Washington, DC: Office of the Undersecretary of Defense for Acquisition and Technology, 1994), *National Defense Panel: Transforming Defense: National Security in the 21st Century,* (Washington, DC: Government Printing Office, 1997), and William S. Cohen, *Report of the Quadrennial Defense Review,* May 1997, n.p. available from http://www.defenselink.mil/pubs/qdr/; Internet; accessed February 2000.

[4] Charles C. Krulak, quoted in John G. Roos, "Changing the Heading: USMC Commandant Puts Training, Modernization Efforts on 21st Century Course," *Armed Forces Journal International* 135 (January 1998): 33. At the time, General Krulak was Commandant of the Marine Corps. Others argue that decisions not to capture cities (Hanoi, Baghdad, Belgrade) in recent wars have committed U.S forces to drawn out periods of occupation that may lead to growing public fatigue with peacekeeping. To bring about final resolution and remove a belligerent regime, the Army must prepare for urban combat in megacities. See William R. Hawkins, *Putting Urban Warfare in Strategic Context,* available from http://www.infowar.com/mil_c4i/99/mil_c4I_122899f_j.shtml; Internet; accessed 24 August 2000.

[5] Russell W. Glenn, ed., *The City's Many Faces: Proceedings of the RAND Arroyo-MCWL-J8 UWG Urban Operations Conference April 13-14, 1999* (Santa Monica, CA: RAND, 2000), 159.

[6] Scales, 160.

[7] *2000 Republican Party Platform*, available from http://www.rnc.org/2000/2000platform8; Internet; accessed July 2000.

[8] Defense Planning Guidance: FY 2000-2005, cited in The Joint Staff, *Handbook for Joint Urban Operations*, 17 May 2000, I-1.

[9] Peter J. Skibitski, "Draft GAO Study Criticizes Pentagon Urban Warfare Capability," *Inside The Navy,* 7 February 2000, 2. Despite the apparent lack of a focal point, the defense community has established several groups tasked to coordinate urban operations efforts. Since May 1998, the JCS J-8 Land and Littoral Warfare Assessment Division's Joint Urban Working Group (JUWG) has led the DOD effort. In January 2000, the Office of the Deputy Assistant Secretary of Defense for Requirements, Plans and Counterproliferation Policy and the OSD Joint Advanced Warfighting Program (JAWP) formed an Urban Operations (UO) Cell responsible for development of an Urban Operations Roadmap by May 2001. In February 2000, the Joint Forces Command Joint

Warfare Analysis Center (JWAC) established an Urban Operations Branch in their J31 Current Operations Division. Within the Air Force, few senior-level "advocates" consistently represent the service position on urban warfare. Air Staff efforts to energize major command proponency for urban warfare have been largely unsuccessful. Background concerning JUWG, JAWP and JWAC efforts described in memorandum dated 29 February 2000 detailing minutes of the 17 February 2000 JAWP-UO meeting, provided to author by Chris Nerney, JWAC J31. Background on Air Staff efforts provided by Colonel Robert B. Stephan, interview by author, 24 February 2000, Arlington, VA.

[10] Gary Anderson, quoted in Skibitski, 2. Colonel Anderson is Chief of Staff at the Marine Corps Warfighting Laboratory.

[11] Brooks Wright, "Urban Close Air Support: The Dilemma," *USAF Weapons Review* 46 (Summer 1998): 15-19, Jon M. Davis, *Urban Offensive Air Support: Is the United States Military Prepared and Equipped?* (Quantico, VA: Marine Corps Command and Staff College, Marine Corps University, April 1995), and Floyd J. Usry, Jr. and Matthew T. Sampson, "MAWTS 1 Urban CAS Initiatives," *Marine Corps Gazette* 83 (May 1999): 33-36.

[12] *Joint Expeditionary Force Experiment 2000 Bullet Background Paper*, available from https://jefxlink.langley.af.mil/mil/jefx2000/about.htm; Internet; accessed 28 August 2000.

[13] Field Manual 90-10, *Military Operations on Urbanized Terrain (MOUT)*, (Washington, DC: Department of the Army), 15 August 1979, 1-1. Marine Corps doctrine is less specific on this point, but it includes a wide range of considerations (including risk analysis) to help commanders decide if attacking an urban area is warranted. See Marine Corps Warfighting Publication (MCWP) 3-35.3, *Military Operations on Urbanized Terrain (MOUT),* (Washington, DC: Department of the Navy), April 1998, 2-1 through 2-2.

[14] Robert B. McFarland, Jr., *MOUT Doctrine and the Third World Threat in 2005-2010: Will it Work?,* (Monograph, School of Advanced Military Studies, U.S. Army Command and General Staff College, Ft Leavenworth, KS: First Term AY 98-99). For additional arguments for updated urban doctrine, see Russell W. Glenn, *We Band of Brothers: The Call for Joint Urban Operations Doctrine* (Santa Monica, CA: RAND, 1999).

[15] At the October 1998 Joint Doctrine Working Party (JDWP) hosted by the U.S. Atlantic Command Joint Warfighting Center (USACOM JWFC), the U.S. Army Training and Doctrine Command proposed the development of Joint Doctrine for MOUT. A Front End Analysis conducted by the USACOM JWFC Doctrine Division recommended against the development of a new publication, primarily because the Universal Joint Task List categorizes MOUT as an environment, not an operation. Instead, they recommended including operational-level considerations into existing JP 3-0 series doctrine.

The Air Force representative noted that no previous urban campaigns have failed due to inadequate MOUT doctrine. Representatives from the nine unified commands, four services and the Joint Staff voted on the proposal, and the JDWP decided 12-2 in favor of developing MOUT doctrine. The USAF and USSPACECOM dissented. See *A Common Perspective: USACOM Joint Warfighting Center Newsletter* 7 (April 1999): 18. Front End Analysis and further background provided by Steve Senkovich, interview by author, 23 February 2000, Suffolk, VA. Lieutenant Colonel Senkovich was the USACOM JWFC Doctrine Division representative responsible for the Front End Analysis of the MOUT doctrine proposal.

[16] *Air Force Doctrine Document 1*, 1.

[17] Air Land Sea Applications Center, *Multiservice Procedures for Aviation Urban Operation (Signature Draft),* March 2000. The final publication is expected to be released in Fall 2000.

[18] The Joint Staff, *Handbook for Joint Urban Operations* (Washington, DC: The Joint Staff, 17 May 2000). For background on the genesis of the handbook, see Glenn, ed., *The City's Many Faces,* 404-413.

[19] Alan Vick et al., *Aerospace Power in Urban Environments: Exploring New Concepts* (Santa Monica, CA: RAND, 2000).

[20] Joint Chiefs of Staff J8, *J8 Land and Littoral Warfare Division Phase I Urban Operations Study, Phase I Final Report,* 14 January 1999, Annex A.

[21] George I. Seffers, "Power on the Front Line," *Defense News,* 27 July - 3 August 1998, 19. Another experimental system, Land Warrior, equips infantry soldiers with personal computers, Global Positioning Satellite receivers, digital maps, headset radios and helmet-mounted eyepiece displays. In September 2000, paratroopers from the 82nd Airborne Division tested Land Warrior prototypes during the Joint Contingency Force Advanced Warfighting Experiment at the Joint Readiness Training Center, Fort Polk, LA. See Tanya S. Blank, "Soldiers Testing Computers in Combat," *Fayetteville (NC) Observer,* 17 September 2000, 1A.

[22] Vick, et al., 149.

[23] Vick, et al., 119-148. For more detail on a recently demonstrated air-deliverable ground sensor system, see David Castellon, "New Toys: Lawn Dart Sensor Among Wares on Display at High-Tech Demo," *Air Force Times*, 21 August 2000, 28.

[24] Joint Chiefs of Staff J8, ii-iii. Additional evidence found in *A Common Perspective,* 18, and author's notes from JUWG-JAWP meeting, Institute for Defense Analysis, Alexandria, VA, 25 May 00.

[25] Carl von Clausewitz, *On War*, ed. and trans. Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1984), 87.

[26] The Joint Staff's *Handbook for Joint Urban Operations* confuses the issue. For example, in describing the effects of actions as strategic, operational or tactical, it states that "levels of command…are not associated with a particular level [of war]." In defining the strategic level of war, however, it notes that "the combatant commander is usually associated with this level of war." See The Joint Staff, *Handbook for Joint Urban Operations,* II-7.

[27] *Air Force Doctrine Document 1*, 23.

[28] Robert B. Oakley, remarks to combined JUWG-JAWP meeting, Institute for Defense Analysis, Alexandria, VA, 25 May 2000.

[29] Carl Ernst, "Mogadishu: The Operational Level," presentation at the 2000 RAND Urban Operations Conference, Santa Monica, CA, 22-23 March 2000. Major General Ernst commanded Joint Task Force (JTF) Somalia, established by U.S. Central Command (USCENTCOM) after the tragedy in Mogadishu. USCENTCOM tasked JTF Somalia to provide force protection for U.S. troops, continue U.S. support of United Nations operations, and maintain open lines of communications.

[30] A. Timothy Warnock, ed., *Short of War: Major USAF Contingency Operations* (Washington, DC: Air Force History and Museums Program in association with Air University Press, 2000), 190.

[31] Air Land Sea Applications Center, III-6.

[32] Field Manual 90-10, 4-1 and MCWP 3-35.1, 4-4.

[33] Gary Anderson, "Applying the Lessons Learned, Take 1: Project Metropolis," (presentation at the 2000 RAND Urban Operations Conference, Santa Monica, CA, 22-23 March 2000).

[34] Ibid. Anderson outlined the following five problem areas for attackers in urban warfare: 1) bunching up, or "stacking" of troops, 2) mistaking speed for momentum, 3) failing to ensure 360 degree security, 4) incorrect actions while crossing danger areas, and 5) improper use of combined arms.

[35] Clausewitz, 357-392.

[36] Ibid, 357.

[37] With minor changes, these definitions use the framework established by John R. Carter, *Airpower and the Cult of the Offensive,* (Maxwell AFB, AL: Air University Press, 1998), 9-10.

[38] Giulio Douhet, *The Command of the Air,* trans. Dino Ferrare (1942; new imprint, Washington, DC: Office of Air Force History, 1983), 16.

[39] Colonel John Boyd developed but never published this OODA theory. For a fuller description of Boyd's theory, see David S. Fadok, *John Warden and*

John Boyd: Air Power's Quest for Strategic Paralysis, (Maxwell Air Force Base, AL: Air University Press, 1993).

[40] Gregory Vistica, "Seeing Through Stealth," *Newsweek,* 5 July 1999, 30-31.

[41] William Craig, *Enemy at the Gates* (New York: Readers Digest Press, 1973), 303.

[42] F-117 pilot who flew in Operation Desert Storm, interview by author, Fayetteville, NC, 5 September 2000. The pilot requests anonymity.

[43] Timothy L. Thomas, "The Battle of Grozny: Deadly Classroom for Urban Combat," *Parameters* 29 (Summer 1999): 94. See also Theodore Karasik, *Chechen Clan Military Tactics and Russian Warfare,* available from http://www.casianalyst.org/headline1.htm; Internet; accessed 22 March 2000.

[44] Benjamin S. Lambeth, *Russia's Air Power in Crisis,* (Washington: Smithsonian Institute Press, 1999), 130.

[45] Vick, et al., 120.

[46] Rebecca A. Grant, "The Radar Game," *Air Force Magazine,* February 1999, 52-60. Grant used simulations of three radar-threat environments to evaluate aircraft survivability and air campaign planning. The Direct Attack scenario was posited against a capital city in 2010 that has a modern Integrated Air Defense System (IADS) with overlapping SAM coverage. She concluded that "in this most dangerous environment, a conventional aircraft signature suffers from both sustained, early detection and from a gigantic spike in detections over the target area." Additionally, high attrition rates would force the JFACC to "devise an air campaign plan that focused on rolling back air defenses prior to launching Direct Attacks of this sort."

[47] Vick, et al., 81.

[48] Bruce W. Watson and Peter G. Tsouras, eds., *Operation Just Cause: The U.S. Intervention in Panama* (Boulder: Westview Press, 1991), 117-118.

[49] Kent DeLong and Steven Tucker, *Mogadishu! Heroism and Tragedy.* (Westport, CT: Praeger, 1994), 13.

[50] Timothy L. Thomas and Lester W. Grau, "Russian Lessons Learned From the Battles For Grozny," *Marine Corps Gazette* 84 (April 2000): 45.

[51] Vick, et al., 80-81.

[52] Anthony H. Cordesman, *The Arab-Israeli Military Balance and the Art of Operations,* (Washington, DC: American Enterprise Institute, 1987), 68-69, cited in J. Marcus Hicks, *Fire in the City: Airpower in Urban, Smaller-Scale Contingencies,* (Master's thesis, Air University, School of Advanced Airpower Studies, Maxwell AFB, AL: June 1999), 23.

[53] Lambeth, 126.

[54] Soviet balloon countermeasures found in Leon Goure, *The Siege of Leningrad* (Stanford, CA: Stanford University Press, 1962): 99. Information on threat of Iraqi balloons over Baghdad obtained from F-117 pilot, interview by author, Fayetteville, NC, 5 September 2000.

[55] The Joint Staff, *Handbook for Joint Urban Operations,* IV-34.

[56] Kaz Purdy, interview by author, Indian Springs Air Force Base, Nevada, 17 May 00. Major Purdy is the 15th Reconnaissance Squadron Director of Operations.

[57] Thomas, Deadly Classroom for Urban Combat*,* 94.

[58] Department of Defense, *Report to Congress: Kosovo/Operation Allied Force After-Action Report* (Washington, DC: Department of Defense, 31 January 2000), 65-66, available from http://www.defenselink.mil/pubs/kaar02072000.pdf; Internet; accessed July 2000. One of the four lessons learned about countering the Yugoslavian IADS was the increasing importance of the enemy's air defense strategy, not just his available systems. See Department of Defense, 71.

[59] Eduard Mark, *Aerial Interdiction in Three Wars* (Washington, DC: Center for Air Force History, 1994), 330-371.

[60] Department of Defense, *Operation Allied Force After Action Report,* 62.

[61] R.D. McLaurin and Paul A. Jureidini, *The Battle of Beirut, 1982* (Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory, January 1986): 33, cited in Vick, et al., 262.

[62] F-117 pilot, interview by author, Fayetteville, NC, 5 September 2000.

[63] Thomas Steck, *Camouflage and Deception Techniques for Urban Warfare* (Fort Belvoir, VA: U.S. Army Mobility Equipment Research and Development Command, October, 1980), 5-7.

[64] Ibid., 7.

[65] The Joint Staff, *Handbook for Joint Urban Operations,* IV-34 and Davis, 54.

[66] Mark, 349-350.

[67] For an interesting proposition that a city's "background noise" provides an excellent framework for deception, see Scott Gewehr and Russell W. Glenn, *The Art of Darkness: Deception and Urban Operations* (Santa Monica, CA: RAND, 2000), 44. Gewehr and Glenn offer five other reasons why urban terrain amplifies the ease and effectiveness of deception: 1) Scope of deception is increased (more men, material and opportunities for CCD), 2) City is rich source of materiel resources for deception, 3) Decision making is hastier and generally less informed, making it more vulnerable to deception, 4)

Enemy can use noncombatants to camouflage their presence or as "living decoys, and 5) Urban clutter blunts sensors and communications required for gathering ELINT, and difficulties corroborating it with uncertain HUMINT increases vulnerability to deception. See Gewehr and Glenn, 43-48.

[68] The most advanced NVG equipment used by U.S. Air Force Air Combat Command aircrews is the Image Intensification Set, Night Vision, AN/AVS-9(V), Model F4949G. Even these advanced goggles create a "halo" around point sources of light, which grows in proportion to the light's intensity. Personal observation of author while flying night sorties with NVGs, 13 July 2000 and 16 August 2000, 75th Fighter Squadron, Pope AFB, NC.

[69] Numerous incidents of Somali shielding tactics are described in Mark Bowden, *Black Hawk Down: A Story of Modern War* (New York: Atlantic Monthly Press, 1999). For an account of Soviet hugging tactics to deny German CAS in Stalingrad, see Vasil I. Chuikov, *The Battle for Stalingrad* (New York: Holt, Rinehart and Winston, 1964), 72. For Chechen hugging tactics to deny Russian artillery and aerial firepower, see Thomas and Grau, 46.

[70] The Joint Staff, *Handbook for Joint Urban Operations,* II-10 through II-11.

[71] The Joint Chiefs of Staff, *Joint Publication 3-0, Doctrine for Joint Operations* (Washington, DC: The Joint Chiefs of Staff, 1 February 1995), III-21.

[72] Ibid.

[73] Robert H. Scales, Jr., "The Indirect Approach: How U.S. Military forces Can Avoid the Pitfalls of Future Urban Warfare," *Armed Forces Journal International* 136 (October 1998): 74.

[74] The concept described in this paragraph is paraphrased from Robert C. Owen, "What a JFACC Should Know About Urban Operations," presentation at the Role of Aerospace Power in Joint Urban Operations Conference, Hurlburt Field, FL, 24 March 1999.

[75] Owen, "Urban Warfare in the Future," 8.

[76] Anatoly Sergeevich Kulikov, *"The Chechen Operation From the Viewpoint of the Military Command,"* presentation at the 2000 RAND Urban Operations Conference, Santa Monica, CA, 22-23 March 2000. General Kulikov assumed command of Russian forces in Grozny on 19 January 1995, shortly after the Chechens destroyed nearly an entire Russian mechanized brigade that reached the center of Grozny. He emphasized how blockading the city enabled enabling control, which became the heart of their strategy five years later.

[77] Thomas and Grau, 47.

[78] Ibid, 48.

[79] The Joint Chiefs of Staff, *Doctrine for Joint Operations*, III-9.

[80] Ibid., 6.

[81] Schwartz and Stephan, 7.

[82] Scales, 72.

[83] Philip S. Meilinger, *10 Propositions Regarding Air Power* (Washington, DC: Air Force History and Museums Program, 1995): 20. Meilinger emphasizes the difficulty of selecting targets and the complexities in assessing strategic effects. Unlike quantifiable tactical strikes on military forces, strategic effects are more difficult to measure. As a source of political, economic, social and military power, a defended urban area offers fertile ground for attackers seeking strategic effects.

[84] Timothy L. Saffold, *The Role of Airpower in Urban Warfare (*Maxwell AFB, AL: Air University Press, December 1998), 25.

[85] The Joint Staff, *Handbook for Joint Urban Operations,* III-2 through III-11. The air considerations and planning factors, many of which are addressed in this paper, are as follows: 1) challenges of CAS and interdiction, 2) air navigation, 3) flight hazards such as wires, 4) ease of detecting aircraft, 5) reduced inflight visibility, 6) effect of lighting on NVGs, 7) comm/nav interference, 8) air defense threat, 9) ground security, 10) personnel recovery, and 11) landing zones.

[86] The formation of the intelligence working group was discussed at the 21 June 2000 JAWP-JUWG meeting attended by the author and confirmed by the director of the JUWG. Vick, et al. present a comprehensive survey of enabling technologies and new concepts that attempt to extract better intelligence from the urban area through a wide range of sensors and systems. For a method to select urban targets, see Edward R. McCleskey, *Urban Warfare at the Operational Level: Identifying Centers of Gravity and Key Nodes* (Research Report, Air University, Air Command and Staff College, Maxwell AFB, AL, April 1999).

[87] Robert Wall, "USAF Tackles Urban Combat," *Aviation Week and Space Technology,* 22 March 1999, 83. For a full description of limited effect munitions, see Vick, et al., 187-197.

[88] Schwartz and Stephan, 8.

[89] Ibid.

[90] Carter, 91.

[91] James R. Callard, "Aerospace Power Essential in Urban Warfare," *Aviation Week and Space Technology*, 6 September 1999, 110.

[92] Robert B. Oakley, Remarks to combined JUWG-JAWP meeting, Institute for Defense Analysis, Alexandria, VA, 25 May 2000, 10.

[93] For USAF Urban CAS, see Wright, 18. For Marine Corps initiatives, see Usry and Simpson, 33-36.

[94] MCWP 3-35,1, 1-16.

[95] Thomas and Grau, 47-48. Emphasis mine.

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