AU/ACSC/176/2000-04

AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

THE FUTURE OF ALL-WEATHER, RAPID REACTION PRECISION TARGETING

by

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A Research Report Submitted to the Faculty

In Partial Fulfillment of the Graduation Requirements

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April 2000

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

Public reporting burder for this collection of information is estibated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burder to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (FROM - TO)
01-04-2000	Thesis	xx-xx-2000 to xx-xx-2000

4. TITLE AND SUBTITLE The Future of All-Weather, Rapid Reaction Precision Targeting Unclassified	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Thomas, Evan C. ;	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME AND ADDRESS Air Command and Staff College Maxwell AFB, AL36112	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME AND ADDRESS ,	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APUBLIC RELEASE
,

13. SUPPLEMENTARY NOTES

14. ABSTRACT

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15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19. NAME OF RESPONSIBLE PERSON
			Public Release	47	Fenster, Lynn lfenster@dtic.mil
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified			19b. TELEPHONE NUMBER International Area Code Area Code Telephone Number 703767-9007 DSN 427-9007

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39.18

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Acknowledgments

I would like to thank Major Thomas 'Himey' Himes for his contributions and guidance during the production of this paper. I would also like to thank Major Carol Rattan at the Air Force Historical Research Agency for her cheerful assistance and support.

AU/ACSC/176/2000-04

Abstract

The Air War Over Serbia (AWOS) featured the first concerted use of a new class of precision aerial weapons, which use Global Positioning Satellite (GPS) signals for guidance. These weapons allow all-weather employment and offer the technical capability to execute rapid reaction attacks against emerging targets. This raises the question of whether or not all-weather, rapid reaction attacks will be a viable option for future air commanders. Pertinent background information on GPS-guided weapons covers their technical strengths and weaknesses. The development of rapid reaction attack capabilities in Operation Desert Storm and AWOS is detailed, emphasizing the lessons from flexible targeting operations conducted in AWOS. The three functional components of a rapid targeting capability using GPS-guided weapons are analyzed, with critical tasks identified and discussed. Postulated operations should center on a dedicated rapid targeting cell, with the ability and authority to approve attacks, re-task sensor and attack assets, and generate precise target coordinates. Accountability for combat effects will shift from the attacking aircrew to the cell planners. Use of GPS-guided weapons eliminates the need to disseminate target imagery to attacking aircrew, and reduces workload. This capability is a viable option for future commanders, if we choose to pursue it.

Part 1

Introduction

Strike the enemy as swiftly as a falcon strikes its target. It surely breaks the back of its prey for the reason that it awaits the right moment to strike.

— Tu Yu, *The Art of War*

On 24 March 1999, NATO forces began the air war over Serbia (AWOS) with strikes using highly accurate weapons, which used Global Positioning Satellite (GPS) signals to achieve all-weather precision. The success of these weapons against fixed targets was one of the highlights of the AWOS campaign. Mobile targets, however, proved to be an elusive problem for NATO airmen. This paper addresses the potential use of GPS-guided weapons to strike time-critical targets.

Rapid attacks against emerging targets, using all-weather precision ordnance, can be a viable option for future air and land commanders. The idea of all-weather, precision attack within a few minutes will be difficult to achieve, however developing a capability to attack within 30 minutes to a few hours is certainly possible, and would yield a method to maintain persistent pressure on an adversary, no matter what the environmental conditions.

Bringing this capability to fruition will require four essential capabilities, or critical links. These links are: all-weather target acquisition systems, the priority to quickly re-task Intelligence, Surveillance, and Reconnaissance (ISR) assets to support rapid targeting, accurate generation and dissemination of GPS-quality coordinates, and a change in traditional views of

combat effects accountability. The resources, tasks and processes necessary to accomplishing all-weather, rapid attacks can be divided into three broad task areas, or enabling components. Joint fire support doctrine identifies these components as target acquisition (TA), command and control (C2), and attack resources.[1] These components will be used as a framework for analysis throughout this paper.

Significance for Future Military Operations

In December of 1944, the German Army deliberately planned to counter Allied air superiority by launching the Ardennes offensive under poor weather conditions.[2] In Kosovo, Serbian military forces, well trained in concealment and deception, also used cloud cover to their advantage. The winter weather conditions over Kosovo led Admiral Ellis, the Joint Task Force (JTF) commander, to comment that, "We may own the night, but the poor weather creates sanctuaries and operational lulls."[3] Our enemies have observed our capacity to control the air, and strike fixed targets with great precision. They will undoubtedly attempt to exploit any available sanctuaries from air attack. GPS-guided weapons offer a method to attack point and small area targets rapidly, despite adverse weather conditions. Such a capability would hold enemy forces at risk whenever they could be detected and identified in a fixed geographic position; i.e. whenever they stopped moving. They would gain no respite from the covering clouds, just the worrying possibility that a GPS-guided weapon might be dropping towards them, at any moment.

Scope of Analysis

The scope of this paper is purposely limited to assessing the potential uses of GPS-guided munitions for executing rapid, all-weather attacks on emerging targets. As such, the phrase

‘rapid, precision targeting’ refers specifically to employment of GPS-guided munitions. Laser-Guided Bomb (LGB) usage for rapid precision targeting is not discussed, except for comparisons or examples of integration. Fielded USAF GPS-guided munitions will be used as examples for illustration and analysis, however this analysis applies to similar systems used by other US and allied services. Rapid attacks against time-critical targets are the focus of the paper. Attacks on fixed targets, which can be included in a standard Air Tasking Order (ATO) planning and execution cycle, are a current capability and are excluded from this analysis. To avoid tangential discussions on doctrinal roles and responsibilities, this paper assumes that the rapid targeting operations take place in an Air Operations Center (AOC), and that these operations directly support the Joint Force Commander (JFC) and Joint Force Air Component Commander (JFACC) strategy and objectives. A restricted political-military situation, with a high emphasis on minimizing collateral damage and political/informational impacts, is assumed to be the future operating environment.

Notes

[1] Joint Publication 3-09, *Doctrine for Joint Fire Support*, 12 May 1998, II-1

[2] B.H. Liddel Hart, *History of the Second World War* (New York: G.P. Putnam’s Sons, 1970), 648-651.

[3] United States Air Forces in Europe, Studies and Analysis Directorate (USAFE/SA). *The Air War Over Serbia, Initial Report*, 8 December 1999, 11-12.

Part 2

Background

GPS-Guided Weapon Capabilities

A new class of air-to-ground weapon was used in significant numbers for the first time during AWOS, the GPS-guided munition. The primary air-deliverable examples of this weapon class are the Joint Direct Attack Munition (JDAM) and the Joint Stand-Off Weapon (JSOW). JDAM is a guidance kit which replaces the conventional, fixed tail fin section on 1,000 and 2,000-pound unguided, general purpose bombs, providing a high altitude standoff range of up to 15 nautical miles.[1] JDAM is categorized as a near-precision weapon. It does not match the 10-meter Circular Error Probable (CEP) accuracy of LGBs, but it comes very close. 90 percent of the JDAMs employed by B-2 aircraft during Operation Allied Force hit within 12 meters of the target.[2] JSOW is a glide weapon, with a standoff range of more than 40 nautical miles for a high altitude release. It features modular warhead sections that enable either area attack using cluster sub-munitions, or a unitary warhead for point attacks.[3]

Both JDAM and JSOW guide autonomously to a target coordinate (latitude, longitude and elevation) using an internal inertial guidance platform, updated by positional reference signals from the GPS constellation. The GPS signals are required to achieve the weapon's near-precision accuracy. The weapon will guide accurately regardless of battlefield obscurants, clouds, or darkness. Because they are guiding to a fixed coordinate, GPS-guided weapons have

no effective capability against moving targets, unless the delivery aircraft can track the target accurately using onboard sensors, and calculate a predicted target coordinate.

Employment of GPS-guided munitions is significantly different then that of other precision guided munitions (PGMs). The weapons are "Fire and Forget"; visual contact with the target is not required at any time, nor is illumination with a laser or any other designation device. The attacking aircrew transfers the target coordinates to the weapon, flies to a location within the kinematic range envelope, and releases. The B-2 possesses the unique capability to update JDAM coordinates autonomously, based on synthetic aperture radar (SAR) imaging of the target area.[4] Other USAF platforms, such as the F-16CJ, will be dependent on external sources for accurate target coordinates. The aircrew will not be able to alter or refine the aim on target, using a sighting device such as the air-to-ground radar. Therefore there is no need for high quality or recent target imagery to execute an attack; a good map or commercial-quality image is sufficient if identification of the general target area is required. Unlike LGBs, accuracy is entirely out of the aircrew's control. The terminal accuracy of the weapon is a function of the quality of the target coordinates, and the errors inherent in the guidance system. In certain cases, pre-mission planning may be required for successful employment. Because JSOW glides to its function altitude, there is a risk of terrain impact if the target is in a low-lying area, surrounded by high terrain. Mission planning can determine a terminal heading and release point that will allow the JSOW to avoid blocking terrain. This, however, takes time and equipment that will not be available to aircraft that are re-tasked inflight.

JDAM and JSOW, along with similar follow-on GPS-guided weapons, are to be employed by the Navy, Marine Corps, and Air Force, as well as NATO allies. In terms of function on the battlefield, the Army Tactical Missile System (ATACMS) and Navy's Extended Range Guided

Munition (ERGM) provide similar capabilities, and should be included as available attack systems for the rapid reaction mission.

Emerging Targets

For the purposes of this paper, an emerging target is defined as a time-critical, militarily-significant target which will remain in a stationary position for an amount of time necessary to attack it. A fixed site, such as a bunker, may fit this category if it unexpectedly becomes a high priority target for a short time. The unique characteristics of an emerging target are the unpredictable locations and times at which it will be exposed, and the length of time it will remain identified and vulnerable. The mobile Scud launchers used by Iraq during the Gulf War are a prime example of a time-critical, emerging target. Other examples might include command posts, artillery units, or mobile surface-to-air missile (SAM) batteries. The time required to find and strike high-value emerging targets will be of critical importance to commanders.

Notes

[1] JDAM Program Office Website, undated, on-line, Internet, 11 January 2000, available from http://www.jdamus1.eglin.af.mil:82/info/info-main.html.

[2] John A. Tirpack, "The State of Precision Engagement," *Air Force Magazine*, March 2000, 29.

[3] USNI Military Database, 15 April 1998, on-line, Internet, 15 December 1999, available from http://www.periscope.usni.com/demo/weapons/missrock/landatk/w0004368.html.

[4] Tirpack, 28.

Part 3

Development of Rapid Attack Capabilities

We invented new processes within the CAOC to get real-time communications between those things that were finding targets, those assets that were identifying the targets as bad guys, and those assets that were bombing the targets.

— General John Jumper

Gulf War Precision and Rapid Attack Capabilities

Operation Desert Storm marked the first large-scale use of PGMs during an air campaign. The experiences gained over Iraq highlighted new opportunities and limitations regarding use of precision weapons, and execution of rapid attacks. Precision LGB attacks became a standard media image for the conflict, although they only comprised just over 4% of the gravity bombs employed by US air forces.[1] The weather was generally clear, but periods of adverse weather hampered LGB usage. Precision weapons were initially reserved for high-value fixed targets, but were used later in the conflict against fielded forces, a practice known as 'tank plinking'. Attacks on Iraqi field forces, using precision and non-precision weapons, were conducted using tactics little different from those employed by roving Mustangs and Thunderbolts over Europe in World War 2. Strikes were controlled by the 'shooter' aircraft themselves, or with the help of target locating 'Killer Scouts'. Assigned a geographic 'killbox' in the ATO, the aircrew detected targets visually or with onboard sensors, assessed the situation, and employed their weapons against the most promising targets. The open, unpopulated desert environment eliminated

concerns about collateral damage, and allowed such decentralized and flexible operations. Despite the individual successes of precision weapons and flexible attacks, it proved very difficult to combine the two in order to hit specific, high-value mobile targets; Iraqi Scud launchers. ISR sensor systems proved unable to accurately locate the mobile launchers before or after launches, due in part to effective Iraqi electromagnetic emission control, decoys, and prepared "hide" sites.[2] An autonomous killbox strategy was then adopted, with strike aircraft patrolling the known launch regions. Once a launch had been visually observed, the aircrew attempted to rapidly locate the launch vehicle using the aircraft's onboard sensors. Despite being equipped with very capable forward-looking infra-red (FLIR) and radar sensors, the F-15E and F-16CG aircrew were unable to accomplish this difficult task. Fundamental limitations of the sensor systems greatly limited the probability of autonomous detection and rapid attack.[3] The great Scud hunt revealed significant limitations in two of the three components essential to rapid precision attacks, the target acquisition and command and control components. Large improvements would be clear in 1999 when the capability to perform rapid precision attack would again be called for during Operation Allied Force, the NATO air campaign against Serbia.

AWOS Precision and Rapid Attack Capabilities

The conduct of the air war over Serbia benefited greatly from the lessons learned over Iraq. Most notably for the topic of this paper, AWOS introduced the large-scale employment of GPS-guided weapons, and the ad hoc formation of a centralized rapid targeting capability at the Combined Air Operations Center (CAOC).

The development and procurement of GPS-guided munitions was undertaken following the Gulf War, where the inability to attack with precision through cloud cover had been recognized as a limitation. JDAM and JSOW were both in the early production phase of procurement, and

were available in limited quantities for use against Serbia.[4] Employment of JDAMs during AWOS was carried out solely by USAF B-2 aircraft, which used JDAM to carry out 656 all-weather, precision attacks against fixed targets only. JSOWs were employed from USN F/A-18 aircraft in small numbers.[5]

The adverse weather, mountainous terrain, and population density of Serbia and Kosovo effectively limited the loosely controlled 'killbox' tactics used in Desert Storm to attack fielded forces. The weather in Kosovo was ill suited to autonomous detection and precision attack using LGBs. For more than 70% of the campaign, cloud coverage was 50% or greater over Kosovo.[6] U.S. and NATO military objectives both focused on diminishing the offensive capability of the Serbian field forces in Kosovo[7], and an air strategy was needed to meet this objective. The difficulties in detecting and attacking mobile ground units, and the requirement to limit collateral damage, made a centralized approach towards rapid execution necessary. A flexible targeting cell was formed in the CAOC, to effectively collate sensor information and cue shooters to the mobile targets.[8] The flexible targeting cell operations can be broken down into areas corresponding to the enabling components for rapid, precision attacks.

Target Acquisition

The sensor assets available to air commanders during AWOS were more varied and capable then what had been available during the Gulf War. Available ISR platforms included the Joint Surveillance, Target Attack Radar System (JSTARS), RC-135 Rivet Joint, U-2, and ABCCC aircraft, and numerous unmanned aerial vehicle (UAV) systems, including the RQ-1 Predator.[9] JSTARS brought a capability to detect moving vehicles across wide areas, provide all-weather SAR imagery of fixed targets and areas, and perform battle management tasks, while also relaying sensor data to commanders on the ground. JSTARS does not, however, possess an

identification capability against moving targets.[10] JSTARS enabled sensor-to-shooter armed reconnaissance operations by cross-cueing, or directing, UAVs to targets. The UAV doctrine, tactics, and procedures did not cover this function.[11] UAVs were used aggressively to detect and image emerging targets in Kosovo. Real-time video from Predator UAVs was used specifically to search for cues to locate mobile Serb targets, and then provide area assessment information that was relayed to aircrew to assist in locating the target.[12] Predator UAVs were able to operate underneath low cloud ceilings, while strike aircraft remained above the clouds.

Command and Control

Command and control at the CAOC level was what made flexible targeting happen during AWOS, and served to illustrate the potentials, and pitfalls, of rapid targeting operations. Real-time ISR and threat information from a number of systems was synthesized at the CAOC, distributed operations centers, and national intelligence centers, and then passed to attack assets.[13] Active command of the battle during ATO execution was very important. One example was the availability of low-density/high-demand ISR assets. In order to use ISR capabilities to find, identify, and fix mobile targets, commanders had to prioritize between collection and support for real-time targeting, and then commanded ISR operators to transition between both tasks as needed.[14] Standard usage of these platforms had been historically slanted towards pre-planned collection activities, which generate large volumes of data for later analysis. Commanders at all levels tasked these collection assets heavily, frequently for information that was not directly useful to the air campaign. General Hawley stated that intelligence efforts should focus "on the information required to support that campaign, rather than just overwhelm the floppies with gigabytes of information and hope somebody can find what they need out of it."[15] Pulling an integrated fusion of relevant operations and intelligence data from the volumes

of tasked collection data was a shortfall that needs to be corrected for future operations.[16] Finally, much of the potential information integration was hampered by communications interoperability and capacity problems. NATO communications systems, in particular, were unable to handle the load of classified information, and dissemination of the ATO to dispersed units took hours.[17]

CAOC manning and training levels impacted the ability to perform attacks on emerging targets. At its peak, over 1400 personnel were assigned to the CAOC, many of them on a temporary basis, with little training in ATO planning or integration of sensor and attack assets. Improving the AOC capabilities to handle dynamic, emerging targets, without disrupting planned attacks against pre-approved targets, was an AWOS lesson learned.[18] Highly publicized collateral damage incidents led to a focus on accountability, and demonstrated that the AOC personnel involved in the targeting process are also accountable for the applied combat effects.

The decision cycle to support rapid operations posed another challenge. Operating in an environment of heavy political and media interest, and without a previous model for flexible targeting operations, commanders attempted to compress the 'standard' strike cycle, from collection and validation through attack, as much as possible. This led to difficulty in making the fast decisions required for rapid strike operations.[19]

Attack Resources

The precision LGB, and non-precision 'iron' bombs used for air attacks against flexible targets relied on aircrew location and identification of the target. The necessary target information had to be communicated to the aircrew, and good weather was needed to find, confirm, and attack the targets. One of the primary limitations to striking mobile forces in Kosovo was the lack of imagery, prior to take-off or into-the-cockpit, which led to considerable

difficulties in target acquisition. Problems and policies relating to ISR data classification complicated operations.[20]

The requirement for timely imagery, to assist in target identification and LGB employment, was a significant challenge to rapid targeting in AWOS. The flexibility offered by such aircrew-directed attacks, however, was a major advantage against mobile forces. Targets that had recently moved, or were currently on the move, were vulnerable to both LGB and non-precision attacks.

AWOS Rapid Attack Results

AWOS demonstrated the potential to execute rapid targeting missions against mobile, time-critical targets. Over 3,400 flex targets were struck, with confirmed success against over 580 armored and soft military vehicles, and 389 artillery or mortar pieces.[21] This was a remarkable feat, which says much for the U.S. and allied personnel who 'made it happen'. The limitations of conducting rapid targeting operations on an ad hoc basis, however, were apparent. Mobile SAM batteries posed a significant threat to allied operations throughout the campaign. SA-6 SAM units launched an estimated 477 missiles, yet only three of the estimated 80 launchers and 25 associated radars were located and destroyed.[22] One of the primary limitations to rapid targeting was the adverse weather. AWOS also featured extensive use of all-weather, GPS-guided weapons, to attack fixed targets. The challenge now is to assess what must be done to refine the rapid targeting process, and combine it with the all-weather capabilities of these new weapons.

Notes

[1] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report* (Washington D.C.: Government Printing Office, 1993), 103,203.

[2] *ibid*, 86.

Notes

[3] *ibid*, 86-87.

[4] Department of Defense, *Kosovo/Operation Allied Force After-Action Report*, Report to Congress, 31 January 2000, section VII.B., 15 February 2000, available from http://www.defenselink.mil/pubs/kaar02072000.pdf.

[5] *ibid*, sections VII.B.2 and VII.C.1.

[6] *ibid*, section VII.B.

[7] USAFE/SA, *AWOS Initial Report*, 9.

[8] *ibid*, 23.

[9] United States Air Forces in Europe Directorate of Studies and Analysis (USAFE/SA), "AWOS Fact Sheet" (Reference document for AWOS Study), 31 January 2000, 6.

[10] 93d Air Control Wing, "JSTARS Capabilities and Employment Briefing", undated, n.p.

[11] Office of the Secretary of Defense, "Task Force on Kosovo Operations", undated briefing, 8, 11.

[12] USAFE/SA, *AWOS Initial Report*, 43.

[13] DoD, *Kosovo After-Action Report*, section VII.B.3.d.

[14] USAFE/SA, *AWOS Initial Report*, x.

[15] *ibid*, 41.

[16] OSD, "Task Force on Kosovo Operations", 13.

[17] USAFE/SA, *AWOS Initial Report*, 54.

[18] *ibid*, 35-37.

[19] OSD, "Task Force on Kosovo Operations", 13-14.

[20] *ibid*, 14.

[21] DoD, *Kosovo After-Action Report*, sections VII.A.2, VII.B.1.

[22] USAFE/SA, "AWOS Fact Sheet", 4.

Part 4

Analysis

> *A superiority of fire, and therefore a superiority in directing and delivering fire and in making use of fire, will become the main factors upon which the efficiency of a force will depend.*
>
> — Marshal Ferdinand Foch

Having detailed the capabilities of GPS-guided munitions, and the development and implementation of flexible targeting processes in both the Gulf War and AWOS, the next step is to analyze the contextual factors and enabling components as they specifically apply to rapid, all-weather precision targeting.

Contextual Impacts upon Rapid Targeting

All conflicts have unique contextual or situational elements, which impact military operations. There are two broad areas, political and strategic constraints, which will likely have a significant effect on the rapid, precision targeting mission.

Political constraints can pose major difficulties for military leaders, yet they cannot be ignored or discounted. The national objectives for any conflict are formulated by the National Command Authority, and are at heart political objectives. The military objectives, strategic and operational, must be in congruence with the national objectives and produce a unified action.[1] Target approval processes and the strong emphasis on collateral damage limitation were two examples of political restraints that effected AWOS planning and execution. Future air

commanders must work to define and adjust for political limitations, including how they will specifically effect the rapid targeting process. If the political context demands cumbersome high-level approval or coordination for all strikes, then there would be little point in establishing a 'within minutes' strike capability in the operations area.

Strategic considerations will also bear on the importance of rapid, all-weather targeting. The nature of the conflict will dictate the relative utility of a rapid targeting capability. In the case of a large-scale conflict between sizable conventional forces, the significant resources required for rapid analysis and execution might be needed to support standard pre-planned taskings. In a conflict where the enemy has discrete strengths or weaknesses, which present fleeting attack opportunities, the diversion of assets to rapid, precision targeting could be critical to success.

Enabling Components for Rapid IAM Targeting

In order to make rapid, precision targeting an operational reality certain tasks must be performed. These tasks fall into three functional phases, which together make up the enabling components required to accomplish the mission. These components are target acquisition, command and control, and the attack resources.

Target Acquisition

The capability to detect and identify hostile military units and equipment is the obvious first step to attacking them. For the rapid, precision targeting mission this capability can be divided into five distinct tasks: detection, identification, geo-location, assessment, and monitoring. The first three are necessary tasks to executing any rapid, precision attack. The last two provide information that will likely be needed during the analysis and employment phases of the attack.

Timeliness of data, and adverse environmental effects, are also vital factors that run through each of the distinct TA task areas.

Detection of a target can come from a variety of sensors, as occurred during AWOS. Clear weather detection systems include UAVs or fighter aircraft, equipped with FLIR or optical systems. The detection sensor might also be an all-weather system, such as the SAR on a JSTARS, U-2, or UAV. Other possible detectors are systems that detect electro-magnetic (EM) transmissions, acoustic systems, space-based assets, or human intelligence (HUMINT) sources on the ground.

Once alerted to the presence of a possible target, the next task is identification. This task is more difficult technically, as it requires either sufficient sensor resolution to physically identify the target, or some synthesis of various information inputs to determine target identity. For example, a reliable HUMINT report of T-72 tanks moving out of a village may be correlated with data from a JSTARS capable of tracking their movement out of the village, but without sufficient all-weather resolution to identify them as T-72 tanks. EM sensors may be able to identify an emitting system based on the signal's frequency, pulse width, or other distinct characteristics. A variety of sensors and sources are available to US military forces to perform the identification task. The ISR community's push towards 'hyper-spectral' capability is an attempt to provide greater speed and accuracy of identification, through data fusion and correlation from multiple sensors.

Determining the target location is another essential task, which will generally follow identification. GPS-guided munitions require a precision target coordinate and elevation, which will likely be beyond the capability of most TA sensor systems to provide. Sensor data, such as imagery from a UAV, will be transmitted to the C2 analysis node, and utilized to determine the

accurate coordinates. The data required to produce these coordinates, resolution of the target and its surroundings, will vary with the sensor system. It is important to note that if optical imagery is required for target location, then the capability is not all-weather.

The assessment function is accomplished at the C2 node, to be discussed below, however it may demand additional sensor information. Specifically, an assessment of the target area may yield status of other hostile units, presence of any nearby civilian traffic or concentrations, or other information that would assist in tactical and collateral damage analysis. An identification sensor system, which provides high resolution over a small area, may not be able to provide the larger-scale picture needed for assessment. It would be analogous to trying to watch all the action in a football game through high-powered binoculars.

Rapid attack preparation and execution will take time, during which the target may move away from the target area. The monitoring task is needed to ensure the target is still at the same coordinate position, and that collateral damage potential has not increased. It is important to remember that the GPS-guided weapon will fly to the exact target coordinates provided to it, and cannot correct for target movement. If the target has moved, then the attack should be aborted to prevent needless risk to the air assets, and preserve the munitions for later use.

A blend of sensors and platforms may well be required to accomplish the TA component tasks. One sensor system may detect the emerging target, but lack sufficient resolution to identify and locate it. Another sensor may then be cued to perform the identification or assessment tasks. The flexible targeting operations performed in AWOS, with cross-cueing between JSTARS and UAVs, demonstrated the feasibility of such focused sensor fusion. The time required to re-task ISR systems to support real-time targeting must remain short, or this will become a limiting factor. The speed of data transfer from the sensor to the C2 node is another

key area of timeliness. Delays moving sensor information will compound the delays in planning and executing the rapid strike. The Task Force on Kosovo Operations noted that availability and timeliness of sensor information flowing to the CAOC during Operation Allied Force showed significant improvement from earlier operations in Bosnia, but that this remained a primary limitation to striking mobile targets. Integration of existing ISR sensors to provide sensor cross-cueing and better tasking and distribution processes, were among the major recommendations for improvement.[2]

The adverse effects of weather and environmental factors on the target detection and identification task must be considered. If the sensors available for rapid targeting support cannot detect, identify and facilitate timely production of GPS-quality strike coordinates due to weather or other environmental factors, then the ability to conduct rapid, all-weather attacks is lost. An inability to perform assessment or monitoring tasks may prevent the rapid attack mission as well, depending on the rules of engagement and constraints for the operation. All-weather capable TA sensors are the first of four critical links in the development of the rapid attack capability.

The target detection component provides information on what the target is. The questions of why, when, how, and precisely where to attack the emerging target are answered by the next enabling component, the C2 node.

Command and Control Node.

The need for a fast-reaction attack capability during AWOS led to the creation of the CAOC flexible targeting cell. The rapid, precision attack mission will require a centralized analysis and decision-making node as well, which has access to a wide spectrum of sensors and coordination capabilities. This rapid targeting cell (RTC) will be faced with a set of tasks spanning the strategic, operational, and tactical levels of war.

After an emerging target has been identified, the question arises of whether an attack is in line with the JFC's objectives and campaign plan. The targeting process normally consists of a target development phase, where key targets are analyzed and validated, followed by a weaponeering assessment, and then production of a jointly coordinated target nomination package for approval. Coordination and approval is accomplished by a Joint Targeting Coordination Board (JTCB), or by a method determined by the JFC.[3] This method would be too cumbersome for approval of individual emerging targets, however it is essential that unity of effort be maintained at the JFC level. Likely time-critical target sets should be included in the standard targeting process for prioritization and pre-approval. Since the circumstances for rapid targeting opportunities will be impossible to predict, direction in the form of commander's intent will be essential to provide a framework for RTC operational decisions.

The RTC will be responsible for conducting an analysis of the benefits and risks posed by the strike opportunity, using the target identification and assessment data, in addition to considerations such as the campaign objectives, and threat order of battle. This cost-benefit analysis clarifies why the target should be struck. The second portion of the analysis should assess which system or capability to employ, and the coordination that will be required with other components of the JTF. This phase of the analysis should provide guidance as to who will execute the rapid attack, and how and when it will be made. Overall, the strike analysis may cover strategic implications, such as political-military or coalition considerations. Collateral damage potential is an example of such a strategic consideration. The analysis will primarily be focused at the operational level. The core questions of the analysis, whether an attack on the emerging target would further overall campaign goals, and which scarce assets to re-allocate or re-prioritize, are essentially operational questions.

A number of detailed tasks at the tactical level are needed to execute the rapid, precision targeting mission. Converting the target location into GPS-quality coordinates is absolutely essential for use of GPS-guided weapons. The process of determining high-quality geo-coordinates is known as mensuration, and the target aimpoint is designated as a Desired Point of Impact (DPI) following mensuration. There is a second component to this task which also very important, and that is the determination of target location error (TLE).[4] All measurements and databases contain margins of error, and TLE quantifies the accuracy error for each DPI. If TLE is significant, then the GPS-guided weapon may guide to the 'right' DPI, but in the 'wrong' place. As an illustration, a GPS-guided weapon with a notional 30-foot CEP is to be used for a mobility kill against an armored vehicle. CEP is the radius within which 50% of the weapons will fall, and is a measure of weapon accuracy. It is assumed that the weapon must detonate within 30 feet to achieve the desired effect. If TLE for the target DPI is zero, then there is a 50% probability that the attack will be successful. If TLE is 200 feet, then the probability drops below 2%. Major General Muellner of the Joint Advanced Technology Program stated that "how accurately you know where a target is in GPS space...is not a trivial issue."[5] The determination of mensurated coordinates requires expertise, and access to a database of high-resolution, ortho-rectified spatial imagery, traditionally maintained at national level. Ortho-rectification is the process by which distortion due to terrain relief is removed from imagery.[6] Reachback to national agencies is one option for obtaining GPS-quality coordinates, however this places a critical function outside of RTC control. Forward deployment of these assets may be well worth the additional logistic and force protection footprint. During AWOS, national agencies provided tools to the theater, such as the Joint Targeting Workstation. This workstation

performs geospatial correlation and targeting, using video or imagery inputs, and was a valuable theater asset.[7]

Not all GPS-guided weapons require the same degree of point precision. Variants of JSOW and ATACMS employ cluster munitions, which detonate over a wider area. The AGM-154B variant of JSOW disperses Sensor Fuzed Weapon (SFW) submunitions over a 1000 foot by 2000 foot search area[8]. Given the example above of a 30 foot CEP and 200 foot TLE, an attack with an AGM-154B would easily cover the entire target area, despite the uncertainty error. With this wider area of weapons effects comes a wider area of collateral damage concerns. It is important to note that these area weapons still require mensurated DPIs for accurate guidance. If point precision is not required, there is a strong possibility of using reachback to CONUS-based units or agencies before or during the conflict. DPIs and TLEs for key transportation chokepoints or suspected dispersion locations could be computed through reachback capabilities, then cataloged in a theater-level database. Peacetime exercise taskings could also be used to build these real-world databases. The development of catalog and retrieval databases annotated with geospatial data was one of the technology recommendations cited by the Task Force on Kosovo Operations.[9] Whether a point or area GPS-guided munition is to be used, the capability to rapidly and accurately produce mensurated DPIs, and their respective TLEs, is another critical link in the rapid, precision targeting process.

There is one unique factor which sets the use of GPS guided weapons for rapid attack apart from previous flexible or conventional attack capabilities, and that is accountability. USAF fighter and bomber crews have long been trained that they are ultimately responsible for target identification prior to employing weapons. Non-GPS precision and non-precision weapons alike require deliberate aiming or designation by the aircrew. With a GPS-guided weapon, whether it

is an air-delivered JSOW or ship-fired ERGM, the person who determines the DPI is responsible for where the weapon will go. All-weather, onboard sensors, such as the F-16's multi-mode radar, may not be capable of positively identifying small tactical targets from the stand-off ranges available for JSOW and JDAM. For most aircraft, the aircrew will not be able to change the aimpoint, and will now be accountable only for providing the correct coordinates to the weapon. This change in accountability is fundamental, and must shape the process by which target DPIs are calculated and approved. The accidental JDAM bombing of the Chinese Embassy in Belgrade was a vivid example of the importance of DPI control. Will a commander be confident ordering a strike, in an area where collateral damage is a concern, when the person responsible for the accuracy of the attack works for a large national agency on the other side of the world? If the answer to this question is not an unqualified yes, then relying on a reachback DPI-generation capability for rapid targeting is a waste of assets; one which would effectively prevent all-weather rapid targeting. The person generating or approving the DPI must have expertise and access to a system such as the Joint Targeting Workstation. It is clear that such a crucial position to the rapid targeting mission should not be filled on an ad hoc basis. Like the aircrews who deliver the weapons, the personnel who generate precision aimpoints should undergo formal upgrade and continuation training, and be certified as 'mission ready'. If rapid precision targeting is to become a viable operational capability, then accountability concerns strongly support treating the RTC and AOC as a weapon system. This concept for future AOC operations was one of the primary lessons emerging from the AWOS.[10]

Even the seemingly straightforward task of disseminating DPIs to the appropriate attack resources may pose a significant hurdle. Anyone who has ever tried to communicate with a distant command post or AWACS, using a secure radio inside a noisy cockpit, knows that this

method of DPI dissemination would be risky. Simply transmitting DPIs from one agency to another always includes a risk of corruption. During a US Navy Fleet Battle Experiment focusing on GPS-guided weapon employment, 14% of the DPIs published in the ATO were incorrect due to transcription errors.[11]

Other tactical details concerned with striking the target must also be determined and communicated to the 'shooter' platform. These would include such key items as ingress/egress and target area threats, mission and strike coordination with other components and assets, and weaponeering details. The threat environment will dictate whether or not a minimum-time tasking, such as an airborne re-tasking or an alert-type launch, is acceptable. Emerging targets in high threat areas will call for stand-off systems, such as JSOW, ATACMS, and ERGM.

From the above discussion it is clear that command and control must be exercised over the rapid targeting process. Four portions of the rapid targeting process will call for decisions from the responsible commander. The first is a decision to divert ISR resources from collection tasks to support a promising rapid targeting opportunity. If multiple opportunities are present, and targeting cell analysis or strike assets are scarce, then the commander must prioritize the targets, either by JTCB direction or clearly understood commander's intent. It is at this point that coordination with the land component's Battlefield Coordination Detachment (BCD) becomes very important. The BCD should be fully engaged in efforts against mobile targets, particularly tactical ground units. Once a target has been prioritized, planning and analysis for the attack must be accomplished as described above, and then a final approval for the strike must be made. This is the point at which combat forces will be tasked or re-tasked. If pre-strike monitoring reveals deterioration in the strike conditions, then the commander must decide whether or not to abort the attack. All four of these decisions need not be handled at the RTC commander level.

With its integral battle management capabilities, JSTARS could coordinate the detection, identification and monitoring TA tasks, and associated decisions, leaving the RTC to concentrate on planning and execution against targets passed to them.

Possible enemy countermeasures must also be considered. An opponent intent on creating a collateral damage incident might present a lucrative target, and then move civilians into the area once strike assets were inbound. Monitoring of the target area would be vital in this case. Enemy use of GPS jammers is another consideration. A 1 kW jammer could disrupt standard military GPS receivers within a 60 km range. Use of adaptive antennas and cancellation software improves anti-jam capability significantly, but simply increasing jammer power can degrade such high-tech countermeasures.[12] Suppression or destruction of GPS jammers may be required before GPS-guided weapons can be employed with confidence, adding another layer of complexity to the rapid targeting process.

The rapid targeting mission takes place entirely within the execution cycle of the ATO planning and execution cycle. Targets that will be fixed for a long enough period to be included in the 48-hour target prioritization and planning process should continue to be included in the ATO. If sufficient assets are available, they may be tasked in the ATO to specifically stand alert for rapid tasking. Otherwise, ATO-tasked assets will need to be re-tasked to strike the emerging target. This may present an armament challenge; to match the weapons and platforms required for the rapid attack with assets available for re-tasking. As the number of distinct and useful munition types continues to increase, this task will become more difficult.

Operation Allied Force demonstrated a need for improved ISR collection management, to ensure that these assets are used optimally to support the joint commanders. A management plan for efficient intelligence collection is no longer sufficient; ISR platforms must be horizontally

integrated, and able to transition to rapid targeting support in a timely and responsive manner.[13] Availability and use of theater ISR assets should be folded into the JFACC's overall air campaign plan, in support of the JFC's objectives. If rapid precision targeting is a priority capability for the JFC and JFACC, then sufficient ISR and strike assets must be available to the rapid targeting cell commander and staff. Priority and timely access is the third critical link for the rapid precision targeting mission.

Attack Resources

The third necessary component for rapid, precision attacks is the delivery platform or system. Whereas the level of complexity and effort to accomplish rapid, precision targeting is increased for the TA and C2 components, it is decreased in many ways for the 'shooter'. The primary benefits of using GPS-guided weapons for rapid strikes are simplified all-weather weapon delivery, and a dramatic reduction of real-time imagery required by the attack platform for mission planning or execution. Use of GPS-guided weapons would eliminate target acquisition difficulties, like those encountered over Kosovo. The reduced task workload would allow crews to concentrate on the other challenges of the all-weather, rapid targeting mission, namely flexible execution in poor weather conditions.

Removing the requirement for pre-mission imagery, or complex delivery of imagery into the cockpit, will significantly reduce the time required to execute an attack. The attacker only requires the DPI, time on target, and any weapon or employment information which is critical to proper weapon function. An example of the latter would be a terminal heading for a JSOW to enable it to glide into a valley without impacting surrounding terrain. Threat information for the ingress/egress and target area would also be needed, in areas where the threat is substantial.

The absence of imagery requirements presents substantial benefits in coalition warfare. Imagery products are frequently the focus of classification and distribution conflicts, commonly known as 'stovepiping'. They are also very large data files, which are slow to transmit through overburdened communications networks. Use of GPS-guided weapons solves both the classification and communications problems. Several NATO nations are participating in the F-16 Mid-Life Update (MLU) program, equipping their F-16A aircraft with avionics which bring them to a level equal to, and in many cases above, USAF F-16CJ aircraft. The ongoing update includes capabilities for GPS-guided weapons.

GPS-guided weapons do possess drawbacks. They may be ill suited for many other missions for which a fighter-type aircraft might be tasked. As an example, the JSOW and JDAM interfaces for the F-16CJ were designed for pre-planned employment from medium or high altitude. Employment of JSOW in a dynamic, low altitude Close Air Support mission would be difficult, making the JSOW-equipped F-16 a poor choice for airborne re-tasking. Along these lines, it is important to recall that current GPS-guided weapons cannot track or compensate for target movement, another shortfall in many situations. AOC commanders and RTC planners must realize that these new, high technology weapons cannot necessarily provide the same capabilities as older, 'legacy' weapons. Current and planned upgrades to LGB or TV-guided weapons, such as the AGM-130 and GBU-15, may bridge this problem by providing weapons with both a visual and all-weather precision capability.[14] The problem with such weapons, naturally, is cost. Finally, all-weather attack provides no Battle Damage Assessment (BDA) capability. The aircrew or delivery platform receives no video signal or feedback from the weapon, unless they observe the impact visually or with onboard sensors. This will certainly add to the difficulties in assessing rapid strikes, however it should not be a limitation on using these

weapons. Emerging targets, by their nature, will rarely present re-strike opportunities. In the quest to quantify our objectives in measurable terms, we mustn't forget that a successful attack without timely BDA is better than no attack at all.

Aircrew training for this mission would likely be specialized, but very similar to pre-planned attacks with GPS-guided munitions. Integration with a RTC or an AOC would be an important component. Tactically, such re-tasking missions would be fluid, emphasizing flexibility during ingress, target area weapon delivery, and egress. For airborne re-taskings, aircrew will need to be able to fight into a target area without detailed route planning or asset coordination. Organic suppression of enemy air defenses (SEAD) capability, air-to-air capabilities, and situational awareness information will be very valuable to the rapid, precision targeting mission.

Notes

[1] Joint Publication 0-2, *Unified Action Armed Forces*, February 1995, I-3-4.

[2] OSD, "Task Force on Kosovo Operations", 6,13.

[3] Joint Publication 3-55, *Doctrine for Reconnaissance, Surveillance, and Target Acquisition Support for Joint Operations (RSTA)*, 14 April 1993, IV-3-6.

[4] Lt Cdr Gene H. Edwards III, "GPS Guided Munitions and Precision Engagement: Do National and Theater Agencies Fully Support the Joint Forces Commander?" (Newport, RI: Naval War College, 13 February 1998), 7-8.

[5] John D. Morrocco, "PGM Strategy Faces Budget, Technical Traps," *Aviation Week and Space Technology*, 27 February 1995, 46.

[6] Joint Publication 2-03, *Joint Tactics, Techniques, and Procedures for Geospatial Information and Services Support to Joint Operations*, 31 March 1999, I-2-3.

[7] OSD, "Task Force on Kosovo Operations", 11.

[8] USNI Military Database

[9] OSD, "Task Force on Kosovo Operations", 26.

[10] USAFE/SA, *AWOS Initial Report*, ix.

[11] Edwards, 10-13.

[12] Stanley B. Alterman, "GPS Dependence: A Fragile Vision for US Battlefield Dominance," *Journal of Electronic Defense*, September 1995, 54.

[13] USAFE/SA, *AWOS Initial Report*, 41.

[14] Tirpak, 27-28.

Part 5

Recommendations

Summary of Recommended Employment Method

Theater Requirements

First and foremost, the rapid targeting mission must fit within the political context of the conflict. Tight political restraints on target validation and approval will directly impact the effectiveness of rapid targeting operations. Rapid targeting must also be required by the JFC and JFACC to support the overall JTF and air campaign objectives. The dedication of significant joint assets and effort to the rapid targeting mission must be balanced against other campaign objectives. Formal prioritization for rapid targeting operations will ensure precedence to re-task ISR assets, swinging them from collection to rapid targeting support on a real-time basis, and assign combat assets to attack the emerging targets. A RTC should be formed, and given authority to coordinate and execute immediate operations against target sets that have been pre-approved by the JFC or JTCB. The decision cycle time for these rapid operations must be highly compressed. The RTC should be a distinct team, able to coordinate rapidly and efficiently with the Combat Operations division of the AOC, as well as the component and coalition liaison elements.

Target Acquisition

An array of sensor capabilities and data must be available to the RTC for the TA tasks of target detection, identification, geo-location, assessment, and monitoring. Each task is a necessary component for rapid targeting, and multiple sensors may be needed at different times to accomplish them all. The ability to cross-cue between sensors will help minimize the time required to shift new sensors and acquire the emerging target. The all-weather capability of GPS-guided munitions requires that the sensors providing TA are all-weather as well. If any of the TA tasks cannot be accomplished in adverse weather conditions, or if the data from all-weather ISR assets is not available to the RTC in real or near-real time, then rapid attacks will be hindered or impossible. An all-weather TA capability is one of the critical links for the rapid targeting mission.

Command and Control

The commander tasked with responsibility for RTC operations will be charged with converting the JFC and JFACC intent into all-weather, precision strikes on targets critical to the overall campaign. Rapid targeting will require active command and control rather then managed execution. Each rapid targeting cycle will contain at least four key decision points: whether ISR assets should be re-tasked to evaluate a detected target, if attack planning and assessment is justified for an identified target, final approval for the planned attack, and whether to abort the attack if conditions change.

The RTC and command elements are responsible for the three remaining critical links that make rapid, all-weather targeting feasible. These critical links are priority and procedures for re-tasking of ISR assets to support rapid targeting, fast and accurate generation and dissemination of DPIs, and RTC accountability for the combat effects of the attack.

Rapid targeting operations must have sufficient priority to warrant quick-reaction shifting of ISR assets from collection to real-time targeting support. The procedures and communications connectivity required to get pertinent TA data from the ISR platforms to the RTC, in a timely manner, must also be in place. A detailed collection management plan, which integrates theater intelligence collection, pre-planned operations, and rapid targeting operations, is vital to providing a framework for efficient ISR asset usage in support of rapid, all-weather targeting.

The RTC must have a capability to quickly produce and confirm the mensurated coordinates required for GPS-guided munitions. This capability may be directly available to the RTC, or it may be realized through reachback to a distributed center or national agency. Once determined, the DPI coordinates must be transmitted to the firing platform using procedures which will minimize or eliminate errors, as the aircrew will have little to no capability to confirm the presence or identity of a target at the DPI. The commander responsible for approving the rapid targeting missions must be completely satisfied with the DPI production and dissemination process. This is essential, because the RTC will assume primary responsibility and accountability for the combat effects of the attack. This shift in accountability, from the aircrew traditionally responsible for target identification to the RTC team, who generated the DPI, is the most revolutionary aspect of the rapid, all-weather targeting process.

Attack Resources

Use of GPS-guided weapons offers significant advantages to the 'shooter' platform, particularly aircraft. For aircrews, all-weather targeting offers a simplified workload during employment, which in turn facilitates the demanding quick-reaction mission. The weapon itself accomplishes the difficult tasks of target acquisition and accurate weapon delivery. Timely imagery products are no longer needed by the aircrew, a DPI and time-on-target are the essential

data requirements for executing the attack. The rapid, all-weather targeting mission will require great flexibility in execution, particularly if inflight re-tasking is used. In such cases, the capability to pass updated threat information directly into the cockpit will be highly desired.

Specific Areas Required for Improvement

Areas which require improvement before a viable all-weather, rapid targeting capability can be employed are broken into three areas: organizational structure, technology, and training issues.

Organizational Structure

The primary change in organizational structure should be the creation of a permanent RTC within the AOC. The cell personnel must be experienced and knowledgeable about access to, and employment of, the widely varied joint ISR and strike assets. The operation and efficiency of the RTC should increase if the AOC itself is staffed and trained as a weapon system. The cell will have direct accountability for rapid combat force application, and must consist of trained personnel who are certified as mission ready.

Technology

Technology is what enables rapid, all-weather targeting, and there are four areas in which technological improvements should be focused. The critical link of all-weather sensor capability for the five TA tasks is the first area. Generation and dissemination of DPIs to the attack platforms is the second area, and another critical link. Additionally, the strike timing, weaponeering details, and threat situation must be transmitted to the aircrews in a clear and timely fashion. Technology that provides the fluid battlespace picture to the front-line warfighters themselves, and not just the command-level in the AOC, is essential.

GPS-guided weapons are not the sole answer to rapid targeting needs. For attacks against moving targets, or in fluid situations, LGBs or non-precision 'legacy' bombs are the weapons of choice. Precision weapons with multiple guidance methods, such as the EGBU-15, should provide greater flexibility in attacking emerging targets, and represent another area for focused technological advances.

Training

Joint training will be the key to success for future rapid, precision targeting capabilities. The C2 complexities involved in ISR integration and prioritization, coordination, and efficient use of joint attack resources will not be solved on an ad hoc basis. An AOC and RTC, manned and trained as a weapon system, must train in a joint or coalition environment, just like it will fight. Like any new concept, rapid precision targeting will likely need considerable refinement and improvements. Joint exercises will pave the way for improved doctrine and procedures for tasking joint systems such as ATACMS or ERGM. Determining the proper balance and use of rapid targeting assets in peacetime will prevent uncoordinated or wasted effort in wartime.

Conclusion

GPS-guided weapons offer a tremendous capability to strike the enemy in all weather conditions, with precision and speed. Most of the necessary components for rapid, precision targeting are already available; it is now a matter of linking them and exercising them regularly to make this an operationally successful strategy. If we choose to pursue it, the capability to conduct rapid reaction, all-weather attacks can become a reality.

Appendix A

Example Scenarios

Scenario 1, Scud Hunt

The enemy troops hurry to remove the camouflage from the Scud transporter erector launcher (TEL) nestled against a building on the outskirts of town. Stratus clouds cover the night sky, a solid deck extending from 7,000 to 20,000 feet in altitude. The Scud commander instinctively hopes that the darkness and weather will hide his planned launch preparations from the ever-present coalition aircraft. Other traffic is moving out of the town now, and he hopes to mingle in with it to travel to the launch point, meet the supply vehicles, accomplish a rapid launch, and then move to a concealed location.

Aboard JSTARS, the nightly traffic is detected by the moving target indicator radar system, and displayed to the battle managers. There is a lot of vehicular movement tonight, possibly an attempt to screen the movement of Scuds, which the JFC and JFACC have prioritized as critical targets. Based on intelligence estimates, the JSTARS battle manager chooses one section of road to concentrate on, and requests Predator coverage to help identify the vehicles. A Predator is specifically tasked tonight to support Scud hunting operations, and flies towards the area underneath the cloud deck. The JSTARS manager cues the Predator to a series of promising targets that have moved off of the main road, getting identifications from the UAV operators and imagery specialists. One is the now-stationary Scud TEL and its supply vehicles. The Predator

operator quickly confirms the identification to the JSTARS, which in turn relays the target to the RTC in the CAOC.

Checking the real-time video imagery from the Predator, the CAOC director tasks the RTC to plan and execute an immediate strike. The coalition is sensitive to collateral damage concerns, and the Predator is tasked to quickly conduct an assessment of the target area. The RTC targeting officer uses the Joint Targeting Workstation to calculate a DPI and TLE for the Scud's location. Another officer assesses the threat and assets available; ATACMS is not within range, the F-15E's airborne are loaded with conventional LGBs, but there is a flight of F-16CJ aircraft enroute to perform area SEAD for that region. The flight is equipped with a mix of High Speed Anti-Radiation Missiles (HARMs) and JSOW. Weaponeering for the JSOWs is quickly accomplished, and provides a JSOW employment heading that will miss the hills surrounding the Scud. Armed with the target DPI and TLE, area assessment, threat update, and choice of desired assets and weapons, the RTC team quickly briefs the CAOC director and gains strike approval.

The attack orders, DPI, JSOW employment heading, and threat update are passed to the F-16CJ flight. The time-on-target is as soon as possible. The flight remains above the cloud deck and accelerates to the flight manual airspeed limits. The flight lead orders the number 2 pilot, carrying the two JSOWs, to release near the JSOWs minimum computed range, to minimize glide time. The remaining three aircraft maintain air-to-air and SEAD searches. Inside the CAOC, the RTC is monitoring the threat area for changes; using video from the Predator that has been positioned well clear of the attack axis.

The Scud commander is anxious as the pre-launch servicing is completed. Soon, the missile will be launched, and the coalition aircraft will converge to try to find them as they race for their hiding location. Operating under strict emission control procedures, he is unaware of the current

enemy air situation. He suddenly hears the disquieting sound of jets high overhead. As the sound begins to fade, he focuses again on the upcoming launch. The crack of the opening JSOW dispenser surprises them all, and there is no time to react before the sub-munitions detonate, and the fully-fueled Scud and its TEL is destroyed.

Scenario 2, Timed Chokepoint Interdiction

The leader of a special operations forces (SOF) deep surveillance team surveys the valley below him. A road winds through the valley, linking two areas of enemy territory. The high mountains on both sides of the valley block the line-of-sight to orbiting coalition ISR platforms, and the SOF team is positioned to collect intelligence on enemy movements, and act as a targeting element if required. Low visibility and rain are slowing enemy travel along the damaged road, particularly at a sharp bend tucked up against the mountainside. The SOF team has already identified this location as a chokepoint for possible attack.

A report comes in from another observation post; a mobile SA-10 SAM radar vehicle has been spotted moving up the valley. It will be at the chokepoint in approximately 20 minutes. It is a large vehicle, and the SOF team leader realizes that it will take some time to maneuver past the sharp bend. He passes the report along.

The special operations liaison element (SOLE) within the AOC passes the target intelligence to the RTC. The SA-10 is a high priority target. If the SA-10 repositions through the valley it will be in a position to threaten coalition ISR platform orbits, and overall ISR coverage will be effected. The CAOC director, in coordination with the SOLE, decides to pursue the attack opportunity. The RTC targeting officer checks the theater DPI database and notes that a DPI for the chokepoint was already calculated by a distributed intelligence center. The SOLE confirms

that the target area is clear of civilians, and will be able to relay when the target is at the chokepoint, as well as any abort calls from the SOF team.

The RTC team re-confirms the accuracy of the DPI, and examines attack opportunities. The surrounding terrain will make attack with ATACMS or JSOW difficult. The TLE for the DPI is very low, raising the possibility of using JDAMs. A B-1 flight is airborne and carrying JDAM, but the fluid nature of the situation will require holding for appropriate timing, in an area of medium threat. A flight of USN F/A-18s on the way to another target is also available, and is chosen for re-tasking. The naval and amphibious liaison element (NALE) coordinates to pass the attack orders, DPI, and JDAM weaponeering details to the flight. The F/A-18 flight takes up a holding orbit outside the target area, above the low hanging clouds. Armed also with HARMs, the F/A-18s can defend themselves against other enemy SAM systems. The signal comes through shortly thereafter that the SA-10 is at the chokepoint. The Hornets begin their run, and drop 4 JDAMs onto the coordinates for the road bend. The SOF team provides the report later; SA-10 destroyed.

Glossary

Abbreviations and acronyms:

ABCCC	Airborne Command and Control Center
AGM	Air-to-Ground Missile
AOC	Air Operations Center
ATO	Air Tasking Order
ATACMS	Army Tactical Missile System
AWACS	Airborne Warning and Control System
AWOS	Air War for Serbia
BCD	Battlefield Coordination Detachment
BDA	Battle Damage Assessment
CAOC	Combined Air Operations Center
CEP	Circular Error Probable
CONUS	Continental United States
C2	Command and Control
DPI	Desired Point of Impact
EGBU	Enhanced Guided Bomb Unit
ERGM	Extended Range Guided Munition
FLIR	Forward-Looking Infra-Red
GPS	Global Positioning System
HARM	High Speed Anti-Radiation Missile
HUMINT	Human Intelligence
ISR	Intelligence, Surveillance, Reconnaissance
JDAM	Joint Direct Attack Munition
JFACC	Joint Force Air Component Commander
JFC	Joint Force Commander
JSOW	Joint Standoff Weapon
JSTARS	Joint Surveillance Target Attack Radar System
JTCB	Joint Targeting Coordination Board

JTF	Joint Task Force
JTW	Joint Targeting Workstation
kW	Kilowatt
km	Kilometer
LGB	Laser Guided Bomb
MLU	Mid-Life Update
NALE	Naval and Amphibious Liaison Element
NATO	North Atlantic Treaty Organization
PGM	Precision Guided Munition
SEAD	Suppression of Enemy Air Defenses
SFW	Sensor Fuzed Weapon
SOF	Special Operations Forces
SOLE	Special Operations Liaison Element
RTC	Rapid Targeting Cell
SAM	Surface-to-Air Missile
SAR	Synthetic Aperture Radar
SEAD	Suppression of Enemy Air Defenses
TA	Target Acquisition
TEL	Transporter Erector Launcher
TLE	Target Location Error
UAV	Unmanned Aerial Vehicle
USAF	United States Air Force
USN	United States Navy

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