

The goal is to put weapons on time sensitive targets in “single-digit” minutes.

Compressing the Kill Chain

By Adam J. Hebert, Senior Editor

THE Air Force wants to be able to strike mobile and emerging targets in fewer than 10 minutes so that such targets will have no sanctuary from US airpower.

Cutting the time needed to strike such targets, known as time critical or time sensitive targets, has been one of Chief of Staff Gen. John P. Jumper’s top priorities. It factored into the decisions to arm Predator unmanned aerial vehicles with Army Hellfire missiles and to establish a high-level warfighting integration office at the Pentagon. Three years ago, while still commander of Air Combat Command, Jumper raised the bar for destruction of emerging targets when he said, “I would challenge us to do it in single-digit minutes.”

The need to act quickly is proven and may be growing.

In the Persian Gulf War, Air Force and Navy pilots were frustrated in attempts to destroy mobile Scud launchers before the vehicles fired



USAF photos by MSGt. Dave Nolan



USAF crews check an F-15E (here and at left) armed with precision weapons before it launches for a mission during Operation Enduring Freedom in Afghanistan.

their missiles. US aircraft had an extremely small window of opportunity to destroy the missiles on the ground, and allied aircraft were unable to take advantage of that limited opening. The time it took to locate the launchers simply exceeded the time it took for the Iraqis to “shoot and scoot.” This failure stood in stark contrast to the success US aircraft had in destroying fixed targets with new precision weapons.

In the years since, the Air Force’s arsenal of laser- and satellite-guided weapons has expanded, making fixed targets highly vulnerable. Consequently, adversaries have taken a page from Saddam Hussein’s Gulf War playbook and attempted to conceal targets or keep them on the move, under the assumption that anything in the open is vulnerable. When not in action, Serb tanks hid under trees during Operation Allied Force in Serbia, and al Qaeda and Taliban forces hid in caves during Operation Enduring Freedom in Afghanistan.

Because enemies have learned to limit the amount of time they and their weapons are in sight and thus vulnerable, these mobile targets require a different approach. The Air Force must compress its six-stage target cycle of Find, Fix, Track, Target, Engage, and Assess, also known as F2T2EA, or, more simply, the “kill chain.” The service has been working to field systems and techniques that yield a vast improvement in effectiveness.

Time can be cut from each of the six stages in the kill chain, as well as from the “seams” between stages.

Gains in Precision Engagement

Through recent operations, USAF has gained experience in this area. Officials say there have been many successful attacks on time sensitive targets during Operations Northern and Southern Watch over Iraq, Allied Force over Serbia and Kosovo, and Enduring Freedom in Afghanistan.

Though attacking such targets is not easy, those who claim it’s im-

possible “would be pretty short-sighted,” said Maj. Gen. Daniel P. Leaf, USAF director of operational capability requirements.

He acknowledged that emerging targets are “a challenge at night—and ... even more of a challenge when there is significant weather between you and the target.” However, the proliferation of satellite-guided Joint Direct Attack Munitions and other all-weather precision munitions means such targets are no longer vulnerable only in daylight.

Precision weapons are much more common today than they were in 1991, allowing a greater number of aircraft to hit targets that require exact placement. JDAM, the Air Force’s current weapon of choice, did not exist during the Gulf War and could be used only with the B-2 stealth bomber during Operation Allied Force in 1999. Today, JDAMs are available to a wider range of combat aircraft and have been shown in experiments to be capable of destroying targets on the move.

Officials report that USAF needs to improve JDAMs and other coordinate-seeking weapons that use Global Positioning System satellites for guidance. Because GPS-guided weapons need precise aim points for accuracy, the processing times can be too long for the bombs to be of use against fleeting targets.

Can GPS-aided weapons hit time critical targets in fewer than 10 minutes? “Absolutely,” Leaf said. “What’s



USAF photo by TSgt. Michael Ammons

Joint Direct Attack Munitions, such as on this F-16, and other new precision weapons increasingly are being used to attack fleeting targets and helping to reduce time in the target cycle, or kill chain.

key to that is eliminating time that is administrative in nature.”

Machine to Machine

Leaf noted, “All that administrative data that we can [transmit from] machine to machine leaves the human in the loop free to do much more important things that the machines can’t do—like not get shot.” He called a high-quality data link “an exquisite efficiency.” It is a central feature in compression of the kill chain.

USAF has had a long-term plan to equip all its combat aircraft with a secure data link system that provides command and control information via a data communications network. Officials say it’s expensive to install and integrate the systems, but it will produce dramatic operational benefits:

- Increased target processing speed.
- Improved accuracy.
- Greater situational awareness.
- Reduced voice communications.

Even the rudimentary data link currently aboard Block 40 F-16s at Aviano AB, Italy, shows the marked advantages that such systems can offer, said Leaf, who commanded the 31st Fighter Wing at Aviano during Allied Force.

Shortly after Allied Force, Leaf participated in two training flights—one with RAF Harriers and the other with F-16s bearing an early data link system—that highlight the difference. The RAF pilots were qualified, combat-experienced pilots in a



Surveillance systems, such as this Global Hawk unmanned aerial vehicle, that can loiter over target areas and could be armed with weapons offer obvious benefits in striking pop-up targets.

capable weapons system, explained Leaf. However, he said, the training scenario, which called for putting bombs on an emerging target, was a “laborious process.”

Directing the pilots to the target required step-by-step communication. Leaf said the directions went like this: “Do you see this bridge or this building? Now move so many meters south.” It took the RAF pilots about 10 minutes just to acquire the target.

The F-16 training flight featured a similar scenario, but it had a very different result. Leaf said the F-16s had a rudimentary data link that pro-

vided the needed basics to engage the target, including heading and distance, elevation, description, and location. It took the F-16 pilots “less than a minute” to put “eyes on target” and attack, said Leaf.

The RAF pilots had to work down from “big to little,” while the F-16 pilots knew the exact information needed to begin their attack, he explained.

That difference—10 minutes vs. one minute—was a huge improvement, observed Leaf.

The Air Force already has equipped most of its F-15s with the Link-16 data link and F-16 Block 30 aircraft with the situation awareness data link. Officials said they expect to complete installation of the Link-16 system on all F-15s by the end of this year and then will proceed with F-16 Block 40 and Block 50 aircraft. Next up will be the service’s bombers, a few of which already have Link-16. Production versions of both the F/A-22 stealth fighter and the F-35 strike fighter will include Link-16 systems.

USAF’s long-range tactical data link roadmap calls for completing the upgrades, including those for special operations aircraft and some airlift and aerial refueling aircraft, by 2010. Currently the service has Link-16 as well as other data links on its large intelligence, surveillance, and reconnaissance aircraft—E-3 AWACS, E-8C Joint STARS, and RC-135 Rivet Joint.

USAF photo by SrA. Chris Flahive



During the Gulf War, Iraq fired Scud missiles from its mobile launchers and moved them to a new location before US aircraft could respond. Improvements in US weapons and tactics are limiting the ability to freely “shoot and scoot.”

Under current Pentagon plans, the other services also will upgrade their tactical aircraft with the Link-16 system.

That and seven other “precision engagement/time sensitive targeting” initiatives were recommended in a precision engagement study by the Defense Science Board. Last spring, Pentagon acquisition chief Edward C. Aldridge designated the Air Force as the executive agent to implement the eight initiatives. (See box “USAF Leads Precision Engagement Initiatives,” below.)

A key factor, though, is the target approval process itself, which

the Air Force has been working to speed up.

“That continues to be an area we have to emphasize as much as the technical solution,” said Leaf. Allied Force, which had more than a dozen nations voting on possible targets, was a nightmare in that regard. It took an average of 14 days for each target to be approved.

In a big war, Leaf said, the Air Force is “going to have to have as much as possible laid out ... before you head out the door” so that assets are properly assigned to a long list of possible targets.

If an aircraft is available for a quick

attack, and pilots are authorized to strike, timelines can be cut to near zero and tracking requirements kept to a minimum. “You can do it, but what’s key there?” Leaf asked. The answer, he said, is for the Air Force to have a “process in place to clear the targets [and] rules of engagement that say when we can employ.”

Working the Seams

Another avenue that will lead to compression of the kill chain entails eliminating what Jumper calls cultural “stovepipes” within the F2T2EA cycle. Stovepipes refers to specialized career fields, such as space, intelligence, surveillance, reconnaissance, and communications, that contribute data to the warfighter. Each career field has its own systems and methods of presenting the data.

Jumper has said the service must remove the barriers between “tribal representatives” to get the “cursor over the target.”

Having seams that data cannot flow freely across adds great amounts of time to the kill chain.

At its Joint Expeditionary Force Experiment last year, USAF tested a new program, called ISR manager, intended to collect and combine data from the various systems such as AWACS, Joint STARS, Rivet Joint, U-2 reconnaissance aircraft, unmanned aerial vehicles, the Navy’s EP-3, and national sensors. The ISR manager is a Web-based software program that creates for the joint forces commander a consolidated picture of the battlespace, based on inputs from all those systems. However, service officials said the program needed more work before it could be fielded.

The Air Force believes another system tested at JEFX—the experimental MC2A-X aircraft—will lead to a single-platform replacement for three of its present-day ISR aircraft: AWACS for air battle control, Joint STARS for ground target surveillance, and, possibly, Rivet Joint for signals intelligence. Air Force officials call the multisensor command and control aircraft a “critical enabler” in efforts to compress the kill chain. (See “Seeking a Triple Threat Sensor,” November 2002, p. 38.)

The single multimission platform, coupled with Air Force plans to install sensors aboard aerial refueling aircraft, would alleviate the now

USAF Leads Precision Engagement Initiatives

DOD appointed the Air Force as executive agent to oversee implementation of eight precision engagement initiatives proposed by the Defense Science Board. They are:

Small weapon with data link. Incorporate a data link into USAF’s 250-pound Small Diameter Bomb. Current plans call for a GPS variant, followed by a seeker variant. DSB recommends in Fiscal 2003 an assessment of a data link variant before initiating either variant.

GPS accuracy improvement. Advance implementation of USAF’s accuracy improvement initiative, which includes six additional ground segments plus a software change. Although GPS already performs better than its operational requirements specify, the initiative would provide more frequent satellite updates and could improve precision targeting by 20 to 30 percent.

Gridlock. Immediately develop the Gridlock system, which employs a common grid and automatic geo-registration process to speed and simplify precision targeting. Demonstrate the concept on the Predator UAV for motion and still imagery first, then transition to other sensor platforms, followed by strike platforms. The National Imagery and Mapping Agency has already started work on the system.

Digital point positioning database. Make a threefold increase in production rate of this NIMA product to get remaining cells to theater commanders within 1.5 years and maintain a three-year update cycle for the database. The image product provides warfighters the capability to discern latitude, longitude, and elevation quickly and accurately on digital workstations.

Tasking, processing, exploitation, and dissemination. Establish an integrated system for shared exploitation and fusion of target information by 2006. Each service plans to field distributed common ground stations that will serve as the foundation for this system. DSB recommends accelerating the pace of fielding for the Air Force by three years and for the Marine Corps by one year to meet the 2006 deadline.

Foliage penetration radar. Develop a sensor package for USAF’s Block 10 Global Hawk that would enable the UAV to find targets under cover and in trees. Dedicate funding to begin integration in 2004, with expected completion by 2007.

Ground moving target indication. Integrate a radar on USAF’s Block 10 Global Hawk that would enable the UAV to maintain a track on moving vehicles. Fund the program to accelerate it by at least two years, from 2009 to 2007. DSB noted a three-year advance might be possible.

Link-16. Deploy the secure Link-16 communications data link on all tactical platforms by 2010.



maintaining that track until you have assets available that can kill it," said Leaf.

Surveillance is of little value, however, without a shooter on hand to attack the fleeting target.

"If an airplane is 20 minutes away from a target, all the data links in the world are not going to make the kill chain nine minutes," Leaf observed. "I'm sorry. That's physics. There are laws that you can't repeal in that case."

That is one reason Jumper advocated putting weapons on UAVs in early 2001. The service successfully proved Predators could fire Hellfire missiles. Air Force officials are now able to match up images from a Predator with coordinates in less than a minute. Operators now can fire a

chronic shortage of airborne ISR platforms brought on by a sustained high operations tempo.

Last year, the Air Force created a new office to manage the efforts under way to provide seamless, integrated command, control, communications, computers, and ISR. The service established the position of deputy chief of staff for warfighting integration (XI), headed by Lt. Gen. Leslie F. Kenne.

When the office was announced, Jumper said, "I have explicitly charged the new AF/XI to close the seams in this kill chain by integrating manned, unmanned, and space systems, thereby enabling commanders to create desired effects in the battlespace."

The service also instituted a taskforce approach to develop requirements. (See "Seven Pillars of Airpower," June 2002, p. 42.) The aim is to find the best way to achieve warfighting results, instead of focusing on specific systems in isolation.

Jumper believes the service is "well on [its] way" toward breaking down the cultural niches.

In fact, the service already has demonstrated that eliminating the seams between platforms can produce big dividends. During Enduring Freedom in Afghanistan, the service put live feeds of intelligence data from Predator UAVs directly into AC-130 gunships. The gunship aircrews were able to gain situational awareness of the areas they were going to strike as they flew to the target. They were able to start firing



During Enduring Freedom in Afghanistan, USAF used a Predator UAV (top photo) to provide live feeds of intelligence data directly to an AC-130 gunship, enabling the crew to strike immediately. That type of time reduction in the targeting cycle improves the ability of US forces to strike fleeting targets, such as this SA-6 missile launcher destroyed in the Gulf War.

immediately instead of making a couple of preparatory passes. In the past, the intelligence data would have been filtered through analysts at an air operations center or even State-side before being sent to the field.

Through their ability to loiter over target areas for long periods, persistent surveillance platforms such as the Global Hawk and Predator UAVs have proved beneficial in the drive to shorten the kill chain. With mobile targets that can hide, "having a surveillance platform that can park overhead and stare until [the target] emerges again is of great value in

Hellfire missile in near real time. In Afghanistan, the US used armed Predators in several successful attacks.

The Air Force is pursuing hunter-killer UAVs and, in the future, larger unmanned combat air vehicles with greater weapons load capability to strike pop-up targets.

Ultimately, as Air Force Secretary James G. Roche has said, it will be networking the range of new systems from precision weapons to ISR platforms that will enable the service to reduce the F2T2EA kill chain to "timelines unimaginable just a few years ago." ■

USAF photo by SSgt. Guadalupe Hernandez