"F^2T^2EA" is shorthand for the operational goal the Air Force will pursue into the 21st century.

Find, Fix, Track, Target, Engage, Assess

By John A. Tirpak, Senior Editor

The Air Force is moving toward pervasive Intelligence, Surveillance, and Reconnaissance, meaning uninterrupted watching of areas of interest. The Global Hawk drone can stay high over a hot spot for 24 hours, its sensors glued to the target.

In October 1996, Gen. Ronald R. Fogleman, the Air Force Chief of Staff, appeared before an Air Force Association symposium, and there he issued an arresting statement. "In the first quarter of the 21st century," Fogleman declared, "it will become possible to find, fix or track, and target anything that moves on the surface of the Earth."

The comment was widely repeated. Over time, it became something of an unofficial Air Force slogan and later was amended to include "engage" and "assess," words describing action on a target and determination of the effects obtained. The statement—F^2T^2EA—proved to be both a prophecy and a challenge to Air Force budgeteers and technologists to focus on bringing about change.

As the Air Force readied a new vision statement—global vigilance, reach, and power—the service showed that, in a sense, Fogleman's prophecy had already come true. The full weight of US Intelligence, Surveillance, and Reconnaissance systems can be focused onto a particular area, and anything of significance within it can be found. The coordinates of the item in question or its vector can be determined and relayed to an aircraft ready to do something about it, according to current Chief of Staff Gen. Michael E. Ryan. This action would range from something as benign as humanitarian relief all the way up to

Staff photo by Guy Aceto

Satellites that provide imagery and electronic surveillance play a huge role in finding targets. The concept of reachback demands that they also be able to pass huge volumes of data back and forth from sensor to analyst to shooter.

delivery of a precision guided weapon. Afterward, USAF can determine the effect of its actions.

A Decade of Work?

However, Ryan and other senior Air Force leaders and thinkers maintain that the total realization of the "Find, Fix" concept will take at least another decade. It will also require the networking and linking together of all the military's sensor and intelligence systems as well as the transfer of many of them from airplanes to satellites.

Gen. John P. Jumper, head of Air Combat Command, said that F^2T^2EA should be "our bumper sticker ... going into this century." USAF's performance in the Balkans last year, he added, "verifies all of that," and "it describes what I think we ought to be aiming for."

Jumper said the Balkans operation showed that the tools USAF needed to meet the Find, Fix challenge already have been fielded (see box, p. 29) and that the task that now confronts the Air Force is to connect its myriad sensors, develop an automatic means of judging what the sensors find out, and streamline the steps needed to act on the information.

"Technologically, I don't think there are any miracles required," Jumper said. "There is ... more capability than we think now and less to do to make the rest of it come true than we think is necessary."

Find

In Jumper's view, the key element is "find"—the act of rapidly locating targets. "It's where we're working the hardest, and that's in this real-time business," he said.

During Allied Force, he noted, U-2s en route to reconnaissance targets in Kosovo could be redirected to scan a different hot spot. The imagery they collected was beamed back to Beale AFB, Calif., for analysis and forwarded electronically to the Combined Air Operations Center in Vicenza, Italy. There, a decision on whether to strike a newly found target could be made and data about it passed to aircraft orbiting near the target area.

Such a process could sometimes be run through in as little as 12 minutes, but Jumper told an AFA symposium in February that the goal is "single-digit minutes" from the scan order to bombs on target.

Jumper pointed out that this procedure is "not something we practice enough in peacetime" but that "we are going to make that, now, a mainstay of our tactical planning and execution."

USAF photo by SSgt. John E. Lasky

U-2s flying over the Balkans could be switched to new reconnaissance targets en route. Rapid retargeting will be crucial to finding and destroying deadly pop-up targets such as mobile ballistic and surface-to-air missiles.

Brig. Gen. David A. Deptula was, until recently, the commander of Operation Northern Watch and is the author of seminal Air Force monographs on parallel warfare and strategic control. He declined to give any specifics about how he employed the Find, Fix concept in retaliatory strikes against Iraq for transgressions of the no-fly rules. However, he did say, "We can bring [ISR] resources to bear to do very well in a particular area. Now, the challenge is to broaden that specialized capability and make it the norm, not the exception."

Ryan said advancing technology is adding greater depth to ISR capabilities. He observed that today's sensors operate in many different wavelengths and frequencies. Soon, however, the Air Force will be able to "meld" them together and, in a few years, develop computer algorithms that "merge the information in a way that things just leap out at you."

Ryan went on to say, "If you could take a satellite photograph, meld it with an Elint [electronic intelligence] hit, meld it with a Predator video, put that on top of a multispectral, high-altitude flyover with a SAR [Synthetic Aperture Radar] picture, ... that would enable you to see" the true nature of what's on the ground. It would eliminate—or at least drastically reduce—the identification problem, added the Chief.

Ryan explained that the technology focus for the Air Force right now is to obtain that networking capability. The Link 16 data-sharing system and Joint Tactical Information Distribution System are projects "we have been talking about ... for years," said Ryan. "It's now time for JTIDS to get on our aircraft in a big way, ... so we can do something about what we find out there."

Ryan has Air Force Research Laboratory working "very heavily" on what are called "multispectral capabilities"—the capacity of a system small enough to fit on a fighter aircraft or even on a missile to see in many different frequencies at once and automatically determine what it's looking at. He calls this initiative TUT, for Things Under Trees.

Such technologies are classified but almost certainly involve varying types of imaging infrared and millimeter wave, extremely high frequency radars that can distinguish between wood and metal or between an empty fuel storage tank and a full one, for example. Ryan said such systems will allow operators to "see tanks whether they're camouflaged or not. And I think we're not too far from that."

Fix or Track

The term "fix" means making an accurate determination of location. The fix portion of what is sometimes called the "kill chain" can be conducted in a number of ways. Items of interest can be imaged and the pictures compared with earlier images, which include landmarks whose location is precisely known. This permits the establishment of a precise geo-location of a given target. In a featureless environment such as a desert, an aircraft or ground troop can help establish position through use of Global Positioning System satellites.

The Air Force has opened a big push to equip nearly all of its ground-attack weapons with GPS capability, so precise target coordinates are essential. Laser designators wielded by launch aircraft, Unmanned Aerial Vehicles in the area, or ground troops can target for laser-guided bombs.

Air Combat Command officials said they have a concept of operations on how to approach the Find, Fix requirement. One official said the notional term for the strategy is "Wolfpack ISR." He explained, "We like the term Wolfpack ISR because we think it describes that process pretty well. ... You've got a lot of wolves out there hounding the target. A lot of times the alpha wolf is going to go in and make the kill, but he's working collaboratively with all the other wolves ... to keep on top of the target until they can do something about it."

Target

At ACC, officials are working to develop a function, called "time-critical targeting," which would be a key element of the Air Operations Center. Intelligence analysts in this area would be charged with finding and directing strike aircraft against pop-up targets such as Scud missile launchers and mobile surface-to-air missile launchers, an ACC official said.

These analysts will be equipped with "predictive tools" that can help them anticipate where the targets will pop up, and with other tools to quickly task whatever sensor is best positioned to investigate them.

An initial operational capability for the time-critical targeting capability is planned for the fall of 2002, but initial versions of the software will be put into wargames at Nellis AFB, Nev., this summer, an ACC official said. There, this software will become part of a new Dynamic Battle Control Center. The center is designed to help train decision-makers to deal with air employment issues that are

USAF photo by MSgt. Steven M. Turner

The synergy between manned and unmanned aircraft—like this A-10 and Predator drone—was demonstrated in the Balkans and will be a hallmark of things to come. ACC envisions wolfpack tactics, hounding the target until the kill.

larger than simply "managing the Air Tasking Order." As tricks and lessons are learned, the software will be constantly upgraded in a "spiral" fashion.

"We're not where we want to be in terms of time-critical targeting, yet," said Deptula, a veteran combat operator who is heading Air Force preparations for the next Quadrennial Defense Review.

In Northern Watch, explained Deptula, he was favored with "flexible and adaptable" rules of engagement which did not demand tit-for-tat strikes against specific offending radar sites; he could, rather, strike targets that could be viewed as part of a generalized Iraqi military capability.

Jumper admonished commanders not to confuse process with product. "In the ISR world ... we paid most homage to the collection process," said the general. "That collection process turned out not to be very agile when we tried to shift it into the targeting cycle, especially the rapid targeting cycle."

He went on, "We will have conquered this problem when we understand that no target ever died in the collection process. It only dies in the targeting process. We don't pop the cork when the image arrives. We pop the cork when the target is dead."

An ACC official involved in time-critical targeting said he believes it will take until around 2010 to get to the Fogleman goal. However, he said, "We're putting some pieces together now" that will bring the Air Force much closer to achieving Find, Fix capability in "the next couple of years."

He said that the effort will continue "to shave minutes off the process."

Engage

"The engagement piece has always been our strong suit," Jumper asserted. "Our tactical proficiency is unmatched. If we know where the target is, we have things that will get that target." He said USAF has the means to "pluck that [a target in the center of a city] out fairly well," and "we're getting better at the deeply buried stuff," such as command bunkers and other facilities underground.

Jumper wants to turn the Air Operations Center into a weapon system in its own right and believes it will be the key element in the Find, Fix concept. "It's the ability to bring decision-quality data before decision-makers," he said.

He noted that air component commanders today have a situation roughly analogous to fighter pilots of the 1960s: They have many different sensors giving them information about the threats around them but have to synthesize that knowledge in their heads to come up with a plan of action.

A future AOC, Jumper envisions, will pull together sensor data from many different platforms, overlay it, and create a comprehensive digital picture of the battlespace where every threat is clearly visible and the commander can focus on how best to use his forces and coordinate with others.

A computer program will "get you to the 90th percentile of certainty" about the best way to package forces, which weapons to use, and how, when, and where to orchestrate refuelings and other types of missions, Jumper asserted. It will then query the planner with the question, "Do you want to do this or not?"

When the joint forces air component commander arrives in the morning, said Jumper, "he punches 'enter' on the computer, and he watches the whole thing [the aircraft in the ATO] fly out in 10-times speed. ... He is now making decisions on the efficiency of the force, on the effectiveness of the force, instead of hearing a verbal description of a plan that [he] can't visualize."

DoD photo

Pop the cork: This Serb tank was caught in the open and destroyed. For harder targets—what Ryan calls "Things Under Trees"—multispectral sensors will be used to create cockpit and AOC displays in which concealed items pop out.

Jumper pointed out, "Not all targets are things that you kill. Some of them ... are targets that you save," and the "engage" portion of the Fogleman catchphrase may mean delivering rations to stranded refugees as easily as it might mean putting precision ordnance on a tank.

The ACC concept is heavy on joint prosecution of time-critical targets, since every minute counts.

"Time-critical targeting is a joint mission area," the ACC official said. "No one component is going to own everything. We're going to have to work collaboratively ... and within a coalition in some cases ... to do this effectively."

All that counts, he said, is finding the fastest, most reliable way to kill the target. He added that there are only a certain number of truly time-critical targets in a theater, but, as the capability is developed, it may later expand and thus permit greater across-the-board flexibility.

"We're going to start with the most important targets," the official explained. "Our initial instinct is, we're not going to try to eat the whole elephant" at once but consume it "one leg at time."

Assess

Jumper acknowledged that assessment, seeing if the desired results have been achieved, requires more knowledgeable analysis.

Unmanned Aerial Vehicles and the nose-mounted cameras on many

new munitions have greatly added to the assessment piece of the chain, a USAF weapons expert explained.

"The process of finding out if you got what you were going after starts when the tape goes fuzzy," he said, referring to the moment of impact recorded on videotapes of imagery relayed back from optically guided munitions or from aircraft gun cameras.

"You look at the tape and you can see, first, if you were in the right ballpark and then if you hit the right bleacher in that ballpark." In the case of laser-guided bombs, which are guided by a cursor on a video display, the explosion itself is recorded. Having that information to start with can speed the process of tasking satellites, manned reconnaissance airplanes, or UAVs to look for the damage done and help commanders decide if the target is dead or must be restruck, the expert said.

In the case of UAVs orbiting nearby, the target assessment can sometimes be made in real time, thus vastly shortening the time required to decide on whether a restrike is necessary.

Subsequent imagery is examined to determine whether there is any activity at the site, whether there were secondary explosions, or whether key structures were collapsed. In the case of bunkers, tapes and images are scrutinized to see if the explosion vented from an air shaft.

The assessment process can be extensive. In Allied Force, a full count of Serb armored vehicles and artillery destroyed by NATO aircraft required on-site visits from experts to determine whether an actual vehicle or decoy was struck and whether damaged hulks had been dragged away by the Serbs.

A greater number of satellites or sensor platforms with "longer dwell time" over the target area would drastically reduce such ambiguity, an ACC official said.

Extreme Vigilance

Deptula noted that today's systems, such as the E-3 Airborne Warning and Control System aircraft and the E-8 Joint STARS radar aircraft, yield only "transitory" depth of knowledge and only in a designated place and time. Still on the horizon is what he calls "pervasive ISR" that would keep watch over large parts of the world—even "quiet" spots—and automatically note changes in activity that should be brought to the attention of decision-makers.

"I'm a big advocate of working toward ... pervasive ISR," said Deptula. "Generally, we focus our ISR assets on the basis of other intelligence directing us" to watch a particular area of interest. "We focus them [ISR assets], and we observe and we try to detect and track." The better approach, he said, would be "to have the capability to observe all the time, and identify patterns of routine, and then if there is ... a deviation from the routine, then we focus on that difference. ... So you're not out there searching for information; you have the information already. It now becomes an analysis challenge."

Such a global-watch capability would be "well into the future" but is exactly the "kind of system and capability we need to be planning to obtain." He added that such a 24-hours-a-day, watching-all-the-time requirement "very quickly takes you to a space-based system."

The Discoverer II program, for example, is an effort to develop a space-based radar capable of spotting moving targets on the ground. It would be like having a space-based Joint STARS but with the ability to remain on station indefinitely.

Secretary of the Air Force F. Whitten Peters, at a recent Pentagon briefing, said, "We will never build enough JSTARS" to observe all the things that regional commanders in chief need to keep watch over.

Deptula said it's too early to estimate costs, but his guess is that "if you took the entire lifetime program cost of AWACS and JSTARS, Rivet Joint, EP-3s, Guardrails, and all the joint airborne reconnaissance and surveillance systems that we have out there, a space-based system would ultimately be more cost-effective."

Resisting Temptation

Some critics have warned that the development of increasing detail in ISR information will tempt decision-makers at highest levels to indulge in micromanagement of a future war. Ryan said he is "not worried" about that happening. "I don't see that" as a future problem, he said. Rather, better information will simply "give them better insight, ... better granularity of information about what's really going on. ... I think this is for the better."

Jumper contended that the torrent of detail that will become available in a few years "begs for enough automation" to quickly answer the questions of greatest concern to political leaders. These systems would automatically assess issues such as potential for collateral damage, the ratio of risk to reward, and the like.

Jumper envisions political leaders agonizing less over targets and having

Staff photo by Guy Aceto

Joint STARS detects moving targets on the ground in an area the size of south-ern Iraq. All regional commanders want one, but there are never enough to go around. Space-based versions could sharply reduce the expeditionary footprint.

Staff photo by Guy Aceto

Constant upgrades have kept AWACS an indispensable element of any air operation for more than 20 years. Merging the AWACS, Joint STARS, U-2, and UAV data through sensor fusion promises unprecedented situation awareness.

fewer unanswered questions about the pros and cons of any particular mission. With less delay in convincing leaders that a target is worthwhile, the battle plan can be more quickly and logically executed, he said.

It is vital, Jumper said, for political leaders to have their questions answered before missions are planned and launched, to avoid situations where strike packages already en route to their targets must be recalled or broken up. This happened on a number of occasions in Allied Force.

"We need to minimize turbulence at the engaged-force level," Jumper said. Missions were carefully timed and sequenced to ensure that everyone in the striking force had "the best possible chance of survival." The veto of a target at the 11th hour "causes an enormous amount of anxiety ... and introduces a dynamic that every military person understands and seeks to avoid." The scrubbed target, for example, might have been first in a chain of targets to be hit and sparing it could expose later strikers to a threat they'd planned on being destroyed.

Jumper asserted that commanders "have to be persuasive" with political leaders "and draw red lines and boundaries" around missions already under way to prevent the "tactical level interference" that could disrupt a planned mission.

Conversely, Jumper does not believe that an abundance of detailed information will make field commanders dependent on it and unwilling to act without it. Airmen are "trained to deal with uncertainty," he noted, in everything from weather and defenses to communications, so "uncertainty is a way of life."

"I don't think we'll ever have perfect information," Ryan observed, noting there will always be "some question about whether you ought to go or not go, move now, or wait." Moreover, he said, "What we must be careful of is that we don't have corrupted information" due to computer attacks or other information warfare. "All commanders should have a fair amount of skepticism about the data they get," he added.

Such tension has always been a part of warfare, he said, and he does not anticipate that the availability of many kinds of data will hamstring commanders always wanting one more piece of assurance. ▪

A Survey of Today's ISR Platforms

E-3C Airborne Warning and Control System (AWACS): Can keep track of hundreds of aircraft flying in an area equivalent to the New York City–Boston air traffic control region.

E-8C Joint Surveillance Target Attack Radar System (Joint STARS): A joint program with the Army that provides detection of moving and stationary targets on the ground in an area as large as southern Iraq, as well as slow-moving rotary and fixed-wing aircraft and theater missile defense targets.

EA-6B: A joint Navy–Air Force electronic warfare aircraft that not only can jam enemy radars but can collect information about their location and operating parameters.

EP-3: A Navy P-3 Orion specially modified to collect electronic intelligence.

RC-12 Guardrail: An Army turboprop aircraft configured for collecting battlefield electronic and communications intelligence.

RC-135 Rivet Joint: Collects electronic intelligence on an adversary's radars, communications, and other systems.

RQ-1A Predator: An Unmanned Aerial Vehicle remotely piloted at medium altitudes to obtain detailed video imagery of enemy vehicles. At least one Predator was modified during Operation Allied Force to carry a laser target designator.

RQ-4A Global Hawk: Now in development, Global Hawk is a large UAV that will be able to provide image collection while maintaining station over an area of interest for many hours at a time.

Satellites: Several classified spacecraft can provide detailed imagery, in many wavelengths, of ground targets. The Lacrosse satellite, for example, can generate detailed images of the ground through cloud cover with its Synthetic Aperture Radar.

U-2: An Air Force high-flying reconnaissance aircraft that collects digital imagery in several wavelengths. The imagery can be transmitted to the aircraft's home base of Beale AFB, Calif., and analyzed while the mission is still under way.