Reactive Targeting
Firefinder and AFATDS in the Digitized Division

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New capabilities in the Field Artillery's advanced FA tactical data system (AFATDS) and Firefinder radars mandate a shift in traditional reactive targeting tactics, techniques and procedures (TTP). While the fundamental doctrine of the *decide, detect, deliver* and *assess* (D^3A) targeting methodology established by *FM 6-20-10 TTP for the Targeting Process* remains sound, hardware and software fielding have added new dimensions.

With the AFATDS' new capabilities come additional responsibilities for the fire support elements (FSEs) and fire control elements (FCEs) to articulate and design the guidance and geometry to prioritize missions to meet the commander's intent. The targeting officer, counterfire officer and radar section must be able to support rapid reactive targeting by simplifying radar zone management.

This article discusses how the radar system works, how changes in technology are affecting radar zone management and the TTP adopted to maximize the counterfire system of systems in the 4th Infantry Division (Mechanized), Fort Hood, Texas.

Firefinder Primer. First, we need a common understanding of how Firefinder works and interacts with different fire control computers. Firefinder acquires incoming projectiles, determines their origin, extrapolates the point of impact and reports these acquisitions to the operator *whether or not they violate a zone*. If the acquisition violates an established zone, the radar sends a fire mission to the supported FCE using an FM;CFF (fire mission; call-for-fire) message format. If the acquisition does not violate an established zone, the radar generates an intelligence report using the ATI;CDR (artillery targeting intelligence; coordinates report) format.

Location Averaging. The Firefinder is limited to 99 acquisitions in the buffer, and there was early concern that it literally could be overwhelmed with acquisitions. Based on this, Firefinder includes a location-averaging function that can be activated by the radar operator.

With location averaging enabled, the Firefinder computer averages all detections from a 238-meter radius and converts that into a single average grid in the center (see Figure 1). The 238-meter criterion is a standard that can't be adjusted by the operator. With location

SGT Daniel Ledesman, 161st Target Acquisition Battery, Kansas Army National Guard, operates a Q-36 Firefinder radar in Bosnia.

averaging, Firefinder can "generate" a target that is more than 200 meters away from the actual acquisition.

Auto-Censoring. Firefinder also has an auto-censoring function that allows the operator to screen acquisitions from a particular area once the threshold is set and reached. Auto censoring prevents tracking the same weapon numerous times. When the function is enabled, the radar ignores acquisitions that originate from the same location (500 meters) after the designated number of tracks are detected (two to 16).

Once the number of tracks are detected, all subsequent acquisitions from the designated area are ignored. The auto-censoring function can lead to a "blind-spot" because the radar will ignore any additional targets that originate from that area.

Both these methods significantly reduce the volume of missions generated by Firefinder and decrease target location accuracy and situational awareness.

Four Zones to Prioritize Acquisitions. The Firefinder uses four zones and can handle a maximum of nine active zones at any time. Traditionally, the counterfire officer establishes multiple zones to prioritize calls-for-fire for legacy systems. These four zones were designed to prioritize acquisitions sent to legacy systems; specifically the tactical fire direction system (TACFIRE) that is no longer in the force, ballistic computer system (BCS), fire direction system (FDS) and initial fire support automated system (IFSAS). The four zones are as follows.

1. Critical Friendly Zone (CFZ). When the radar's computer predicts an enemy round will impact in a CFZ, the computer reports the location of the weapon that fired in precedence ahead of all other detections. Because the legacy fire control systems prioritized missions based on message format, any location of a weapon firing into a CFZ would result in a priority "immediate" call-for-fire (FM;CFF).

2. Call-for-Fire Zone (CFFZ). In legacy systems, a target identified in a CFFZ generates a FM;CFF Priority 2 message.

3. Artillery Target Intelligence Zone (ATIZ). Any weapons acquired in this zone are reported to legacy systems ahead of all target detections, except CFZ and CFFZ; the detections only result in a target report (ATI;CDR).

The ATI;CDR message also is the default format for Firefinder. Any acquisition that does not violate a zone is reported to the supported artillery unit in this format. The message provides the counterfire officer or the intelligence officer (S2) intelligence on the enemy artillery's location and activities.

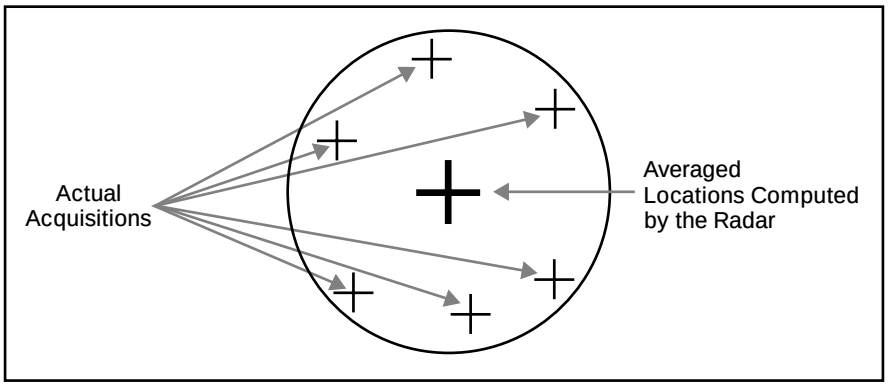

Figure 1: Location Averaging in Firefinder. When location averaging is turned on, the radar averages all detections from the same 238-meter radius into one single grid location. This prevents overloading the radar's storage queue with acquisitions from the same location but can "generate" a target more than 200 meters away from the actual acquisition.

4. Censor Zone (CZ). A CZ prevents the radar computer from generating acquisition solutions.

AFATDS Primer. Prioritization based on multiple zones was a technique well suited for legacy digital systems, but it is not ideal for managing reactive counterfire with AFATDS. The important distinction between AFATDS and IFSAS is that AFATDS prioritizes targets based on *mission value* while legacy systems, such as IFSAS, use a *message-based* priority system. Using IFSAS, an FM;CFF message has priority over an ATI; CDR. AFATDS does not recognize the character in the message header that distinguishes the ATI;CDR message from the FM; CFF message as IFSAS does. AFATDS uses the target information contained in each message to calculate a mission value, which becomes the basis for multiple automated processes and, ultimately, prioritization.

As division and brigade planners develop courses-of-action (COAs), AFATDS determines the components of mission value and other criteria for mission processing and automated decision making, using the commander's guidance, the high-payoff target list (HPTL), priority of fires and location of the target (AFATDS uses target area of interest, or TAI). These are all products of the military decision-making process (MDMP) and D^3A methodology. These traditional *decide* targeting products provide the data the AFATDS operator needs to generate the desired mission-value prioritization.

Each target type, subtype and category on the HPTL receives a unique value and enables AFATDS to calculate the mission value. While the entries in AFATDS are pretty straight forward, AFATDS employs a substantial amount of analysis and "art" to establish the mission values to ensure the recommended solutions meet the commander's intent. During mission processing, AFATDS derives mission values from the entries shown in Figure 2.

- **Target Type Value.** This value is based on the target value in the target management matrix (TMM) for non-high-payoff targets (non-HPTs) on the high-value target (HVT) list.
- **Associated Target Area of Interest (TAI) Value**. The TAI value is based on the TAI, if any, that encloses the target. If the target is in multiple TAIs, the TAI with the highest ranked value in the mission-prioritized guidance is used.
- **Associated Priority-of-Fires (POF) Value.** This is based on the observer's identification, the observer's supported unit identification or the unit that sent the mission to the local operational facility (OPFAC). If more than one of these units are in the POF guidance, then the unit with the highest ranked POF is used in the calculation.
- **On-Call Value.** This value is based on whether or not the mission was initiated off the on-call target list.

Figure 2: AFATDS Database Settings for Mission Analysis. Each category of the database is weighted and factored into an AFATDS formula that determines the target value.

AFATDS has additional features that streamline the counterfire process. AFATDS can degrade targets over time. This target decay time helps manage any backlog in processing.

Much like a shot clock, a unique time setting can be established for each target type so missions against highly mobile targets will "time-out" if they aren't processed quickly enough to have a high probability of effects. The decay time is determined for each target type during the MDMP and is a component of the digital attack guidance matrix (DAGM). An example of a DAGM is shown in Figure 3.

AFATDS also can employ fire support rules that further refine the tactical fire control solution. These rules can be used to designate targets located in defined areas (TAIs) or target types for attack by specific fire units.

Unit leaders and the counterfire team now can develop TTP that capitalize on the software and user interface advances in AFATDS, as well as improvements in the Firefinder software.

Reactive Targeting TTP. As we developed our TTP, we based them on four considerations. First, the value of the target, not the value of the message format, is the basis for target priority Second, managing multiple small zones is inefficient; it can interrupt acquisition processing. Third, we want to kill all enemy artillery capable of influencing our area of operations. Last, we want to automate as many of the decisions as possible using AFATDS.

Additionally, we considered the enemy has spread out his artillery, so we planned to fire at individual pieces. Our multiple-launch rocket system (MLRS) and cannons, to some extent, can fire accurately at several discrete locations simultaneously. If we set the standard fire orders and mission value criteria correctly, we can rapidly engage multiple targets and allow AFATDS to automatically process acquisitions according to the criteria.

One Large Zone. With these considerations in mind, we established one ATIZ. (Because the default in the radar is ATIZ, this is the equivalent of having no zone.) The ATIZ covers the entire battlespace forward of the coordinated fire line (CFL) within the supported headquarters boundaries. (See Figure 4.) Previously, multiple CFFZs were established over suspected enemy locations and manipulated during the fight to maintain the proper message-based priority. Now, all acquisitions are processed as ATI;CDR messages and sent to AFATDS.

	IHF (OPLAN 01-02) Security Zone		AFATDS TMM Data	Attack System Preference (Shooter Unit) AFATDS FA Attack Preference						TSS Max TLE (M)	TSS Max Report Age (Min)	Min #	Activity	Remarks IEW, Coordination Required, Exclusion, TBA, etc
	High-Payoff Target Descriptions	AFATDS Target Type		DS/R	GS	ATACMS	Atk Hel	CAS	EW					
ADA	ADA (AFATDS HVTL Data: D/A/100)													
	SA-11 (FireDome, Snow Drift, Tube Arm)	ADA,Missile	A/D/100/Y	3	1	2				50	20	3	Stationary	ADA and associated radars protecting fire direction artillery/ maneuver ASAS target; type is: ADAMSL, RDRAS, ADAL, RDRFC, RDRGDN, SAM
	SA-8 (Land Roll, Flat Face)	ADA,Missile	A/D/98/Y	3	1	2				50	20	3	Stationary	
	SA-13 (Hot Box)	ADA,Missile	A/D/96/Y	2	1					50	20	3	Stationary	
	Crotale	ADA,Missile	A/D/99/Y	3	1	2				50	20	3	Stationary	
	Rolland (Thompson-CSF)	ADA, Light	A/D/95/Y	3	1	2				50	20	1	Stationary	
	Rapier (Marconi)	ADA, Missile	A/D/97/Y	3	1	2				50	20	3	Stationary	
Fire Support	Fire Support (AFATDS HVTL Data: D/A/96)													
	WM-80 (273-mm)	Missile, Hvy	A/D/100/Y	5	1	4	3	2		50	15	1	Stationary	
	9A52 (300-mm)	Missile, Hvy	A/D/99/Y	5	1	4	3	2		50	15	1	Stationary	
	Arty UNK	Arty, UNK	A/D/98/Y	2	1	5	4	3		50	15	3	Stationary	
	Mortar UNK	Mortar UNK	A/D/97/Y	1	2		4	3		50	15	3	Stationary	
	2S7 (203)	Arty, Hvy SP	A/D/96/Y	4	1		3	2		50	15	5	Stationary	
	BM-11, -21 (122-mm)	Missile Med	A/D/95/Y	4	1		3	2		50	15	2	Stationary	
	G-5 (155-mm)	Arty, Towed	A/D/94/Y	4	1		3	2		50	15	10	Stationary	
	G-6 (155-mm)	Arty, Med SP	A/D/93/Y	4	1		3	2		50	15	2	Stationary	
	GCT/AU-F1 (155-mm)	Arty, Med SP	A/D/92/Y	4	1		4	2		50	15	2	Stationary	
	BL904 (Type 704)	Counterbattery Radar	A/D/91/Y	4	1	3	5	2		100	30	1	Stationary	
Engineer	Engineer (AFATDS HVTL Data: D/A/86)													
	GMZ Mineclearer	Armor, Light	A/D/100/Y	3	1			2		50	60	30	Stationary	
	UMZ Minelayer	Armor, Light	A/D/99/Y	3	1			2		50	60	30	Stationary	
	PMR-3 Trailer Minelayer	Armor, Light	A/D/98/Y	3	1			2		50	60	30	Stationary	
	BAT M Dozer	Armor, Light	A/D/97/Y	3	1			2		50	60	30	Stationary	
	BTM Dozer	Armor, Light	A/D/95/Y	3	1			2		50	60	30	Stationary	
	MDK-2 Tank Ditcher	Armor, Light	A/D/96/Y	3	1			2		50	60	30	Stationary	

Legend:

ADA = Air Defense Artillery
AFATDS = Advanced FA Tactical Data System
AGM = Attack Guidance Matrix
ASAS = All-Source Analysis System
ATACMS = Army Tactical Missile System
CAS = Close Air Support
DS/R = Direct Support/Reinforcing
EW = Electronic Warfare
GS = General Support
HPT = High-Payoff Target
HVTL = High-Value Target List
IEW = Intelligence and Electronic Warfare
IHF = Ironhorse Fighter
SP = Self Propelled
TLE = Target Location Error
TMM = Target Management Matrix
TSS = Target Selection Standards
UN = Unknown

Figure 3: Appendix 5 (Digital HPT/AGM) to Annex D (Fire Support) to OPLAN 01-01 (Ironhorse Destroyer). The HPTs are rank ordered by category based on the AFATDS HVTL data; the categories include ADA; Fire Support; Engineer; Maneuver; Command and Control; Nuclear, Biological and Chemical (NBC); Reconnaissance, Surveillance and Target Acquisition (RSTA); and Combat Service Support (CSS).

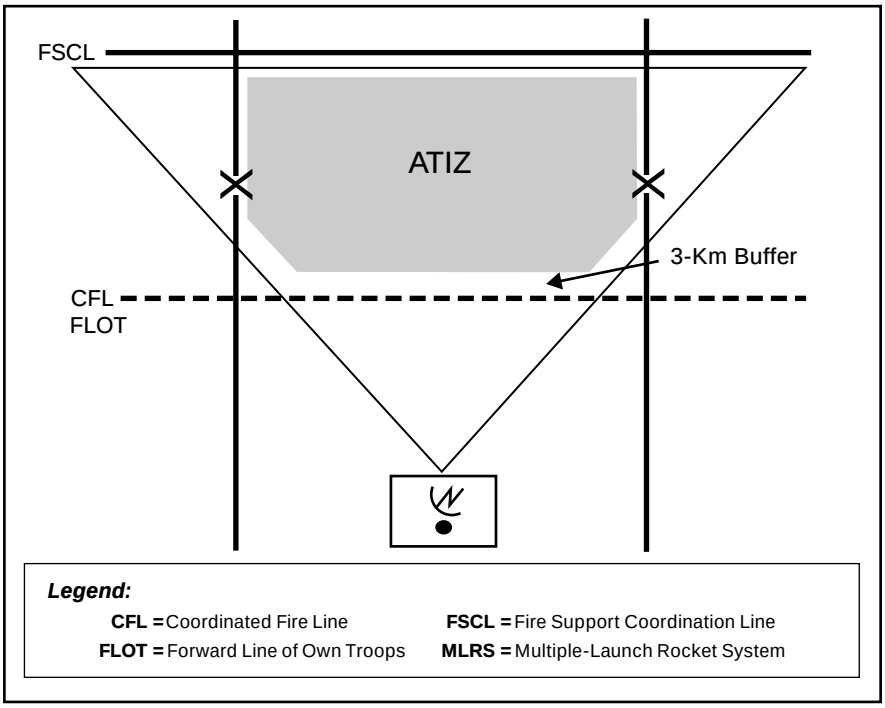

Figure 4: One Large Artillery Target Intelligence Zone (ATIZ). The three-kilometer buffer zone facilitates clearance of fires. MLRS has a two-kilometer surface danger zone, and the three-kilometer buffer ensures all acquisitions will be clear of the CFL.

AFATDS checks the acquisitions against the fire support coordination measures (FSCM) and uses its DAGM to determine the correct method of attack. If the target description is loaded in AFATDS as a HPTL, AFATDS generates a target and sends the fire mission directly to the firing unit without user intervention. The clearance of fires and focus of fires decisions are made in advance. One major advantage of the ATI;CDR format is it indicates the points of origin and impact of enemy fires, enabling AFATDS to generate red vectors on its battlefield displays showing the enemy shooters' locations and his targets.

Recognizing the need to focus friendly fires when the enemy concentrates his resources, we can build TAIs in AFATDS to generate mission values and prioritize the missions in the ATIZ much the same way as for CFFZs. The key is that we maximize AFATDS by using its digital analysis of target data to determine mission values rather than using the priority value of the message format to generate calls-for-fire.

There are several benefits to using one large ATIZ. Foremost, the AFATDS screen displaying the ATIZ points of origin and impact of enemy fires allows the fire support coordinator (FSCOORD) to show the maneuver commander precisely where the enemy is focusing fires, thereby telegraphing his intent. Further, one zone simplifies zone management for the counterfire officer, brigade targeting officer and radar section. It maximizes AFATDS digital mission prioritization and saves time, allowing the targeting officer more time to perform other duties, such as targeting with the unmanned aerial vehicle (UAV) or tracking the battle with the joint surveillance and target attack radar system (JSTARS).

As we fight the counterfire battle, we use our counterfire acquisitions to cue other sensors, such as the UAV. The battalion or division artillery S2 receives a "copy" of acquisitions from AFATDS on his all-source analysis system (ASAS) in an ATI;ATR (artillery target intelligence; artillery target report) format. Using the newest version of the Army tactical command and control system (ATCCS), Version 6.2x, the S2 refines templated artillery groups and develops a counterfire overlay that is "shared out" to other ATCCS systems across the division.

The brigade targeting officer and the division FA intelligence officer (FAIO) use the counterfire overlay to orient sensors to look for artillery groups acquired by Firefinder radars. Sensors, such as the UAV, can assess battle damage and conduct proactive targeting.

Conclusion. As the Army moves toward full digitization, we must carefully assess our technology-based TTP and ensure they keep pace with the advantages of new capabilities.

The radar's mission to acquire hostile artillery systems hasn't changed; our ability to process its acquisitions has become more efficient by relying on AFATDS. By using one large ATIZ and maximizing the automated features of AFATDS, we can streamline the counterfire process. These TTP give our targeting officers the opportunity to aggressively cross-cue detection systems as well as manage simplified zones.

By integrating reactive and proactive fires, we maintain constant pressure on the enemy and our situational dominance, taking the fight to the enemy and making the 4th Infantry Division more efficient and lethal.

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