The Transformation of Land Warfare:
An Operational Perspective for Engineers

Remarks for the 47th Annual Tri-service Radar Symposium

Paul F. Gorman, General, U.S. Army (Retired)

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I am a retired infantryman who spent three years of his adult life in combat. I am bereft of any credentials that would enable me to contribute technically to this conference, but I accepted your invitation for two reasons: First, I hope that I can present an operational perspective useful to your proceedings. Second, this conference is something of a return to my youth, for I may very well be the most ancient of the radar technicians in this room.

Let me ask for a show of hands. Who remembers the Navy's Eddy Program of World War II? Well, the rest of you should know that Admiral Eddy concocted a scheme to recruit a corps of technically promising young sailors to operate and to maintain the radars that were then being proliferated within the fleet. Exactly 56 years ago this month, in May 1945, I was sworn into the U.S. Navy as a Radar Technician, Seaman 1st Class, and sent to Boot Camp at Great Lakes, Illinois. The war in Europe was all but over, but the invasion of Japan was imminent, and the Navy needed radar technicians badly enough to offer early promotion and schooling, and to promise a ship-board billet well removed from chipping paint and swabbing decks.

The nuclear attacks on Japan in August 1945 transformed the world, the U.S. armed services, and my naval career. The Peter Principle asserted itself, and I rose rapidly to a position of full responsibility for the cleanliness, resupply and 1st echelon maintenance of a 32 commode head on the 5th deck of the Fargo Building in South Boston. I never laid a hand on a Navy radar —which was probably all to the good of the war effort.

Realizing that prospects for upward mobility equaled a shot at a larger head on the deck above, I sought and obtained a chance to compete for an appointment to West Point that led to an honorable discharge from the Navy, a brief sojourn with the 52-20 Club, and entry into the Military Academy with the Class of 1950. As a cadet I found new aptitudes, and wandered away from technology into arts, letters, and eventually infantry. Frankly, I would be more comfortable addressing a convocation of historians, or even novelists.

Nonetheless, here we are, and I shall now subject you to my lecture on the basic verities of Land Warfare so that you can better consider how electronic sensors can assist its transformation.

The year is 1962, the place the Pentagon, the issue of the day whether the Army should adopt the 22 caliber rifle now known as the M-16. I was at the time one of the know-it-all majors serving on the Army staff under a superb mentor, Lt. General Harold K. Johnson,

then the Deputy Chief of Staff for Operations. One day the General assembled a number of us majors in his office, and produced the rifle at the center of the ongoing controversy.

"What is the purpose of this mechanism?" he asked, handing the weapon to one of my colleagues. The latter spouted without hesitation the Field Manual's statement of the mission of Infantry: "To close with and destroy the enemy."

Johnson shook his head sadly, passed the rifle to the next officer, and repeated the question. The response was slower, more tentative: "To kill with?" Again the gray head signaled negative, and again the rifle was passed. He was likewise dismayed with "For discriminate, pin-point accurate elimination of an adversary," and other variations on the same theme. I don't remember what I said, but remember clearly that I too flunked.

Finally the General taught us a lesson I have never forgotten: "The U.S. Army does not exist for killing," he said. "That principle was laid down by Abraham Lincoln when he approved War Department General Order Number 100, dated 24 April 1863, subject: *Instructions for the Government of Armies of the United States in the Field.* Article 68 of that order stated unequivocally that 'modern wars are not internecine wars, in which the killing of the enemy is the object. The destruction of the enemy in modern war, and indeed, modern war itself, are means to obtain that object of the belligerent which lies beyond the war.' This rifle – like any of the Army's weapons-- exists to enable movement. By maneuver, thus facilitated, the Army establishes control over territory and the people therein. With such control, the United States can achieve its objective beyond the battles."

You should know that General Orders Number 100 lives on in the consciousness of the Army today as it operates in the Balkans to prevent renewed aggression and ethnic cleansing. You should understand that, for land warfare, sensors and the situational understanding that they enable are essential for discriminate use of firepower, and are vital for territorial control.

I serve as a member of the Senior Advisory Group for Future Combat Systems, a science and technology program being jointly pursued by the Army and DARPA. Two years ago, in the spring of 1999, Lieutenant General Paul Kern and Frank Fernandez, Director of DARPA, convened the FCS SAG to explore ways to transform the Army to meet strategic, operational, and tactical exigencies foreseen for the period 2010-2020. The SAG had among its members two former Directors of DARPA, three prominent members of the Defense Science Board and the Army Science Board, and four retired generals, including General Al Gray, former Commandant of the U.S. Marine Corps, and General Glen Otis, U.S. Army who is considered to be father of the M-1 tank. The first question we confronted was "why should the U.S. seek to transform the best Army in the world?" Glen Otis gave one answer, as follows:

> ***In 1999 the tank stands in military affairs in the position occupied in 1939 by the horse. The task we face is no less daunting than that confronting the advocates of armor in the '20s and '30s. Force designers and technologists on***

both sides in World War II had decades to grope for means to restore tactical and operational maneuver for land forces. We [the FCS SAG] have only two months to find a developmental path for enhancing tactical and operational maneuver while enabling worldwide strategic maneuver.

The SAG eventually formulated three purposes for FCS: first, to deter: to require would-be aggressors to calculate that the U.S. could suddenly enter any theater of war with a sea-land-air Joint Force when and where it chooses, and mass effects such as optempo, fires, and maneuver to dominate and ultimately to win decisively; second, to control territory and population, to forestall or redress aggression, to separate combatants, to establish peace and the rule of law, and to conduct humanitarian operations; third, to secure bases on land for sea and air components of the Joint Force.

The SAG observed that air and sea forces will always be necessary to exert American power, but that these will often be insufficient. To the degree that national purposes include the three just mentioned, to that degree would sustained employment of land forces be required. We quoted T.R. Fehrenbach's statement in his book on the Korean War: *...you may fly over a land forever, you may bomb it, pulverize it, wipe it clean of life – but if you desire to defend it, protect it, and keep it for civilization, you must do this on the ground, the way the Roman legions did, by putting your young men into the mud...*

When the SAG reported the results of our study, we urged that the Army undertake to develop an early-entry force with enhanced combat capability, built for strategic mobility exploiting all available air and sea lift, and to adopt a concept of operations based on sensor-informed collaboration. We urged that experiments be conducted that would lead to choices among technologies and operational concepts not later than 2005. These recommendations were accepted, and the Army and DARPA launched a concerted program to actualize FCS. You are aware, I am sure, that four large industry teams are now competitively designing the system of systems within guidelines that component subsystems must fit within the weight and volume capacity of the C-130 aircraft.

But what may not have come to your attention is that sensors, and radars in particular, are pivotal sub-systems of FCS. The SAG stated repetitively the central elements of FCS must be robust communications integrated with means for intelligence, reconnaissance, surveillance, target acquisition, and assured situation awareness of both friendly and enemy forces.

FCS posits a broad transformation of Army doctrine, organization, materiel, logistics, and training. It is true that FCS seeks a new generation of more fuel-efficient and mission-capable ground and air platforms, and extended-range, precision weapons to expand the so-called "red zone" close battle. But more importantly, FCS would replace the "trickle down" concepts underlying current systems for reconnaissance, surveillance, and target acquisition with a layered architecture predicated upon self-sufficiency in sensors for each echelon of command. Even the foremost combatants will be advantaged not only by information from "higher," but also equipped to generate actionable intelligence within its own battle space expressly to eliminate latency in fires, and to enable synchronized

maneuver. FCS also aims to reverse the allocation of bandwidth within land forces, which today is generous at higher echelons of command, but is miserly for units engaged in close battle. Robotics, using that term to embrace aerial as well as ground-based unmanned systems, will play a major role in RSTA.

What this entails is a pervasive, redundant, radar environment in the zone of close combat. I see the FCS units capable of constant stare at its battle space, detecting changes, and to some degree interpreting them. I believe that necessitates supplementing fly-through aircraft with constellations of hovering or loitering platforms. I envision the FCS commander engaged in close combat maneuvering his sensors in the way he would today position his fire support and maneuver elements —sending sensors on unmanned vehicles to search out at close range what may be hidden from higher or rearward echelons. I envision that combatant commander's carrying an interactive display upon which there would be continuously displayed to him the real-time output from his sensors, overlaid upon terrain data, and upon a plot of the opposing forces. I see FCS sensors capable of generating high-definition terrain elevation data for spots or strips within his battle space, DTED to facilitate sensor management and maneuver of manned and unmanned elements of his force. I envision radars that are as important to him for communications as they are for RSTA, and as important to him for tracking the location of friendly forces as they may be for detecting and locating hostiles. I see radars that interact with his internetted unattended ground sensors, and with on-soldier sensors that monitor medical status. Hence, I see sensors contributing not only to the lethality of FCS, but also to its survivability.

Many among you are understandingly skeptical. Some can adduce, I am sure, examples of less elegant systems that took a decade or more to develop, and cost many millions of dollars more than the Army is likely to be able to spend. Others may believe that infantry and armor-trained commanders would be swamped by the information I postulate.

But listen: aside from Moore's Law and associated phenomena, the Army has experience with the rudiments of FCS:

Remember SOTAS? That program involved staring radar hung on helicopters. When the SOTAS prototypes were deployed to NATO for the annual fall maneuver in the late '70s, I happened to be in charge of the controllers for the exercise, so I learned a good deal about the system and its capabilities. For example, I learned that divisional TOCs -- Tactical Operations Centers -- were very easy to locate because of the radial pattern of vehicles and helicopters generated when the commander gathered his subordinates for the canonical morning and afternoon briefings. SOTAS taught me that TOC stands for "target of choice" and led me to break up the command post of the 8th Infantry Division into small cells, interconnected with camera-like millimeter wave radios capable of transmitting full color, streaming video with the cells separated by up to five kilometers. I also eliminated the gatherings for briefings. That command post operated successfully for some eighteen months in that conformation. Today I advocate that FCS be TOC-less, with similar distributed staffs, and similar broad-band connectivity.

SOTAS was one of the forerunners of the Joint STARS E-8 program, which remains useful to higher echelon commanders. But FCS needs staring radars overhead to overcome the limitations imposed by JSTARS' look angle, its requirements for broad area coverage, and its understandable preoccupation with higher echelon mission priorities.

As this audience knows well, today's radars are smaller, lighter, and more discerning, and antennae are much improved. Moreover, DARPA is testing the A-160 robot rotorcraft that has a ceiling above twenty five thousand feet, a payload in excess of two hundred pounds, and an endurance of better than 24 hours. And the price appears to be such that every FCS battalion could have its own eye in the sky, and a radio relay as well!

Save your TOA, folks, SOTAS will fly again!

On the information overload issue, the Army has only recently embraced the digital revolution, and is only now becoming culturally attuned to commanding with computer-generated abstractions as opposed to those in grease pencil on acetate. Just fifteen years ago there was a big controversy at Fort Knox over plans to put position-locating devices aboard tanks, many tankers then believing that it was enough to follow your leader's tank. Subsequent experiments demonstrated conclusively that on-board positional information enabled faster maneuver and better use of terrain, whence greater survivability and increased lethality. Since, large-scale field experiments within the Army's digital division have proven conclusively that reliable information, well presented, is indeed a combat multiplier, and that wireless networks and on-board displays enable units to control more territory and to fight more effectively. In the most recent such event at Fort Irwin, second generation FLIR, UAVs, JSTARS and satellites displayed in each vehicle enabled 4th Division soldiers to act with sure knowledge of where they and their teammates were located, and where the OPFOR was as well. By and large, the information systems performed as expected. In the very first operation, two brigades of the 4th Infantry Division attacked the OPFOR in a blinding sandstorm and ended up controlling an area 60 kilometers in width — more than three times the width of the Fulda Gap sector that my 8th Infantry Division, with four brigades, was tasked by NATO to control in the late '70s. I have heard no complaints of information overload.

Some of you may have attended the symposium last October of the Precision Strike Association where the Army's PM for Combat Identification presented a paper describing experiments with downlinking raw data direct from a multisensor UAV to M1A1 tank crews. Output from MTI radar, cooperative friendly ID, and FLIR-based target recognition were provided to ascertain whether these data assisted or hindered maneuver and targeting. The experimental subjects were trained tankers of the Army National Guard; the crew commanders were sergeants or lieutenants. Trials with and without the MTI/cueing established that tankers were much more lethal when they could collaborate with the UAV. The time between an enemy vehicle coming into line of sight, and the tank gun's rotating to bear on the target was cut by over half, from 52 seconds to 24 seconds. With direct feed from a UAV, crews adopted more aggressive tactics: rather than waiting for the enemy to appear, they maneuvered to find a better firing location,

and thereby gained tactical advantages: they opened the engagements at ranges they chose, and thereby became both more lethal, and less vulnerable.

As I speak, experiments are underway at the Mounted Battlespace Battle Laboratory at Fort Knox with maneuver command from a moving vehicle by a three-man team, using all-source information feed, including direct down-link from GMTI radar aloft. I foresee a day when every small unit within FCS will have its own UAV, and its own sensors. Some of you may have seen the DARPA solicitation for the FCS Organic Air Vehicle. The program manager seeks a very small autonomous UAV designed to be launched from a ground vehicle for missions of up to one hour's duration carrying a multi-sensor RSTA payload out to ranges of up to 10 kilometers.

Ladies and gentlemen: every President of the United States has employed land forces to support his policies. The world is such that future Presidents will almost surely have cause to thank the far-sighted Americans, in uniform and out, who have supported the transformation of today's land forces and the fielding of Future Combat Systems. They need your interest, your support, and your engineering prowess.