United States Marine Corps
School of Advanced Warfighting
Marine Corps University
2076 South Street
Marine Corps Combat Development Command
Quantico, Virginia 22134-5068

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AUTHOR: MAJOR ANDREW J. GEBARA,
UNITED STATES AIR FORCE

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EXECUTIVE SUMMARY

TITLE: Beyond the Wild Blue on Blue: Leveraging Counter-Fratricide Technologies for Operational Effects

AUTHOR: Major Andrew J. Gebara, United States Air Force

THESIS: Only the coordinated energy of the entire combined/joint force will produce truly effective counter-fratricide technology, tactics, techniques, and procedures. Failure to standardize counter-fratricide Link 16 integration efforts in all combatant aircraft will lead to asymmetrical and piecemeal solutions that will strain coalitions, with harmful operational and strategic level effects.

DISCUSSION: 21st century warfare has exacerbated the effects of air-to-ground fratricide. While always tragic, contemporary blue-on-blue incidents can now have detrimental effects at the operational and even strategic levels of war. In an effort to combat fratricide using technological innovation, two key technologies stand out: Blue Force Tracker and Link 16. Using Link 16 architectural modifications, friendly positional data can be displayed in individual cockpits, revolutionizing situational awareness.

CONCLUSION: By continuing and or expanding implementation of the above technological solutions and strict adherence to JTTPs, the combined/joint force has the potential to finally zeroize air-to-ground fratricides. It is imperative that adequate funding and priority be given to fielding this triad of innovation throughout not just the U.S., but throughout allied and coalition militaries.

PREFACE

My interest in the topic of fratricide avoidance, a topic of key importance to me as an A-10 pilot, was rekindled in 2003 when I was directed in-flight to coordinate a multi-ship attack of 24-Joint Direct Attack Munitions (JDAMs) on targets in Baghdad during Operation IRAQI FREEDOM (OIF) I. Although I received clearance to engage my strike package's targets from the Air Support Operations Center (ASOC), it felt horrible that I was forced to rely on someone else for deconfliction. My—any—pilot's worst nightmare, the thought of accidentally killing friendlies, stuck with me the entire flight home. Although in my case the proper use of Joint Tactics, Techniques, and Procedures (JTTPs) worked, and I killed enemy, not friendly forces, I felt—and still feel—that there had to be a way for tactical commanders to get blue force tracking information into the cockpit.

Two years later, after interacting extensively with U.S. Marines and Allied soldiers in the School of Advanced Warfighting, I am struck by the way isolated instances of air-to-ground fratricide affect the relationship between air and land component forces. Although by any measure air-to-ground incidents are a small portion of overall fratricide events, there is something emotional about the air aspect of an already emotional event that drives a wedge between comrades in a way that ground-to-ground frats don't.

For whatever reason, while it may be impossible to completely eliminate fratricide on the battlefield, it is imperative that ZERO air-to-ground fratricide incidents be the goal of any air combat operation. This can only be achieved by fire discipline, Rules of Engagement (ROE) adherence, and by-the-letter conformance with JTTPs. Further however, technology exists for significant situational awareness (SA) enhancement that promises to greatly aid in fratricide

elimination. This technology will only work if standardized across the combined, joint spectrum, and only if implemented in ALL weapons platforms.

I am honored to recognize the assistance I have received from my mentor, LtCol Jerome Driscoll, Head School of Advanced Warfighting. LtCol Driscoll provided the filter that turned my ideas into something that makes this paper a worthy academic and military pursuit. I would also like to thank the many A-10 instructors and weapons officers that turned a bomber driver into a fighter pilot and emphasized the importance of protecting the grunt on the ground. Finally, nothing in my life is possible without the support of my amazing family. I will be forever grateful for the wonder, beauty and love of all things they bring to my life.

Fratricide is caused by our inability for the Air Force A-10 pilot to look at a vehicle and have an immediate recognition, friend or foe. The same is true with tanks. If… he can't query a target, then we aren't where we need to be with regard to the avoidance of fratricide.

***Lt.Gen. James T. Conway, USMC*[1]**

Ground-to-ground fratricides, or "frats", the act of killing one's own forces, historically account for approximately 90% of overall friendly fire incidents[2]. While all mourn those needlessly lost through such mishaps, military analysis concentrates on this one form of fratricide—to the exclusion of ground-to-air or air-to-ground frats, when attempting to minimize or eliminate this "ulcer of warfare". Air-to-ground fratricides however, while numerically small, have a disproportionate effect on the battlefield from their more common ground equivalents. These effects can range from simple distrust between the land and air components to operational and even strategic consequences. Today, through the proper leveraging of technology, these tragedies be completely eliminated from warfare. Unthinkable only a few years ago, such a lofty goal is within the realm of possibility today through fire discipline, Rules of Engagement (ROE) adherence, and by-the-letter conformance with Joint Tactics, Techniques, and Procedures (JTTPs). One key aspect of this goal, leveraging counter-fratricide equipment, is easily achievable utilizing current technology: all that is required is coordination, standardization, and funding.

Contemporary warfare has perhaps forever changed the way planners must view fratricides on the battlefield. Throughout 20th century warfare fratricide was widely regarded as an unfortunate yet unavoidable part of warfare. When western countries practiced attrition warfare frats, while always tragic, were often acceptable if the operation was necessary. In a

[1] Lt.Gen James T. Conway, USMC "The First Marine Expeditionary Force in Iraq", briefing, *United States Department of Defense News Transcript*, The Pentagon, Washington D.C., 9 Sep 2003.
[2] George Cahlink, "Better "Blue Force" Tracking" *Air Force Magazine*, 87, no. 6 (June 2004): 67.

famous World War II example, Operation COBRA, the Allied breakout from the Normandy beachhead, approximately 580 soldiers were killed or wounded by air-to-ground fratricide, in a plan Army leadership pushed despite knowing that friendly troops were well inside the circular error probable (CEP) of friendly aircraft[3]. While investigations into the event were conducted, no one was ever disciplined, and it is generally accepted that the unfortunate deaths were believed to be acceptable at the time in order to achieve the decisive result of breakthrough and breakout. In his article "The Ethics of Operation Cobra and the Normandy Breakout" LtCol James Jay Carafano, USA, describes General Omar Bradley's view of the incident:

> ***It was a difficult choice. General Bradley had already seen the tremendous disruption that could be caused by a short bombing. If he had any hopes that the other safety measures he had put in place would be sufficient, he now had incontrovertible evidence that they were inadequate. If the planes attacked the same way again, Americans would most likely die from American bombs. Bradley decided to repeat the bombing the next day and again planes hit friendly troops. The total losses in the VII Corps were approximately 108 dead and 472 injured[4].***

Amazingly, even some junior officers, men whom presumably had everything to lose from errant bombing agreed with this philosophy, as shown by the statement of Lt Joseph L. Gude, a company commander forced to undergo the American bombing:

> ***I believe every man in the company will agree that if we have such an attack again they would want the bombing just where it was, right to our lines. We would rather take the ones that fall on us to get the effect on the Germans in front of us[5].***

In contrast, to the early years of air warfare, western experience with 21st century warfare

[3] Headquarters, First U.S. Army, "Investigation of Bombing of Ground Troops by Friendly Planes on 24 and 25 July 1944", Adjutant General Section, General Correspondence 1940-47 (16 August 1944): 1.
[4] LtCol James Jay Carafano, USA "The Ethics of Operation Cobra and the Normandy Breakout" *Joint Force Quarterly*, n.p., on-line, Internet, available from http://www.usafa.af.mil/jscope/JSCOPE00/Carafano00.html.
[5] Joseph L. Gude, LT, USA, quoted in Carafono.

has shown a low tolerance for air-to-ground fratricides. Incidents such as the one described above are unthinkable now: even a handful of casualties can now have effects far beyond the tactical battlefield. Two examples illustrate:

On May 7th, 1999 during Operation ALLIED FORCE, a B-2 aircrew expertly struck their assigned target, not knowing that the building was the Chinese embassy in Belgrade: the ill-fated attack killed three Chinese nationals. In addition to the now well known international uproar the bombing caused, moves to negotiate an end to the war were hampered, and the incident halted any further bombing of targets in Belgrade for two weeks, or approximately 20% of the length of the war[6]. While not technically a fratricide, the above incident shows how a single incident can have operational effects: the bombing of Belgrade was a key aspect of the NATO air war, and its temporary sanctuary status undoubtedly lengthened the conflict.

Almost three years later, on April 18th, 2002 during Operation ENDURING FREEDOM, a USAF fighter pilot, radioed to an Airborne Warning and Control System (AWACS) that he and another F-16 had taken enemy ground fire. He was given permission to mark the target and return for a second look. During the subsequent fly-over, the pilot requested weapons release authority. Permission was denied unless the pilot felt he would be acting in self-defense. At that point, the pilot again reported ground fire, invoked his right of self-defense and dropped a 500-lb laser guided bomb on what was later discovered to be friendly soldiers from Princess Patricia's Canadian Light Infantry Battle Group: the Canadians, who were conducting a live-fire training exercise, had been mistaken for Taliban fighters[7]. Outrage in Canada over the incident was widespread, and resulted in a strain in the US-Canada relationship. While the Canadian government at the time pledged that the incident would not deter Canada from full participation

[6] Benjamin S. Lambeth, *The Transformation of American Airpower* (USA: Cornell University Press, 2000), 206.
[7] AP article, "U.S.: Friendly Fire Pilot Reported Being Fired Upon", *CNN.com/World*, n.p., on-line, Internet, 18 Apr 2002, available from http://archives.cnn.com/2002/WORLD/asiapcf/central/04/18/afghanistan.canada/.

in the Global War on Terror, Canadian public opinion dramatically shifted away from the United States in the year following the terrorist attacks. In September 2002, 35 per cent of Canadians wanted US/Canadian ties to be more distant – up from only 13 per cent a year earlier[8]. Additionally, actual numbers show that Canadian participation in Afghanistan has fallen 40%, from around 2,000 troops in late 2001, to around 1,200 troops today, at a time when NATO member states are attempting to take a greater role in the Afghanistan mission[9]. In this case, the tragic deaths of four soldiers clearly had the disproportionate strategic effect of weakening the US/Canadian alliance.

Given that fratricides are both dreadful in and of themselves and seem to be increasing in their after effects, it should come as no surprise that western states have attempted to reduce friendly fire through a multi-avenue approach, including both JTTP standardization and Identify Friend-or-Foe (IFF) technologies. For an excellent analysis of counter-fratricide technologies, see "Air-to-Ground Fratricide Reduction Technology: An Analysis", by Major Sean P. Larkin, USAF.

This paper focus's on two technologies of particular significance, which must be integrated into the entire combined/joint force: Blue Force Tracker (BFT) and the Tactical Digital Information Link-Joint (TADIL-J) hereafter referred to by its NATO designation "Link 16". In his article "Standardize Blue Force Tracking", Daniel Goure describes the most widely deployed BFT:

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[8] Parkin, Andrew "More Canadians distance themselves from U.S. neighbors," *Centre for Research and Information on Canada*, 9 September 2002, n.p., Internet, available at: http://www.cric.ca/pdf/cric_poll/borderlines_ca_us/borderlines_press_neighbours_sept2002.pdf.

[9] Peter Whelan, "Canadian Forces International Operations: 2001-2005" *The Ploughshares Monitor*, 26, no. 3 (Autumn 2005).

> ***Perhaps the most revolutionary ground force location and tracking system deployed in Operation IRAQI FREEDOM is the Force XXI Battle Command, Brigade and Below System (FBCB2). Also known as the Blue Force Tracker, or BFT, it gives combat vehicles a dashboard-mounted laptop and a roof-mounted transponder/receiver to beam information via satellite to headquarters and other vehicles. The result is an all weather, always-on, near real time picture of the battlefield that answers the questions: Where am I—and where are my friends? This helps coordinate a force's striking punch and reduce friendly fire[10].***

Goure continues to emphasize the chaotic procurement of BFT systems:

> ***But FBCB2 is far from the only command-and-control system on today's battlefields. During the full combat phase in Iraq, joint force planners juggled more than 60 such systems. All have different protocols and policies; none presents itself as the single standard others will adopt. In addition to technical compatibility issues, every system brings with it its own funding stream and management structure, giving its "owner" a vested interest in maintaining a fractured status quo. Add tracking devices employed by other coalition members and the situation gets even more problematic[11].***

In recognition of the above and as a result of lessons learned in OIF I, the Joint Requirements Oversight Council (JROC), in JROCM 161-03, August 2003, directed the Army and Marine Corps to integrate their respective BFT capabilities[12]. This is an important step, but it must be emphasized that BFT technology is greater than a joint issue—it is a combined one as well. Any successful BFT capability must include NATO and coalition partners if it is to be constructive.

The second key technology for future counter-fratricide efforts is Link 16. What precisely is Link 16 and how can it apply to BFT? Marine Corps Warfighting Publication (MCWP) 3-22 defines Link 16 (TADIL-J) as:

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[10] Daniel Goure, "Standardize Blue Force Tracking" *DefenseNews.com*, 8 Nov 2004, n.p., Internet, available from http://staging.defensenews.com/story.php?F=494578&C=&P=true.
[11] Goure, 1-2.
[12] Lt.Gen. Edward Hanlon, Jr., "Future Combat System and Force Protection Initiatives" Testimony before the House Armed Services Committee, Subcommittee on Tactical Air and Land Forces, United States House of Representatives, 108th Cong., 2d sess., 1 Apr 2004.

> ***…a secure, high-speed digital data link. It uses the joint tactical information distribution system (JTIDS) transmission characteristics and protocols, conventions, and fixed- length message formats defined by the JTIDS technical interface design plan. TADIL-J is intended to replace or augment many existing TADILs as the joint standard for data link information exchange. Information is passed at one of three data rates: 26.88, 53.76 or 107.52 kilobits per second. TADIL-J devices will be located in ground, airborne, and sea-based air defense platforms and selected fighter aircraft[13].***

Given that Link 16 is the already the joint standard data link therefore, it makes sense for the DoD to use this existing network architecture to pass BFT information down to the tactical level—the individual cockpit. But how prevalent is Link 16 equipment outside of the lab? If not currently fielded in a weapons platform, how long before it will be installed in applicable aircraft?

Selected U.S. and other NATO platforms are already Link 16 equipped, and more are undergoing modifications. Table 1 below shows a list of current and planned Link 16 capable platforms through the year 2010[14]. More recent data suggests U.S. Link 16 fielding is at least two years behind this initial schedule[15]. While exact fielding dates for each allied and coalition country is beyond the scope of this paper, it is reasonable to assume that Link 16 modifications, even for countries already committed to fielding such systems, will continue far beyond 2010.

[13] Marine Corps Warfighting Publication (MCWP) 3-22 *Anti-Air Warfare*, 23 Jun 2000, Appendix A.
[14] Myron Hura et al, *Interoperability: A Continuing Challenge in Coalition Air Operations* (USA: Rand, 2000): 111-112.
[15] *JDICE Program Briefing*, 10 Nov 2005.

Representative Installations of Link 16 Terminals

Terminal	Current	Planned (2010)
JTIDS Class 1	None	None
JTIDS Class 2	US: F-14D, E-2C, ABCCC, JSTARS, MCE/TAOM, Rivet Joint, F-15C,[a] submarines	No additional systems
	UK: ADGE, Tornado F3,[b] NIMROD MR	
JTIDS Class 2H	US: AWACS, MCE/TAOM NATO: AWACS, NADGE UK/FR: AWACS	No additional systems
JTIDS Class 2H Shipboard	US: aircraft carriers, destroyers, cruisers	UK: carriers, destroyers
JTIDS Class 2M	US: FAAD, Patriot NL/GE: Patriot	No additional systems
JTIDS Class 2R (never developed)	None	None
SHAR (2R derivative)	None	UK: Sea Harrier
MIDS LVT(1)	None	US: F-16, ABL, F/A-18A/F, Navy ships, submarines
		FR: Rafale, AF ground C2, Navy platforms
		GE: EF-2000, ACCS platforms, Navy Frigate 124
		IT: Tornado FBX/SEAD, AMX, EF 2000, Navy platforms
		SP: EF-2000, EF-18
		UK: EF-2000, JSF
MIDS LVT(2)	None	US: FAAD, THAAD, other C2 FR: Army platforms IT: Ground C2 (AF & Army) SP: ACCS platforms (AF)
MIDS LVT(3)/FDL	None	US: F-15A/E
Specific terminal to be determined[c]		US: F-117, A-10, F-22, B-1, B-2, B-52, JSF
		UK: JSF

NOTES:
ABCCC = Airborne Battlefield Command and Control Center (USAF).
ACCS = Air Command and Control System (NATO).
ADGE = Air Defense Ground Environment (U.K.).
FAAD = forward area air defense (U.S. Army).
MCE/TAOM = modular control equipment/tactical air operator module (USAF, USMC).
NADGE = NATO Air Defense Ground Environment.
THAAD = Theater High-Altitude Area Defense (U.S. Army).
[a]Eighteen F-15Cs are equipped with Class 2 terminals.
[b]Three squadrons of Tornado F3s are equipped with Class 2 Link 16 terminals.
[c]At the end of 1999, Air Force data link plans envision incorporating Link 16 terminals on all fighters and bombers. Terminal selection has not been made.

Table 1 seems to promise an impressive degree of interoperability in the short term: unfortunately the list of non-participants is at least as impressive. It seems clear that a system can only be interoperable if all participants acquire the system. Non-participants must make Link 16 acquisition a top priority now in order to have any hope of fielding platforms in the next fifteen years. Failure to do so will result in a widening of the technology split currently seen between the U.S. and select allied and coalition partners. Western militaries concerned with becoming marginalized on the high tech battlefield should note the words of the late VADM Arthur Cebrowski, USN, Joint Staff-J6:

> ***If you are not Link 16 capable, you will not be welcomed on the US Battlefield, and in fact you will be considered a blue on blue engagement generator—a threat to friendly and coalition forces[16].***

[16] VADM Arthur Cebrowski, USN, Quoted in *JDICE Program Briefing*, 10 Nov 2005.

These two technologies, BFT, with its ability to track ground order of battle, and Link 16, with its ability to transmit data over a common combined/joint datalink, clearly need to be integrated to allow friendly ground positional data into the cockpit as well as the Combined Air Operations Center (CAOC). The result will be unprecedented situational awareness on the position of the ground battle in near-real time, allowing maximum support from the air to the land component when needed, and maximum deconfliction between air and land components when simultaneous missions are underway.

BFT data, like airborne IFF, is only useful if it is received by the warfighter in a timely, accurate manner. Untimely, inaccurate, or even cluttered information will fail to prevent, and may actually cause, a fratricide mishap. In OIF I, the first large scale conventional conflict to utilizing BFTs, timeliness of data was lacking, as tactical aircrew had no access to this potential wealth of information.

As an example, B-2 pilots launching from Whiteman Air Force Base took off approximately 20 hours prior to weapons release. Given the time required for pre-flight ground operations, it is reasonable to assume pilots received their intelligence briefings concerning friendly ground order of battle 24 hours prior to dropping their bombs. When retargeted therefore, pilots had to query the CAOC for friendly location, since the Fire Support Coordination Line (FSCL) could and probably did move at least once while they were en route to the area of operations. This requirement often ended up extending time over the threat area. It was a situation such as this that contributed to the F-16 fratricide described above. The pilot, frustrated by what he perceived to be both hostile ground fire and an unresponsive headquarters, invoked his right to self-protection with disastrous results. If technology of the time had allowed the F-16 pilots to see BFT tracks in their cockpits, and if the Canadian's had been properly

equipped with BFT equipment, Sgt. Marc Leger, Cpl. Ainsworth Dyer, Pte. Richard Green, and Pte. Nathan Smith might be alive today, and Canadian participation in the Global War on Terror might well be far more extensive.

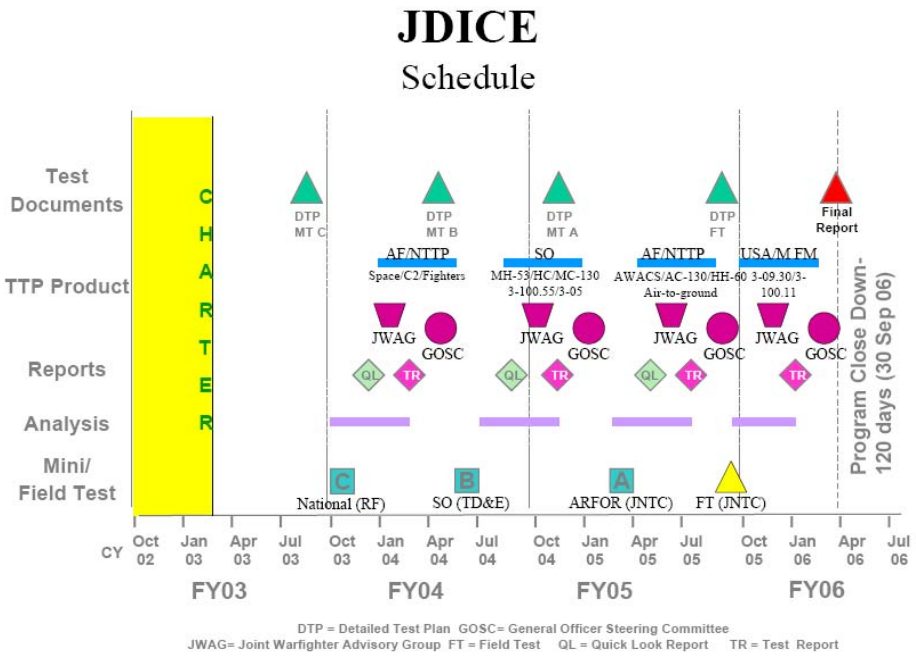
In addition to its inefficiency, forcing a flight lead to query the CAOC for every ground attack makes no more sense than if the CAOC kept MODE IV IFF interrogators at the operational level of war, equipment that is standard in all F-15C aircraft and has been for years. Failure to get BFT information down to the tactical level runs counter to the Air Force's basic doctrine of "Centralized Control, Decentralized Execution". Air Force Basic Doctrine Document 1 states:

> ***Centralized control and decentralized execution of air and space power are critical to effective employment of air and space power. Indeed, they are the fundamental organizing principles for air and space power, having been proven over decades of experience as the most effective and efficient means of employing air and space power[17].***

With the above in mind, and in an effort to get BFT data into the cockpit via Link 16 architecture, the Joint Datalink Information and Combat Execution (JDICE) program was chartered in March 2003 by the Office of the Secretary of Defense to "develop JTTPs and associated Link 16 network architecture modifications to increase situational awareness at the tactical level, emphasizing deconfliction, fratricide prevention and targeting"[18]. JDICE, manned with representatives from the all U.S. military services, is currently conducting a three and a half year Joint Test and Evaluation (JT&E) program including testing with AFFOR, ARFOR,

[17] Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 17 Nov 2003, 28.
[18] Perry Koger, "JDICE - Increasing Situational Awareness" *The Tactical Link*, 3, no. 4 (October 2005): 1-2.

MARFOR, Special Operations, and national assets, as well as a "final exam" field test utilizing all assets simultaneously. Figure 1 below shows the proposed JDICE testing schedule[19]. Major tests are shown as blue triangles, while the final report, shown below as a red triangle, is due in April 2006.



As may be seen above, most mini-testing of the JDICE JT&E has been successfully completed. The last mini-test, the MARFOR phase, was conducted at MCAS Yuma during the USMC's Weapons and Tactics Instructor course:

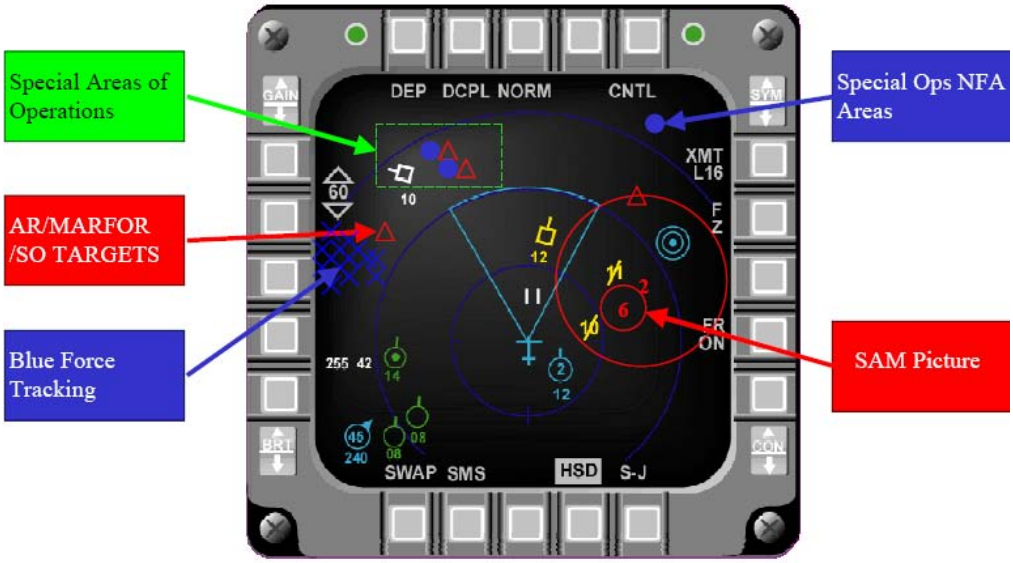
> ***JDICE conducted Mini-Test A, Marine Forces (MARFOR) phase, from October 7-14, 2004…The test resulted in a revolutionary stride forward in Marine Forces JTTP and situational awareness. For the first time ever, due to the JDICE-developed Marine Forces JTTP, friendly Marine Corps tracks were transmitted via Link-16, providing close air support aircraft a fully-digitized "God's eye" view of the battlefield. The F-15E and F/A-18 aircrews, however, were not the only beneficiary of this effort. The derivative effect of the Link-16 friendly force transmissions was unique Marine Forces information, not only to the cockpit, but also***

[19] *JDICE Program Briefing*, 10 Nov 2005.

to the Tactical Air Control Parties (TACP) controlling the fighters, as well as the Marine Corps Tactical Air Control Center (TACC). The result was ground-breaking situational awareness[20].

While it is too early to declare victory with respect to JDICE's work, preliminary results seem to point to a truly revolutionary capability with respect to the integration of BFT and Link 16. Figure 2 below shows a notional cockpit display with JDICE-provided BFT data[21]. Instead of determining friendly location by querying, guessing, or hoping, BFT data is beamed directly into one display. Not all friendly locations may be BFT equipped, and while and it goes without saying that such a display is no substitute for fire discipline, ROE adherence, and conformance with applicable JTTPs, the advantages of this system in regards to counter-fratricide efforts are obvious.

Link 16 Display



[20] *Joint Test & Evaluation Program Highlights*, May 2005, 8, available at: http://www.jte.osd.mil/docs/May%202005%20JTE%20Highlights.pdf.
[21] *JDICE Program Briefing*, 10 Nov 2005.

BFT, and Link 16, and JDICE may have revolutionary potential, but as with so many promising technological solutions, the successful integration of technology and JTTPs will fail to come to fruition if the combined/joint force lacks the will to properly organize, train, and equip their forces with all three links to this counter fratricide triad. Due to the long lead time required to go through the military aviation acquision process, it is imperative that adequate funding continue to go to BFT standardization, Link 16 installation, and JT&E research. It is highly probable that in a budget constrained environment during a time of war that there will be efforts to delay, cut back, or even eliminate at least one aspect of these technologies, in one or more allied or coalition nations. These efforts must not be allowed to slow the fielding of these important counter-fratricide designs, as not only the lives of future soldiers are at stake, but possibly the outcome of future campaigns as well. While supplemental aid for Link 16 installations is impractical due to current budget realities, the U.S. and her properly equipped allies should insist on BFT and Link 16 standardization across a coalition force. Failure to come to a future battle so equipped should preclude use of that asset in a non-emergency joint/combined close air support role.

On 23 Mar 2003, 10 U.S. Marines were mistakenly killed in the vicinity of An Nasiriyah by two USAF A-10 pilots when a USMC ground forward air controller (GFAC) directed them to attack what was thought to be enemy vehicles north of the Euphrates River. Due to a lack of communication with higher authority and an inaccurate understanding of the friendly scheme of maneuver, the GFAC cleared the A-10 pilots "Hot" on what sadly turned out to be elements of Charlie Company, 1st Battalion, 2nd Marines[22]. As in so many fratricide events, JTTPs were disregarded, leading to an irreversible tragedy. In the future, provided the combined/joint force

[22] U.S. Central Command *Investigation of Suspected Friendly Fire Incident Near An Nasiriyah, Iraq, 23 Mar 03*, (MacDill AFB, FL: 6 Mar 2004), 5-6.

has the will to do so, such mishaps will be a thing of the past. Referencing a Link 16 cockpit display projecting BFT data through JDICE designed architecture, close air support aircraft could easily have identified the GFAC's mistake before tragedy struck. The results will save lives on future battlefields and may well prove to have long term effects considerably beyond the tactical level of war.

BIBLIOGRAPHY

Air Force Doctrine Document (AFDD) 1, *Air Force Basic Doctrine*, 17 Nov 2003.

AP article, "U.S.: Friendly Fire Pilot Reported Being Fired Upon", *CNN.com/World*, n.p., on-line, Internet, 18 Apr 2002, available from http://archives.cnn.com/2002/WORLD/asiapcf/central/04/18/afghanistan.canada/.

Bickers, Richard Townsend *Friendly Fire: Accidents in Battle from Ancient Greece to the Gulf War***.** London: Leo Cooper, 1994.

Cahlink, George *"Better Blue Force Tracking."* Air Force Magazine *87, no. 6 (June 2004).*

Cahlink, George "Fog of War." *Government Executive* 36, no.31 (July 2004).

Carafano, LtCol James Jay, USA "The Ethics of Operation Cobra and the Normandy Breakout" *Joint Force Quarterly*, n.p., on-line, Internet, available from http://www.usafa.af.mil/jscope/JSCOPE00/Carafano00.html.

Conway, Lt.Gen James T., USMC "The First Marine Expeditionary Force in Iraq", briefing, *United States Department of Defense News Transcript*, The Pentagon, Washington D.C., 9 Sep 2003.

Erwin, Sandra I. "Army to Upgrade Land Warrior System with Blue Force Tracker." *National Defense* (February 2004).

Goure, Daniel "Standardize Blue Force Tracking" *DefenseNews.com* 8 November, 2004, n.p., Internet, available from http://staging.defensenews.com/story.php?F=494578&C=&P=true

Gruetzmacher, Jeffrey K.; Holtery, Michelle J.; Putney, Jonathan R. *Fratricide: The Ultimate Cost of Joint Interoperability Failure.* Norfolk, VA: National Defense University Press, 2002.

Hanlon, Lieutenant General Edward "Future Combat System and Force Protection Initiatives" testimony before the House Armed Services Committee, Subcommittee on Tactical Air and Land Forces, United States House of Representatives, 1 April, 2004.

Headquarters, First U.S. Army, "Investigation of Bombing of Ground Troops by Friendly Planes on 24 and 25 July 1944", Adjutant General Section, General Correspondence 1940-47, 16 August 1944.

Hura, Myron et al, *Interoperability: A Continuing Challenge in Coalition Air Operations*. USA: Rand, 2000.

JDICE Program Briefing, 10 Nov 2005.

Joint Test & Evaluation Program Highlights, May 2005, 8, available at: http://www.jte.osd.mil/docs/May%202005%20JTE%20Highlights.pdf.

Koger, Perry, "JDICE - Increasing Situational Awareness" *The Tactical Link*, 3, no. 4, October 2005.

Lambeth, Benjamin S., *The Transformation of American Airpower*. USA: Cornell University Press, 2000.

Marine Corps Warfighting Publication (MCWP) 3-22 *Anti-Air Warfare*, 23 Jun 2000.

Parkin, Andrew "More Canadians distance themselves from U.S. neighbors," *Centre for Research and Information on Canada*, 9 September 2002, Internet, available at: http://www.cric.ca/pdf/cric_poll/borderlines_ca_us/borderlines_press_neighbors_sept2002.pdf..

Regan, Geoffrey**.** *Blue on Blue: A History of Friendly Fire*. New York: Avon Books, 1995.

Sanchez, Bennie *Fratricide, Technology, and Joint Doctrine*. Newport, Rhode Island: Naval War College, 2004.

Steinweg, Kenneth K. "Dealing Realistically with Fratricide." *Parameters* (Spring 1995).

U.S. Central Command *Investigation of Suspected Friendly Fire Incident Near An Nasiriyah, Iraq, 23 Mar 03*, MacDill AFB, FL: 6 Mar 2004.

Whelan, Peter, "Canadian Forces International Operations: 2001-2005" *The Ploughshares Monitor*, 26, no. 3, Autumn 2005.

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21ST CENTURY WARFARE HAS EXACERBATED THE EFFECTS OF AIR-TO-GROUND FRATRICIDE. WHILE ALWAYS TRAGIC, CONTEMPORARY BLUE-ON-BLUE INCIDENTS CAN NOW HAVE DETRIMENTAL EFFECTS AT THE OPERATIONAL AND EVEN STRATEGIC LEVELS OF WAR. IN AN EFFORT TO COMBAT FRATRICIDE USING TECHNOLOGICAL INNOVATION, TWO KEY TECHNOLOGIES STAND OUT: BLUE FORCE TRACKER AND LINK 16. USING LINK 16 ARCHITECTURAL MODIFICATIONS, FRIENDLY POSITIONAL DATA CAN BE DISPLAYED IN INDIVIDUAL COCKPITS, REVOLUTIONIZING SITUATIONAL AWARENESS. BY CONTINUING AND OR EXPANDING IMPLEMENTATION OF THE ABOVE TECHNOLOGICAL SOLUTIONS AND STRICT ADHERENCE TO JTTPS, THE COMBINED/JOINT FORCE HAS THE POTENTIAL TO FINALLY ZEROIZE AIR-TO-GROUND FRATRICIDES. IT IS IMPERATIVE THAT ADEQUATE FUNDING AND PRIORITY BE GIVEN TO FIELDING THIS TRIAD OF INNOVATION THROUGHOUT NOT JUST THE U.S., BUT THROUGHOUT ALLIED AND COALITION MILITARIES.

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