

A New Era in Close Air Support

Digital Situational Awareness for
Dismounted Ground Forces

01. Introduction

Since the early days of World War I, forces have struggled with how to integrate air power to achieve decisive effects on the battlefield on the ground. The key issue that has remained constant for over one hundred years has been the difficulty in seamless communications between supporting aircraft and ground forces in order to establish a common understanding of the situation on the battlefield, locations of friendly and enemy forces, and the desired effects required by ground forces from their supporting aerial components.



FIGURE 1. World War I: Fragmented Air-Ground Picture and Disjointed Communications

With the advent of the Battlefield Awareness and Targeting System – Dismounted (BATS-D AN/PRC-161) radio, a great leap forward has been made with enabling seamless communications between air and ground forces.

For the first time in history, Joint Terminal Attack Controllers (JTACs) can digitally broadcast their friendly positions as well as the desired target impact points directly into Close Air Support (CAS) aircraft mission computers via machine-to-machine interface over Link 16. The result of adding this capability onto the battlefield reduces the time to prosecute a kill chain by 95%, substantially increasing the lethality of air-to-ground forces while simultaneously reducing the likelihood of fratricide during CAS operations.

Before we discuss how this is accomplished, this paper will first describe how typical CAS missions have been conducted prior to BATS-D/PRC-161 from both the perspective of the aircrew as well as the JTAC. Then, along with describing the underlying Link 16 advancements that have occurred technologically to enable this type of capability, this paper will address the evolution of doctrinal changes that are necessary to translate the technology into an operational capability. Finally, we will describe the capability itself and share our perspectives on the future of coordinated air-to-ground operations as a result.



FIGURE 2. BATS-D AN/PRC-161 Handheld Link 16 Radio and Android End User Device

02. Traditional Close Air Support Mission: Aircrew Perspective

An Unreliable and Complex Process for Requesting and Coordinating Fires

The fundamental mission set of CAS has remained largely unchanged for over a hundred years. In many respects, a CAS mission that is conducted today in the Central Command Area of Responsibility (AOR) would be largely familiar to the pilot of a P-47 Thunderbolt aircraft flying CAS missions in northern France in 1944.



FIGURE 3. Traditional Close Air Support Aircraft

Upon being assigned to support a JTAC or Forward Area Controller (FAC), aircrew would check in with a prolonged series of scripted voice communications to advise the JTAC as to the weapons that the aircraft has available, the amount of fuel remaining (and resulting time on station), and their general location over the battlefield.

This would be followed by a considerable amount of voice-intensive radio communications from the JTAC or FAC to the aircrew to build situational awareness as to the events unfolding on the battlefield, including threats, terrain, friendly and enemy locations, as well as other amplifying data.

For the aircrew, perhaps the most significant amount of time would be spent on obtaining a positive visual of both the location of the JTAC, as well as the location of the target. This would all need to be accomplished while the aircrew is flying the aircraft, navigating, and deconflicting their flight path from other aircraft and/or flying formation of other aircraft. It typically involves writing down coordinates that might be 20 digits in length on an aircraft kneeboard card, and then manually entering those coordinates into the aircraft mission computer through some type of keypad interface.

In some instances, the aircrew is listening to the JTAC describe his location on the ground, while simultaneously looking out of the cockpit trying to make some semblance of the description with what the aircrew sees from the air. This is very subjective as descriptions of items of visual significance vary widely between different perspectives. Descriptions like “we’re on the east side of the third white building on the west side of the wide road” might make perfect sense on the ground, but will almost be meaningless from the vantage point of the aircraft orbiting tens of thousands of feet overhead.

All of this serves to expend a lot of crucial time (measured in time to engage the enemy as well as the aircraft's available time on station) and inevitably creates a fog of war and uncertainty in the mind of the aircrew as to whether or not what they are interpreting in the air is the same picture as what is being described by the JTAC on the ground. This can oftentimes prevent a CAS mission from being executed if the aircrew does not have sufficient confidence in their understanding of the situation on the ground, potentially risking friendly fire or fratricide incidents.

03. Traditional Close Air Support Mission: JTAC Perspective



FIGURE 4. Joint Terminal Attack Controller (JTAC)

A JTAC or FAC is embedded into a larger maneuver element and often called upon as a means of leveraging air power to achieve the intent of the ground commander during preplanned and on-demand missions.

Due to the dynamic nature of combat operations and ambiguity of both friendly and enemy forces maneuvering upon each other to achieve tactical advantage, the situational awareness required to effectively escalate is often lacking.

In the middle of all of this chaos, the JTAC is also trying to “stack” the supporting CAS aircraft that are orbiting overhead, from MQ-9 Reapers, to AC-130s, to helicopters, to B-52s. This requires extensive coordination and maneuvering of forces as the JTAC determines the sequence into his area of operations. This

includes a series of lengthy, back-and-forth verbal exchanges that include a general situation update, the type of target or objective the ground force is fighting, the threat types and general location, the friendly positions, whether there's any artillery and what the maximum altitude and line of fire is, what type of clearance the JTACs will use, and any other restrictions.

The JTAC is tasked with communicating this information in a way that makes sense to the aircrew who is looking at the battlefield from an entirely different viewpoint. This effect is exacerbated by human emotional responses, exertion, and often traumatic injuries incurred by the JTAC from prolonged engagement.

As communication breaks down, so follows the reasonable assurance of both air and ground forces to effectively engage the threat and in some cases, the aircraft's available time on station before the target is "cleared hot."

04. Evolution of Link 16 Technology

The waveform is the same, but with advancements in technology, the information now gets to a new class of users who need it most today

Originally designed for air-to-air missions in the 1980s, Link 16 provided secure, jam-resistant, line-of-sight data exchanges between the computers on military platforms that needed real-time situational awareness, command and control, navigation, and identification. Defined by the United States Department of Defense's MIL-STD-6016, the original Link 16 messages and protocol have expanded over the years to fill more roles and missions, but the fundamental waveform is essentially the same.

The first radio terminals to implement Link 16 were refrigerator-size racks that only capital ships and capital command and control heavy aircraft could afford (weight and cost). However, these Joint Tactical Information Distribution System (or JTIDS) terminals were instrumental in showing how the information carried over Link 16 was indispensable for the commander's control of the battlespace.

With Class 2 JTIDS terminals on F-14s and F-15s, fighter aircraft were dominating every engagement, which was the driving factor for the development of the Multifunctional Information Distribution System (or MIDS) terminals that are currently onboard many coalition fighter aircraft and ships.

MIDS also introduced the ground warfighters to the benefits of digital data exchange with the air and sea components and allowed for a common operational picture that reduced the likelihood of fratricide. Software defined radio technology also led to the ability to support rapid upgrades to terminals to support new missions and needs, at a reduced cost to the user.

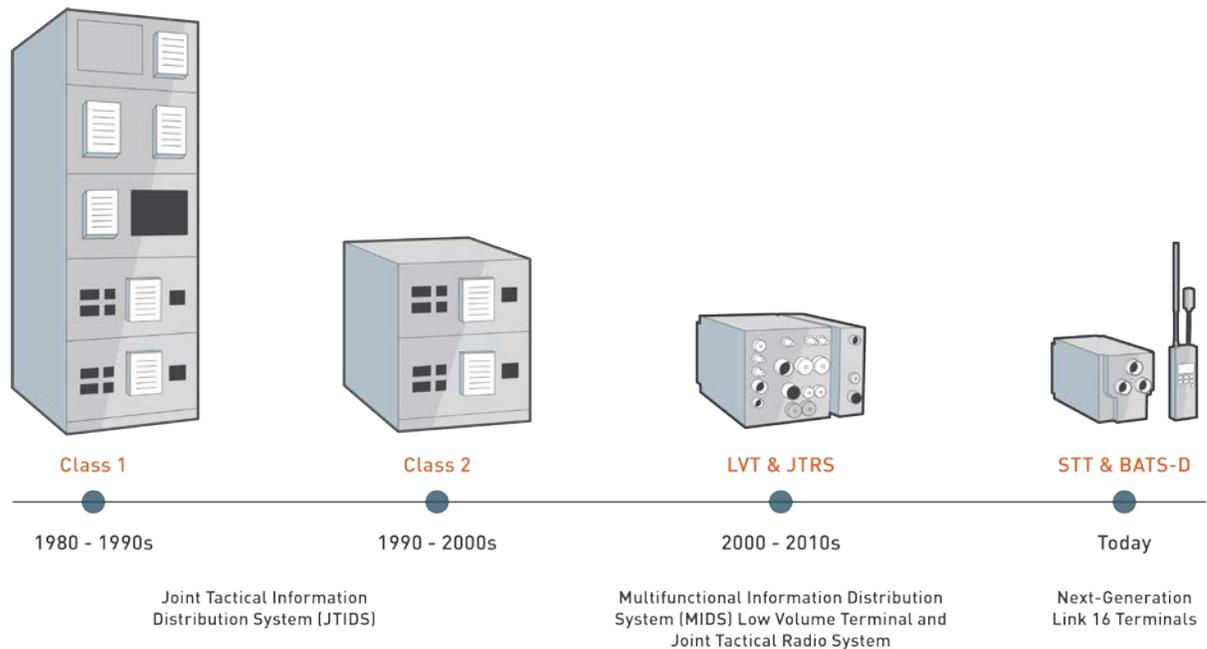


FIGURE 5. Link 16 Evolution

With today's battlefields dominated by CAS missions, smaller terminals were needed for weapons (to change/send targeting information while in flight for weapons delivery), attack helicopters as part of a combined-arms team, as well as small boats that supported coastal actions. Industry came forward with smaller, lighter, less-costly terminals that were fully interoperable within the Link 16 network, bringing the same benefits to these non-traditional platforms. The experiences of these tactical edge warfighters along with their emerging requirements, have opened up more and more uses for Link 16.

The most recent user to discover the benefits of a direct digital connection to fighter aircraft is the JTAC in the CAS mission. This is all due to the further reduction in size, weight, power and cost of a fully interoperable Link 16 radio in a handheld format. Ground forces can now use their smartphones and tablets to directly share reliable target data and position location, identification, and status information directly to the aircrew's computer, bridging a critical capability gap and providing real-time fused air/ground situational awareness.

Technology has been the catalyst for allowing these smaller and less costly platforms access to the real-time situational awareness information provided by Link 16. And now with the innovations of the 21st century, Link 16 access is delivered directly into the hands of warfighters that need it the most.

05. Evolution of Close Air Support Doctrine: Digitally-Aided CAS (DaCAS)



FIGURE 6. Traditional Digitally-Aided Close Air Support

Digitally-aided CAS has existed for a decade, but there have been a number of significant limiting factors that have precluded its widespread operational use. Lack of standardization of MIL-STD-6017 has produced many different aircraft implementations that do not allow for collaboration. Variable Message Format (VMF) transmissions over VHF UHF line-of-sight single channel radios to aircraft also have a very low incidence of success. Situation Awareness Data Link (SADL) and other traditional Link 16 radios had their own set of challenges. Large size, high cost, complexity, and power constraints have kept these systems from being a portable solution for DaCAS. However, the promise of DaCAS has remained, and by providing a direct digital connection between the JTAC and the supporting CAS aircraft, many of the coordination and deconfliction problems associated with traditional CAS tactics, techniques, and procedures are largely mitigated.

06. DaCAS Conducted with BATS-D/PRC-161

With the introduction of the world's only handheld Link 16 radio, BATS-D/PRC-161, DaCAS can now be fully realized for the dismounted warfighter at the tactical edge. The radio can be used vest-worn, handheld, or mounted, and is ideal for bringing full Link 16 network access to JTACs and other non-traditional users.



FIGURE 7. BATS-D AN/PRC-161 Provides New Capabilities to JTACs

There are a variety of configurable operations and the most common method of employment is fully tethered mode, where the radio is connected via external cable to an Android End User Device (EUD). This increases message capability and user accessibility through tactical data link integration and hosting software. The information is then forwarded into a purpose-built tactical application that enables digital mapping, sensor point of interest correlation, free-text chat, and targeting information and is sent directly into the weapon system of an aircraft.

The JTAC can observe the CAS aircraft's Precise Participant Location Information (PPLI) on his EUD's digital map as well as weapon load-outs, time on station, and other tactical status information. Through the publishing of the JTAC's PPLI over Link 16 using the PRC-161, supporting aircraft can "hook" the JTAC and see his location on their situational awareness displays (Head-up Display and Joint Helmet Mounted Cueing System).

The PRC-161 also has the capability to send and receive the full MIL-STD-6016 message library allowing future capabilities to be implemented into the application suite. The JTAC can plot a target on geo-rectified imagery and send this information machine-to-machine mitigating human interface errors or ambiguous, lengthy talk-ons.

In this manner, the desired mean point of impact from the JTAC can be automatically ingested into the CAS aircraft mission computer so its sensors and weapons are designated to the location without any manual activity by the aircrew. All of this information can be simultaneously relayed to any other participant and/or operations center in the network for enhanced situational awareness and combat teaming of assets, thus allowing for massing of effects. This digital interoperability enables JTACs to Find, Fix, and Finish the target at an exponentially faster rate with greater accuracy than ever before.

07. Conclusion

Prospects for the future of combined air-to-ground operations

At some level, all of the advantages of having a direct, digital connection between air and ground forces over Link 16 using the BATS-D/PRC 161 have not been fully realized yet.

Imagine a scenario involving extraction of dismounted ground forces from a hostile area where supporting fixed and rotary wing aircraft conducting the extraction have a detailed, digital understanding of the locations of the friendlies on the ground and can broadcast their position over Link 16 using the PRC-161.

Or perhaps there is a scenario where ground vehicular convoys can broadcast their position to aviation elements in the same manner. This would further enable commanders on the ground to have situational awareness of nearby air assets to more rapidly seek assistance in the event of an unexpected troops-in-contact (TIC) situation.

Over time, Link 16 has evolved from being an isolated network of large fighter and command and control aircraft into the widely adopted solution for line-of-sight situational awareness and command and control for essentially every manned and unmanned platform in today's air domain. By enabling direct connectivity with these platforms and now ground forces, many of the theoretical advantages and principles of network-centric warfare can be fully recognized.



FIGURE 8. Link 16 Connectivity at the Most Remote Edges of the Battlefield

These advancements in technology also require additional thought in terms of leveraging different approaches to the sharing of information among participants in the network (by adjusting the network designs). This will enable greater local awareness, potentially trading awareness at the theater or operational level and perspective.

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