The Theater Air Ground System Synthetic Battlespace

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ABSTRACT

The Theater Air Ground System (TAGS) elements have no persistent common synthetic battlespace in which to train. Because the TAGS includes the operational and tactical levels of war, it requires vertical and horizontal systems integration within components and between components. This has long been a training challenge due to limitations on exercises, ranges, and airspace allowing the live participation of air and ground forces. Planning, coordinating, tasking, controlling, and assessing can be the hardest aspects of Joint operations, yet we do not have the continuation training tools to enable us to do this regularly and affordably. Relying solely on large-scale Joint training events is too expensive, infrequent, and can lead to readiness shortfalls and operational risk.

This paper will define an initiative that will leverage systems integration of ongoing Joint Live, Virtual and Constructive simulation for TAGS training to include each Service's distributed command and control (C2) training network and the Joint National Training Capability (JNTC). It will focus on multi-Service efforts in developing a Joint Theater Air Ground Simulation System (JTAGSS) to link horizontal and vertical simulation elements of the C2 kill chain. This includes Joint Terminal Attack Controllers (JTACS), Joint Fires Observers (JFOs), Air Support Operations Centers (ASOC), Fire Support Cells (FSC) and eventually to Joint Air Operations Centers (JAOC) for persistent Joint and component training. In addition, JTAGSS would be designed to enable Joint integration of distributed links to Marine air ground C2, airborne C2, and close air support (CAS) platform simulators and simulation systems. This system would also include a recording and after action review (AAR) capability. The challenges to make this Joint team training a reality include adequate connectivity, sharable databases and scenarios, open Modeling and Simulation (M&S) architectures (standards compliance), common scheduling tools/processes and funding.

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SCOPE

The Theater Air Ground System (TAGS) elements have no persistent common synthetic battlespace in which to do continuation training. As stated in AFTTP(I) 3-2.17, the TAGS includes an overarching joint command and control (C2) architecture and Service coordination links that facilitate the integration, synchronization, planning, and execution of joint air-ground operations which includes Joint Fires. The Theater Air Ground System is used to plan, prepare, execute and assess effects of the Joint Close Air Support (JCAS) mission area, a critical Joint Fires capability. It is a system of systems, a synergy of the various component air ground systems, orchestrating the planning and execution of air-ground operations.

Figures 1 and 2, and 3 taken from *Joint Tactics, Techniques, and Procedures for Close Air Support*, Joint Pub 3-09.3, are connectivity charts but represent each Service's portion of the TAGS (Figure 1 represents the Army Air Ground System/USAF Theater Air Control System, Figure 2 is the Navy Tactical Air Control System/Marine Command and Control System and Figure 3 is the Special Ops Close Air Support Connectivity Architecture). In combination, they make up the TAGS. Because it includes the Operational and Tactical levels of war, it requires vertical and horizontal systems integration within components and between components.

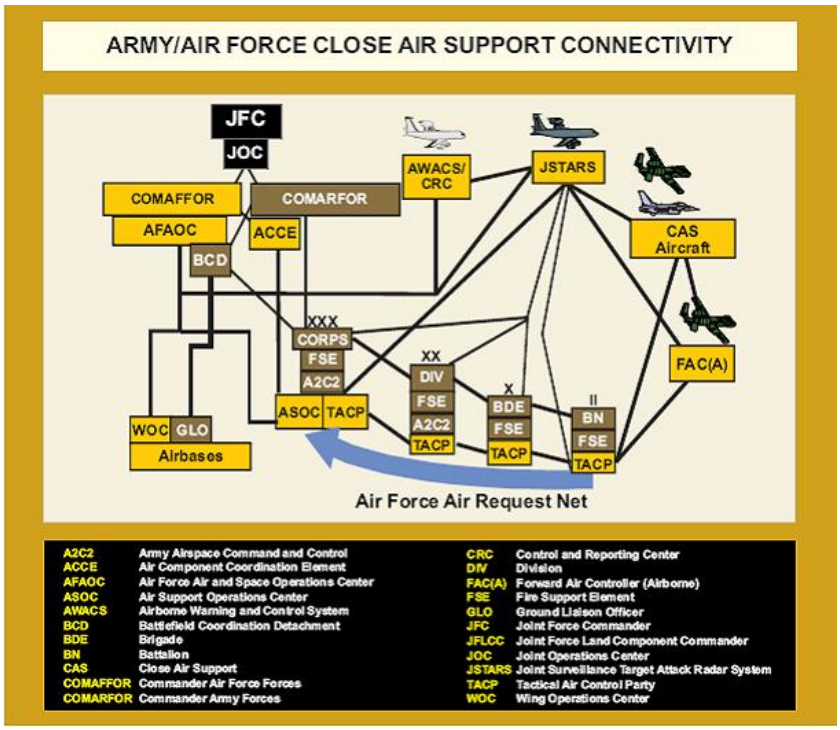

Figure 1 Army/Air Force Close Air Support Connectivity Architecture

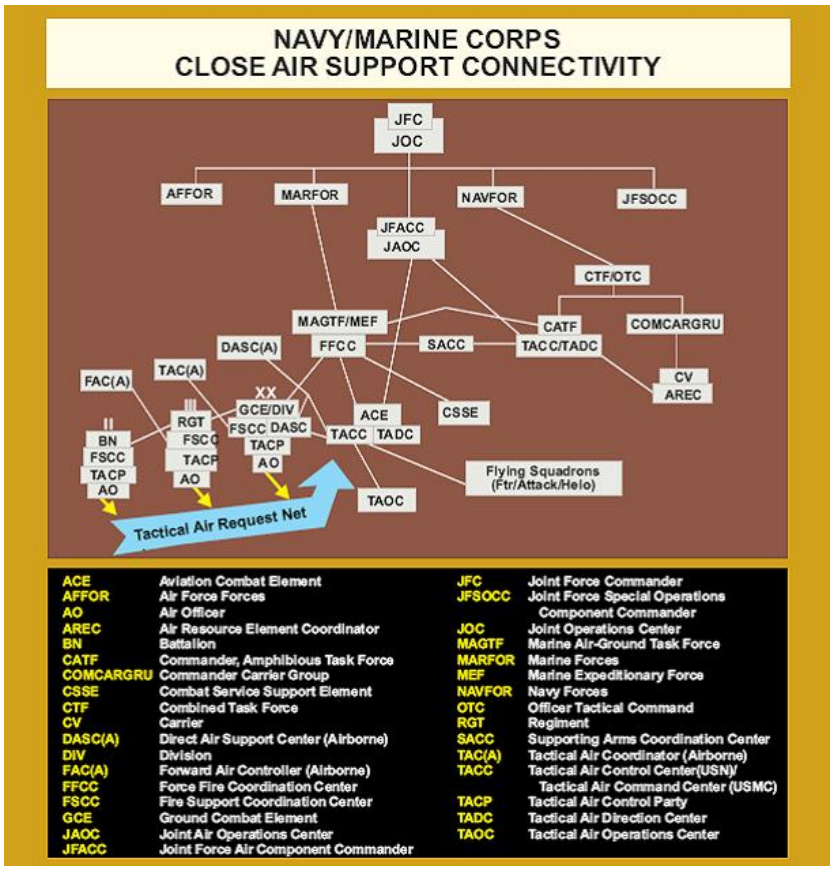

Figure 2 Navy/Marine Corps Close Air Support Connectivity Architecture

Figure 3 Special Operations Close Air Support Connectivity

Relative to successfully employing JCAS, the size and complexity of the Theater Air Ground System presents training challenges to warfighters.

In meeting the JCAS training challenge, the Services have agreed, through the JCAS Executive Steering Committee, to commit to developing and utilizing distributed simulation technology to enhance Joint training opportunities within the Joint National Training Capability Strategy. This is delineated in JCAS Action Plan Issue 7. Although issue 7 covers the simulation needs of the Joint Terminal Attack Controller (JTAC), it also addresses the planning/coordination and C2 training needs of the Tactical Air Control Party (TACP), USAF Air Support Operations Center (ASOC) and Marine Direct Air Support Center (DASC). It directs the USAF to begin the Joint Capabilities Integration and Develop System (JCIDS) process, in coordination with all of the Services, to build a funding strategy to enable research and development, procurement, and sustainment of JCAS distributed training systems. This paper will focus on the acquisition challenges faced in procuring a system to meet the C2 training needs required of our Air Support Operations Centers, and Tactical Air Control Parties. The Distributed Mission Operations (DMO) is the cornerstone for Air Force training transformation supporting the DoD Strategic Plan for Training Transformation and supports Service level and Joint National Training Capability (JNTC) objectives. The objective is to train the way we intend to fight, enabling Air Force warfighters to maintain combat readiness and conduct mission rehearsal in an environment as operationally realistic as possible.

DMO is the USAF's attempt to provide complete integration of live, virtual, and constructive systems for training, mission rehearsal, and operations support in a theater of war environment. It will enhance the kill chain by enabling the sensor to shooter training links that is currently not available because of the high demand realities of our limited ground and airborne C2 systems. The realism achieved by this capability will further increase the commander's ability to "be inside the opponent's decision loop" and improve combat effectiveness. The Army has a similar effort to achieve JNTC objectives through their Live, Virtual, Constructive – Integrating Architecture and Infrastructure (LVC-IA) Program.

US Army Live Virtual Constructive Integrated Architecture and Infrastructure Program and DMO.

The LVC-IA Initial Capabilities Document requires standards, protocols and interfaces to link disparate Army live instrumentation and simulation systems, Virtual simulators/simulations and constructive simulations that enable Battle Command Training Capability (BCTC). This includes linking to each Service's JNTC contribution such as USAF DMO. DMO provides the same requirement for common standards and protocols, enabling both virtual and constructive simulations to interact in a common synthetic battlespace. This becomes more practical as we integrate training between Joint components for recurring daily/weekly/monthly continuation training other than large-scale warfighters and exercises. This is particularly important for Joint Fires training to practice all the JCAS phases of planning, preparation, execution and assessment. Planning and coordination can be the most difficult aspect. CAS must be integrated in the Military Decision Making Process timelines in order for CAS assets to be available when needed to reinforce success of the ground commander's objectives. The JCAS mission area process is particularly complex because it can touch all elements of the TAGS from Operational to Tactical levels and horizontally between Air/Ground component command and control elements.

Joint Fires and specifically JCAS distributed simulation training must enable the same complex characteristics needed to target, coordinate, task , and assess effects experienced during actual air ground operations.

AIR/GROUND TRAINING CAPABILITY GAP

As stated in the 2005 JCAS Action Plan, "…simulation now offers realistic and affordable training options for some joint tactical tasks that previously required live assets and/or live fire ranges to achieve a high degree of training fidelity." We know simulation can never completely replace live JCAS training, current technology allows reliable substitution for specific events in initial and follow-on individual and team training for air and ground units. The ongoing JNTC initiative will help evolve joint requirements for live, virtual and constructive training simulation. Certified stand-alone virtual simulators could expand training opportunities and resolve shortfalls in selected JTAC training events for initial qualification, mission qualification and continuation training. Current Service, USSOCOM and USJFCOM efforts already have the underpinning elements for Joint virtual team training. However, JCAS training is not just about the execution phase of terminal attack control and weapons

employment. It is also about planning, preparation and assessment. This is mostly found in the battlestaff functions of the ASOCs, TACPs and Army Fire Support Cells. Constructive simulations that network staff and liaison elements to practice battle management and fire support integration are already done in large exercises and schoolhouses. However, persistent battlestaff simulation capability does not exist for recurring continuation training between air/ground components.

In particular, elements of the Joint Theater Air Ground System (e.g., Joint Air Operations Center, ASOC, TACP, Fire Support Cell, JTAC, aircrew, etc.) cannot conduct virtual or constructive, collaborative training or mission rehearsal in a persistent recurring synthetic continuation training environment. An on demand ASOC/TACP Command and Control Battle Management training/rehearsal system is therefore required to network to all these critical joint close air support elements.

This Joint Theater Air Ground Simulation System (JTAGSS) would be designed to provide any ASOC, and TACP a distributive command and control training capability enabled by DMO or any Joint mandated live, virtual, constructive architecture. The intent is to be compatible with Direct Air Support Center, Fire Support Cells, and other sister Service command and control battlestaff systems and elements training nodes. It also needs to be deployable so that command and control units will be able to rehearse air ground battle plans in order to strengthen the ground commander's success in operational locations. Additionally, it should provide common networked scenarios for all ASOC and TACP battle management systems for either training or rehearsal. In combination with the virtual JTAC Joint Terminal Control Training and Rehearsal System (JTC TRS) and future Joint Air Operations Center simulation systems, JTAGSS would provide a complete representation of Air Component command and control in the battlespace with JCAS supported units for joint fires training. Equally important is the ability to link with Marine Tactical Air Control System elements to include the Direct Air Support Center, Fire Support Coordination Centers (FSCCs), Tactical Air Coordination Centers (TACCs), Tactical Air Direction Centers (TADCs), and CAS platform simulators. When these elements are not participating, JTAGSS should serve as a host to replicate command and control functions by providing intelligent agent message traffic responses so air/ground users are still able to perform their mission training tasks as they would during live interaction.

Some but not all capabilities need to include:

1. Simulate and/or stimulate air ground C2 elements and joint fires functional systems for distributed or stand-alone continuation training/rehearsal
    a. Stimulate – system must stimulate all ASOC command and control systems based on the selected scenario for the training event
    b. Simulate – Replicate ASOC functionality:
        - retrieve Joint Air Operations Center products from database
        - receive and process immediate Joint Tactical Air Support Requests (JTASRs)
        - transmit air mission data to the JTAC
        - assign and commit aircraft to the JTAC
        - stimulate joint fires command and control systems and Supporting Element mission tools
2. Interactive intelligent agents. System must be able to receive doctrinally correct voice transmission or receive digital transmissions accurately.
3. Data collection, playback and debrief for training/rehearsal and real world operations
4. DMO/Joint Training and Experimentation Network (JTEN) multi-level security capable. It must provide on-demand access to a distributed training architecture that will allow multi-level security joint training/mission rehearsal with air ground Joint Fires C2 elements
5. Scenarios – It must have the capability to interactively develop, import, store and distribute unit generated scenarios to train for or rehearse any global contingency desired
6. Deployability - JTAGSS equipment and support items must be configurable for air-, sea-, land- lift using standard modes of transportation.
7. JTAGSS requires the ability to schedule monthly, weekly and daily in-garrison training events for continuation training.
8. Limited to no on-site contract support needed

FIELDED SYSTEMS

Our review of current USMC modeling and simulation capabilities has surfaced training systems that need to be part of the total training capability. Air Force Air Support Operations Centers must be able to link to USMC Direct Air Support Center training systems in order to do cross-Service air/ground training. This becomes particularly important in scenarios like those that we experienced in OPERATION IRAQI FREEDOM where Marines and Army shared USAF, USN, and USMC CAS aircraft. USAF and Army

training requirements vary but JTAGSS must be able to support daily/weekly training events at in-garrison locations between non-collocated joint fires Theater Air Ground System elements. The following are specific USMC training capabilities.

Combined Arms Command and Control Capability Training Upgrade System (CACCTUS). CACCTUS is a replacement to the USMC Combined Arms Staff Trainer used at 29 Palms. It is a transformational program that will add significant enhancements to the all aspects of Marine Air Ground Task Force (MAGTF) training. It provides a synthetic environment to run scenarios with modeling and simulation that stimulates USMC command and control systems for comprehensive air ground training[7]. In addition, CACCTUS blends the operational environment with a live, virtual, and constructive backbone for collaborative training among widely dispersed sites. It will federate with JNTC.

Joint Expeditionary Tactical Trainer (JETT). JETT is currently used by the USMC Expeditionary Warfare Training Group Atlantic (EWTGLANT) schoolhouse to train Direct Air Support Center and USMC Tactical Air Control Party personnel. It includes the Expeditionary Fires Module (EFM), Multipurpose Supporting Arms Trainer (MSAT), Expeditionary Fighting Vehicle (EFV) mock-up, secure classrooms and 10 configurable training modules. It also includes a modeling and simulation backbone "stimulating" real world computer systems to enhance operator and staff training.

These USMC modeling and simulation systems are designed to stimulate USMC command and control systems with tailored scenarios. The USAF uses similar command and control systems but they are not configured to link with the current USMC systems. This is not insurmountable, but our goal is to provide an on demand, scalable in-garrison continuation training capability. The Air Force is completing technical reviews of Marine, Army and other command and control training systems. In addition, the Air Force Research Lab is completing system/software capabilities definition, and exemplar design as part of a risk mitigation strategy to use during acquisition.

PROGRAM CONSIDERATIONS

Connectivity. Effective command and control requires the sharing and integration of data vertically and horizontally. The movement of data requires interoperable modes, ability to interpret the data, and compatible encryption schemes. In this regard, distributed simulation capabilities are no different from operational systems. For example, one of the primary air component command and control systems is the Theater Battle Management Core System (TBMCS). While primarily used at the operational level, tactical users require data such as the air tasking order and airspace control order from TBMCS directly or through some type of interface. These remote users require a communications circuit appropriately encrypted and the ability of their system to interpret and display the data if they are using an interface with a system such as the Army's Advanced Field Artillery Tactical Data System (AFATDS). Command and control simulation requires the same capability in order to ensure realism during training or mission rehearsal events.

ASOC and TACP elements need two primary types of simulation connectivity. The first type is to have data circuits that are able to carry large amounts of data (large bandwidth) and used to replicate the capabilities of Theater Deployable Communications and the Integrated Capabilities Access Package.

The second connectivity requirement is to replicate tactical communications. Typically, this includes narrow bandwidth systems such as Tactical SATCOM, UHF/VHF, and VHF/FM SINCGARS. While it is preferable to use the actual radio device, this is usually not possible. However, interfaces for these devices can be adopted using voice over IP (VOIP) capabilities. This allows an operator to train on what appears to function as an actual device, but in actuality, the operator is using an interface device that emulates the real system.

Architecture standards. Network connectivity challenges need to be solved as some of the USAF distributed mission operations capability is on both the DMO Network (DMON) and Air Reserve Component Network (ARCNET), the Air National Guard's primary distributed training network. Both networks have similar but separate standards. The USAF intends to first use ARCNET for JCAS distributed training. For that reason, any future training system capability would need to be ARCNET capable. This will allow TACPs to send JTASRs from the future JTC TRS to a secure ASOC constructive simulation system.

Currently, the A-10 Full Mission Trainer is on ARCNET and F-16, F-15E, B-52 and other close air support platforms are on the DMO Network. Eventually all will migrate to the DMO Network, but until then the simulation systems will uses gateways to link these two networks. More issues arise as we add

cross-service elements such as a fire support cell to the network. As ARCNET security issues arise, they must be resolved before a full-distributed training capability can be realized. Network security issues further expand as we link air ground joint fires teams to DMON. This would enable the inclusion of the Joint Surveillance Target Attack Radar System (JSTARS) simulator that would be an added benefit to Army battlestaff training. The challenge is to integrate all air ground C2 elements using compatible networks and potentially one secure training network that will open up more opportunities to work with multiple Joint Fires assets within a joint synthetic battlespace. Eventually this should lead to Joint National Training Capability accreditation and certification as part of the overall Training Transformation Strategy.

Sharable, scalable databases and scenarios. Sharable databases and scenarios become a challenge when they are linked to a specific image generator or any other type of stovepipe system. Databases and scenarios in the future need to be sharable among all the participants in distributed training, regardless of the software and hardware such as the image generator their system is running.

Database size can also be a challenge. In order to maneuver, aircraft require large operating areas where a ground unit is capable of training in a relatively small area. However, considering the large amounts of data that can be stored on the latest hard drives, database size should be less of a problem.

Database and scenario security is also an issue. Participants may be operating in systems with different security levels depending on the weapons system. All ARCNET and DMON capable Air Force and Air National Guard simulators and Mission Training Centers operate secure which necessitates that all future network simulators connecting to these networks must meet the same standards and security requirements. Linking cross-Service and coalition simulators would necessitate using multi-level security filters and permissions to allow required data sharing at the appropriate security level.

Common scheduling tools/processes. Simulation is not subject to time constraints such as weather, noise limitations, or daylight/nighttime training requirements. This allows around the clock scenario play for systems to work together regardless of their time zone and widens the audience needing to satisfy training requirements. The Air Force is working with US Joint Forces Command and the other Services in investigating different web-based scheduling tools to enable inter-service scheduling of distributed training events on DMON and ARCNET. As recurring Joint continuation training becomes routine, the JTEN will serve more than just large-scale Joint exercises. It will become a routine part of the persistent Joint team training synthetic environment for daily/weekly air ground training.

Funding. Obtaining funding for new systems and new simulation systems in particular, is a challenge because of the difficulty in finding offsets from existing programs. Until actual simulation systems have been developed and are being used, it is difficult to quantify or project the savings from using simulation instead of live training. This savings offset can be used to pay for training system costs. Therefore, as operations experts and material developers identify and develop the capabilities for simulators they need to be conducting analysis to determine the live training costs in conjunction with the developmental effort.

System sustainment funding also has its challenges. In addition to the cost of maintaining the DMO network infrastructure, the system must stay concurrent with fielded C2 systems so upgrades must be funded throughout its lifecycle.

Acquisition. Typically, funding for modeling and simulation in support of training has not fared well against high budget defense programs. This is particularly true when we try to cut corners by avoiding programmatics in favor of relying on fall-out dollars to purchase commercial off the shelf (COTS) simulators that were not built with distributed Joint training in mind. Although this is a means to provide warfighters a training capability quickly, it may be without needed sustainment as would be found in a complete life-cycle acquisition strategy that is built to meet warfighter training needs. It is therefore imperative that new systems intended to comply with OSD's Training Transformation Strategy are born Joint from the beginning. As many know this is precisely why the Joint Capabilities Integration Development System was established. However, it will only work if all the Services participate from the beginning for systems that have Joint impact. This begins with the Functional Area Analysis to the milestone decisions and the associated Initial Capabilities Documents, Capabilities Development Documents and Capabilities Production Documents.

CONCLUSION

In summary, a joint fires modeling and simulation capability is needed now to ensure Theater Air Ground System operators are trained and mission ready. It

must support the four phases of the JCAS model: planning, preparation, execution, and assessment. JCAS is unique because it touches all Services whether it is a ground commander requesting it or an air component commander providing it. Consequently, if JCAS is going to be effective all ground commanders (Army, Marine, and Special Operations Forces) must be ready to plan, request and employ it in order to maximize its effects and minimize its risks. This emphasizes the need for Joint participation in the capabilities definition process to acquire a valid ASOC and TACP command and control joint distributed simulation training and mission rehearsal capability. One that is capable of interfacing with ground component joint fires command and control elements. This process has begun for such a training system, the Joint Theater Air Ground Simulation System.

JTAGSS offers great potential for enhanced training and interoperability with USAF, Service, and joint distributed training capabilities. As the number of fighter and bomber aircraft, platforms are reduced and the numbers of joint terminal attack controllers are increased, collaborative and distributed training is essential to train the command and control elements and aircrew in an environment beneficial to all participants.

As JTAGSS matures, it will permit ground and air TAGS elements to train and mission rehearse in a valid Joint synthetic battlespace. It will be the linchpin to link the operational level Joint Air Operations Center command and control to execute the unique joint mission performed by ASOC operators. This mission is the execution of JCAS for Army ground forces. In the end, ground commanders will benefit as joint terminal attack controllers use their simulators to train directly from Army installations with aircrew flying high fidelity aircraft simulators in support of valid ground and air joint training scenarios.

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