

THE INTERNATIONAL
C2 JOURNAL

VOLUME 5, NUMBER 3, 2011

SPECIAL ISSUE

*Integrating Air, Land and Sea Operations:
C2 Teams and their Technologies*

GUEST EDITOR

Stuart Grant
Defence Research and Development Canada

The Need for Dynamic Airspace Management in
Coalition Operations

Anthony W. Potts
James W. Kelton

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 2011	2. REPORT TYPE	3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE The Need for Dynamic Airspace Management in Coalition Operations		5a. CONTRACT NUMBER	
		5b. GRANT NUMBER	
		5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)		5d. PROJECT NUMBER	
		5e. TASK NUMBER	
		5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Office of the Assistant Secretary of Defense (NII), Command and Control Research Program (CCRP), Washington, DC, 20301		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)	
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited			
13. SUPPLEMENTARY NOTES			
14. ABSTRACT The United States? Central Command (CENTCOM) has highlighted Airspace Command and Control (AC2) as an area where national ISAF, and NATO systems can deliver enhanced benefits to forces in the Afghanistan theater of war through leveraging a new CENTRIXS-ISAF (CX-I) Afghanistan Mission Network (AMN). There is a need to streamline AC2 procedures and find the right mix of battle command systems to most effectively and efficiently perform AC2 planning and execution in a coalition environment on CX-I/AMN. The Coalition Attack Guidance Experiment (CAGE), conducted in May 2010, took the constructs developed by a CENTCOM Operational Planning Team AC2 Working Group and experimented with solutions that can have a direct positive operational effect in the near term; CAGE also focused on future capabilities and potential solutions. This manuscript will identify how CAGE contributed to evolving coalition AC2 operations toward Dynamic Airspace Management - a mission-execution centric approach - versus today?s planning-centric processes. The efficacy of the U.S. Army?s Tactical Airspace Integration System (TAIS) Dynamic Airspace Collaboration Tool (DACT), as demonstrated during CAGE, will be analyzed as one tool available today to improve coalition AC2 processes on CX-I/AMN.			
15. SUBJECT TERMS			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	Same as Report (SAR)
			18. NUMBER OF PAGES 11
			19a. NAME OF RESPONSIBLE PERSON

THE INTERNATIONAL C2 JOURNAL

David S. Alberts, Chairman of the Editorial Board, *OASD-NII, CCRP*

The Editorial Board

Éloi Bossé (CAN), *Defence Research and Development Canada*

Berndt Brehmer (SWE), *Swedish National Defence College*

Lorraine Dodd (GBR), *Cranfield University*

Reiner Huber (DEU), *Universität der Bundeswehr München*

William Mitchell (DNK), *Royal Danish Defence College*

Sandeep Mulgund (USA), *The MITRE Corporation*

Mark Nissen (USA), *Naval Postgraduate School*

Mink Spaans (NLD), *TNO Defence, Security and Safety*

Andreas Tolk (USA), *Old Dominion University*

About the Journal

The International C2 Journal was created in 2006 at the urging of an international group of command and control professionals including individuals from academia, industry, government, and the military. The Command and Control Research Program (CCRP, of the U.S. Office of the Assistant Secretary of Defense for Networks and Information Integration, or OASD-NII) responded to this need by bringing together interested professionals to shape the purpose and guide the execution of such a journal. Today, the Journal is overseen by an Editorial Board comprising representatives from many nations.

Opinions, conclusions, and recommendations expressed or implied within are solely those of the authors. They do not necessarily represent the views of the Department of Defense, or any other U.S. Government agency.

Rights and Permissions: All articles published in the International C2 Journal remain the intellectual property of the authors and may not be distributed or sold without the express written consent of the authors.

For more information

Visit us online at: www.dodccrp.org

Contact our staff at: publications@dodccrp.org



The Need for Dynamic Airspace Management in Coalition Operations

Anthony W. Potts and James W. Kelton (U.S. Army, USA)

Abstract

The United States' Central Command (CENTCOM) has highlighted Airspace Command and Control (AC2) as an area where national, ISAF, and NATO systems can deliver enhanced benefits to forces in the Afghanistan theater of war through leveraging a new CENTRIXS-ISAF (CX-I) Afghanistan Mission Network (AMN). There is a need to streamline AC2 procedures and find the right mix of battle command systems to most effectively and efficiently perform AC2 planning and execution in a coalition environment on CX-I/AMN. The Coalition Attack Guidance Experiment (CAGE), conducted in May 2010, took the constructs developed by a CENTCOM Operational Planning Team AC2 Working Group and experimented with solutions that can have a direct positive operational effect in the near term; CAGE also focused on future capabilities and potential solutions. This manuscript will identify how CAGE contributed to evolving coalition AC2 operations toward Dynamic Airspace Management - a mission-execution centric approach - versus today's planning-centric processes. The efficacy of the U.S. Army's Tactical Airspace Integration System (TAIS) Dynamic Airspace Collaboration Tool (DACT), as demonstrated during CAGE, will be analyzed as one tool available today to improve coalition AC2 processes on CX-I/AMN.

Introduction

The United States' Central Command (CENTCOM) has highlighted Airspace Command and Control (AC2) as an area where national, International Security Augmentation Force (ISAF), and North Atlantic Treaty Organization (NATO) battle command

systems can deliver enhanced benefits to forces in the Afghanistan theater of war through leveraging a new CENTRIXS-ISAF (CX-I) Afghanistan Mission Network (AMN) (CENTCOM 2009, 1-14). In addition to establishing and maintaining free flow of operational AC2 data between Coalition/NATO forces on CX-I/AMN, there is also a need to find the right mix of battle command systems to most effectively and efficiently perform AC2 planning and execution in a coalition environment.

Execution of AC2 today is heavily reliant on chat tools. While providing a rudimentary text messaging collaboration capability, these tools lack the capability to present a common visualization and representation of data and they do not offer 3D collaboration or approval of airspace requests in real time. Most AC2 functions revolve around a deliberate planning process and the procedures do not adapt well to time sensitive mission execution requirements—requirements which demand real-time changes to airspace, coordinated with all applicable airspace stakeholders in order to facilitate immediate approval.

The Coalition Attack Guidance Experiment (CAGE)

Under the auspices of the CENTCOM CX-I/AMN Operational Planning Team (OPT), several workshops and experiments were held to address these issues. The Coalition Attack Guidance Experiment (CAGE), conducted in May 2010, served as a venue to experiment with solutions for ISAF that can have a direct, positive operational effect in the near term, and to also focus on future capabilities and improvements. The Canadian Forces Warfare Centre (CFWC) executed CAGE at their Joint Battle Lab in Ottawa, Canada. (National Defence Headquarters 2010, 1)

The aim of CAGE was to analyze battlespace management and integration technologies and processes to identify opportunities to increase situational awareness, freedom of maneuver, effectiveness

of fires, and AC2 processes. CAGE, a human-in-the-loop experiment, utilized experienced operations personnel in a representative Afghanistan scenario to focus on both joint fires support and AC2 domains within the ISAF shared command and control AMN configuration. (National Defence Headquarters 2010, 1)

Although other commands and agencies design and execute what may appear to be similar events, CAGE was unique in several respects. For example, AGILE FIRES is a Joint U.S. Army and U.S. Air Force experiment that focuses on improved AC2 processes, procedures, and C2 systems, but it does not currently incorporate coalition mission threads and players. Other exercises such as ALLIED AURORAS, the Coalition Warrior Interoperability Demonstration (CWID), and the Joint Forces Expeditionary Experiment (JFEX) series of exercises incorporate coalition play, but they are broad in scope and do not fully focus efforts on the subset of AC2 gaps and issues against real world scenarios and ongoing missions in Afghanistan.

U.S. Army Battle Command systems that participated in CAGE were the Tactical Airspace Integration System (TAIS) with a web-based Dynamic Airspace Collaboration Tool (DACT), Advanced Field Artillery Tactical Data System (AFATDS), Aviation Mission Planning System (AMPS), Command Post of the Future (CPOF), and Global Command and Control System-Army (GCCS-A). These U.S. Army systems interfaced and interoperated with the Canadian Land Combat Support System (LCSS) and programs common to both nations, including the Joint Automated Deep Operations Coordination System (JADOCS), Theater Battle Management Core System (TBMCS), and Air Defense System Integrator (ADSI). NATO's Integrated Command and Control (ICC) system was also integrated within the Canadian Joint Fires Support testbed to analyze the evolving coalition C2 shared AMN configuration for the ISAF in Afghanistan. CAGE was designed to provide an operationally relevant, realistic experiment with the ISAF Regional Command South (RC-S) order of battle, real-world products, Afghanistan

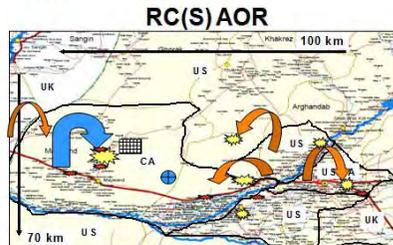
terrain database, and scenario. Focusing CAGE on the current fight provided a mechanism to produce revised Concepts of Employment (CONEMPs) and Tactics, Techniques, and Procedures (TTPs) that could be rapidly provided back to the warfighter to influence immediate improvements, versus the usual experiment paradigms that focus on the future force and technologies. (National Defence Headquarters 2010, 1)

CAGE was split into two conditions with each condition exercising three operational experiment phases (Figure 1). Phase 1 was cordon and search. Phase 2 was transition to occupy and expand the area captured in Phase 1 into a coalition Forward Operating Base (FOB). Phase 3 was insurgent counter-attack against the newly established, immature FOB.



JFS HF-3: CAGE Scenario Context and Triggers

Participation from the United States, Canada, Australia, and the United Kingdom executed at the SECRET ISAF level using the Regional Command South – Area of Responsibility (AOR), terrain, ORBAT, and SOP / TTP



High intensity conflict encompassing the full spectrum of military operations

- Phase I – Cordon and Search**
- Cdn BG conducts cordon and search of enemy village/stronghold
 - 82nd CAB inserts troops, and provides attack aviation and MEDEVAC support
 - 5/2 Stryker Brigade Combat Team provides artillery support
 - UK provides CAS
 - UAVs provide surveillance
 - Enemy forces engage, then retreat to desert
- Phase II – Transition**
- Insurgent occupied village is overrun and occupied by Coalition Forces
 - Insurgent forces conduct continuous "hit and run" attacks
 - Logistics convoy resupply mission
 - Special Operations Forces - deconfliction events
- Phase III – Insurgent Offensive Assault**
- Enemy attempts to overtake the Strong Point

Minimum Activity Level for each Phase

	MedEvac	CAS	UAV Operations	CFF
4		3	As Required	5
3		2	As Required	7
5		4	As Required	9

Subset of Persistent Events

NGO Aircraft • NGO Convoy • Civilian Casualties • Ambushes • Patrols • Sig INT / EW • SOF operations

Figure 1. CAGE

Condition 1 consisted of operations “as-is”, and did not leverage other nations’ net-capable tools. Cells were established to replicate a Canadian Task Force Kandahar (TFK), a U.S. Army Combat Aviation Brigade Task Force Pegasus (TFP), and a Higher Control (HICON) to provide an interface to elements such as the ISAF Regional Command-South (RC-S) airspace cell, the U.S. Air Force Control and Reporting Center (CRC), and other key nodes. During Condition 1, airspace coordination and execution involved exchanging data messages between national systems using sendmail protocols, shared network folders, Voice Over Internet Protocol (VOIP), and a chat program. TFK primarily used JADOCS, TFP used TAIS, while RC-S headquarters and the CRC used JADOCS and ICC.

In Condition 2, the TAIS DACT (Figure 2) was exposed for use by all commands. The DACT is a web accessible, 3D mapping thin client that allows any user on the network to observe and participate in the AC2 planning or execution process with TAIS. The DACT, powered by an open 3D mapping engine developed by NASA, can be accessed by navigating to the TAIS server via a web browser. Once approved by the TAIS operator, the DACT user has access to a host of information from the TAIS. This includes visual and textual representations of the Airspace Control Order (ACO), Airspace Control Means Requests (ACMRs), and airtracks. DACT users also have the ability to create, draw, and submit their own ACMRs and track the status of those ACMRs. Users of the DACT can also collaborate with other DACT users or TAIS operators on an ACMR, interactively modifying Airspace Control Measure (ACM) information in real-time. Condition 2 allowed CAGE participants to visualize current and immediate changes to the airspace, plus near-real-time airtracks, to assist them in making expeditious decisions.

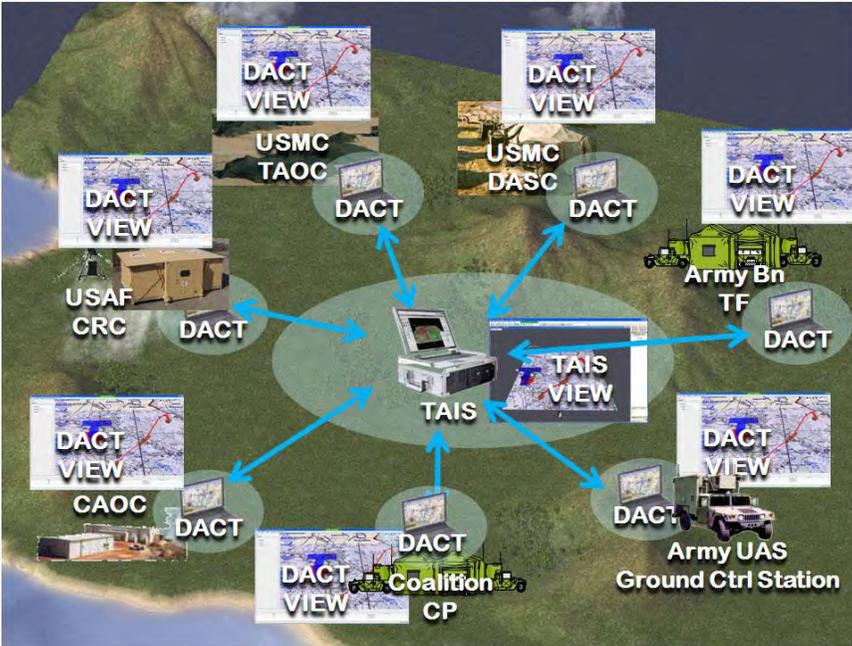


Figure 2. TAIS and DACT Shared Visualization and Collaboration

The dominant driver of airspace requests during CAGE was immediate missions that did not need to be approved by the Joint Forces Air Component Commander (JFACC)/Airspace Control Authority (ACA) at the Aerospace Operations Center (AOC). Since the USAF CRC was granted authority for these missions, they did not need to be submitted to TBMCS at the AOC for inclusion in the daily ACO or change ACO. Missions requiring rapid response, such as MEDEVACs, fire missions, and close air support were initiated at the task force level and communicated to RC-S for deconfliction approval and CRC clearance. RC-S, using VOIP and chat would communicate back with the requesters to discuss intentions, changes, conflicts, and other pertinent details. Once a consensus had been reached by all stakeholders, the requests would be approved or denied accordingly.

RC-S and CRC role players found that one of the most useful mechanisms for deconflicting and clearing airspace in Condition 1 was to use the Global Area Reference System (GARS) grid to designate areas to clear. TFK used JADOCS to construct airspaces based on the GARS grid, and would communicate those grids over chat and VOIP. These grid values could be quickly and easily communicated to the CRC for rapid clearance.

Once the DACT was introduced as part of Condition 2, RC-S and CRC were able to work more efficiently by sharing the same airspace picture and receiving access to full 3D visualization with terrain. The CRC role player from the U.S. Joint Forces Command (JFCOM) stated that the 3D visualization of airtracks and airspace volumes provided great benefit in fulfilling his mission as the CRC. Both RC-S and the CRC were able to discern aircraft and airspace conflicts within seconds of the ACMR being submitted to the TAIS. This was particularly evident during TFP fire missions where the AFATDS would generate a precise Munition Flight Path (MFP). This MFP clearly showed the arc which the munitions would follow, and made it very easy to determine if aircraft flying under the arc were in any danger from the fire mission.

During a High Mobility Artillery Rocket System (HIMARS)/Army Tactical Missile System (ATACMS) fire mission, as soon as AFATDS had the firing solution calculated, it transmitted ACMRs representing the Position Area Hazard (PAH), the Target Area Hazard (TAH), and the Munition Flight Path (MFP) trajectory arc to the TAIS (Figure 3). TAIS immediately checked ACM-to-ACM conflicts for incoming ACMRs against the current Unit Airspace Plan. The ability to immediately visualize the geometries and their relation to other geometries greatly increased the RC-S headquarters' ability to clear fire missions and significantly decreased the amount of time required for approval. The ability to visualize the aircraft in three dimensions against those fire mission geometries enabled the CRC to make informed, immediate decisions regarding airspace clearance. RC-S and the CRC, enabled with the DACT, were able to

clear cross-boundary airspace for fires where U.S. Army firing batteries were supporting a Canadian fire mission in under a minute. This was a significant achievement and it highlights the importance of seamless digital transference of time critical data to enable knowledge management and situational understanding.

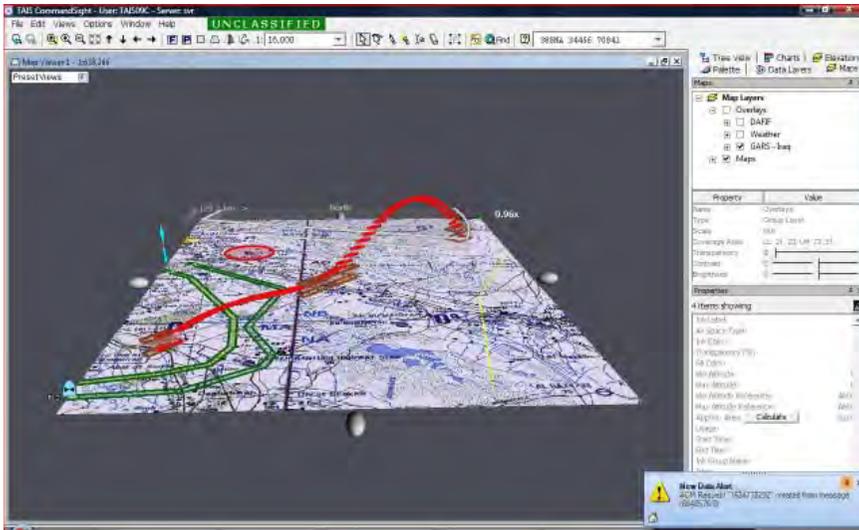


Figure 3. Munition Flight Path as Seen on TAIS or DACT

Users agreed that the data made available through the DACT was invaluable. At any given time, the users had complete visibility of the current and pending airspace. This was particularly evident at the RC-S/CRC cell in the CAGE HICON work area, where five users simultaneously used the DACT to monitor current and in-progress airspace actions.

Although the TAIS DACT is but one component of moving from static, planning-centric processes toward more dynamic airspace management, CAGE clearly demonstrated the value of shared collaboration, visualization, and situational understanding to enable more timely approval practices with lower inherent risk by leveraging

common tools available over a shared mission network. U.S. Army Battle Command systems will continue to explore opportunities to evolve toward dynamic airspace management in future experiments.

Army Battle Command envisions a consortium of capabilities on a common hardware platform. This effort, known as Battle Command Convergence, will consolidate maneuver, fires, logistics, and airspace C2 functions into a common architecture. The Command Post of the Future (CPOF) will form the basis for this product line consolidation with a supporting effort of enhanced web services. These additional web services beyond the DACT will provide even more opportunity to explore how to improve coalition processes and enhance C2 for all forces.

References

CENTCOM CENTRIXS-ISAF OPT Meeting Notes, MacDill AFB
(Tampa), Florida, 30 March-3 April 2009.

2010. "Joint Fires Support Human Factor-3/Coalition Attack Guidance Experiment (JFS HF-3/CAGE) First Impressions Report." National Defence Headquarters, Ottawa Ontario, 24 June.