

16th ICCRTS

“Collective C2 in Multinational Civil-Military Operations”

Tactical Edge Command and Control On-The-Move

“A New Paradigm”

Topic 10: C2, Management, and Governance in Civil-Military Operations

Topic 1: Concepts, Theory, and Policy

Topic 5: Collaboration, Shared Awareness, and Decision Making

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Abstract

Tactical Edge Command and Control On-The-Move (C2OTM) is essential today and in the future because of the distributed nature of our operations. These operations are characterized by forces (Joint, Interagency and Multinational) widely dispersed in multiple domains throughout an operating area. Frequently, operations exceed mutually supporting distances and tactical units operate independently of one another. Because of remoteness, differing missions, and traditional fixed command post capabilities, they must be supported by a variety of transportable assets and capabilities that are not organic to the various units. Leaders from the tactical edge to the operational level of this varied environment need C2 capabilities that facilitate and support agile information flow and decision making, while moving from position to position with mobile command posts. C2OTM implies reliability, appropriate redundancy and agility to operate effectively, both independently and with our mission partners in austere and/or denied or degraded environments. Currently mid-term solution sets for the tactical edge are being addressed by the C2OTM Focused Integration Team (FIT) through the C2OTM Initial Capabilities Document (ICD) as a baseline. The C2 community must continue to investigate potential long-term capability solutions to improve the tactical leaders' capability to conduct C2 in a distributed environment.

Introduction

Command and Control (C2) is first and foremost a human endeavor. It is leader-centric and network enabled, reflecting both the Commanders' decision making ability and staff recommendations. While materiel solutions, processes, and engineering can enable decision making, C2 is not synonymous with network operations or the employment of advanced technology, rather it maintains the flexibility to exploit both.¹ The need to execute C2 while on the move is not limited to commanders. The modern battlefield continues to be more irregular in nature, with Joint forces at increasingly lower echelons routinely working through, and with, mission partners that include multinational forces, other US Government agencies, international agencies, and host nation entities to make decisions that have operational and even strategic consequences. To empower subordinate leaders to take the initiative and make decisions consistent with their superior's intent, subordinate leaders must have access to the same relevant information, and an appreciation for the context of their superior's decisions. The need for Command and Control On-The-Move (C2OTM) will continue to increase as future operating environments will demand the application of military power in ever smaller increments, which in turn will require the achievement of joint synergy at ever-lower echelons of command.²

Joint forces will conduct these operations in coordination with host nation forces, multinational forces, interagency and nongovernmental organizations (Community-based, National, and International conducting charitable and service activities). As such, joint force leaders will use C2 capabilities to operate in symmetric, asymmetric, traditional and nonlinear/noncontiguous operating environments. Joint forces will be trained and organized to be functionally interdependent at increasingly lower echelons. At these lower echelons operations will seldom be conducted from static positions, they will be conducted while on-the-move. A higher level of interdependency will require that C2OTM capabilities be extended to these echelons. From a warfighter's perspective the environment that these forces operate in is referred to as the "tactical edge". Users at the tactical edge today are constrained by limited communications connectivity and limited storage availability. These constraints are the result of three conditions associated with operating at the tactical edge. These conditions are disconnected, intermittent, and low bandwidth (DIL).³

¹ Memorandum for US Joint Forces Command, Command and Control (C2) Vision, (Norfolk: Headquarters Joint Forces Command, 7 May 08)

² Capstone Concept for Joint Operations, (Washington: Headquarters Joint Chiefs of Staff, Jan 09), p. 25

³ White Paper: NECC Disconnected, Intermittent, Low Bandwidth Requirements and Architectural Approaches, (Suffolk, VA: US Joint Forces Command, J9, 17 Oct 08), 2.

Background

The 2006 Quadrennial Defense Review (QDR) report stated that the Department of Defense (DOD) should strive to deliver integrated Joint C2 capabilities, improve interoperability, identify and capture efficiencies, reduce capability redundancies and gaps, and increase joint operational effectiveness.⁴ There was emphasis on the need to continue building upon the Department's capability-based planning and management efforts to better enable strategic choice and improve its ability to make capability tradeoffs. Department of Defense Directive (DoDD) 7045.20 dated September 2008 established roles and assigned responsibilities for the use of Capability Portfolio Management (CPM). The CPMs correspond to the nine Tier one Joint Capability Areas (JCAs): Force Application, Command and Control, Battlespace Awareness, Net-Centric, Building Partnerships, Protection, Logistics, Force Support, and Corporate Management and Support.⁵ Department of Defense Directives and Chairman, Joint Chief of Staffs (CJCS) 2009a and CJCS 2009b can be reviewed for further JCA terminology that fully describe each capability portfolio.

The Commander, U.S. Joint Forces Command (USJFCOM) was assigned as the military C2 CPM lead with Assistant Secretary of Defense for Networks and Information Integration (ASD (NII)) as the civilian co-led. The USJFCOM Joint Capability Development (JCD) Directorate (J8) was tasked to establish a C2 CPM "joint program office" to satisfy the intent of the 2006 QDR. The C2 CPM's purpose was to advance warfighter effectiveness and improve combat capability by leading the development and transition of joint capabilities, architectures and technologies to maximize operational effectiveness for warfighters in the Joint environment. The CPM synchronizes the C2 portfolio with its derived authority from access to the Deputy Secretary of Defense Advisory Working Group (DAWG) and as the senior DOD proponent charged with integrating, synchronizing and coordinating portfolio content to ensure alignment to strategic priorities on current and future capability needs and investments. Accordingly, the CPM is afforded access to the Joint Requirements Oversight Council (JROC), Defense Acquisition Board (DAB) and other established Component forums to raise portfolio issues.

USJFCOM J8 delegated the responsibility for routine management and execution of the specific C2 issues to Focus Integration Teams (FITs) who identify joint shortfalls and capability gaps by collectively working the issues with the military Services, other Combatant Commands (COCOMs), mission partners, and agencies. The FITs develop recommendations to fill those gaps with integrated capabilities that are vetted through the C2 Senior Steering Group, a two star forum, the C2 Capability Integration Board, a three star forum and with the COCOMs, Services, and Agencies (C/S/As).

⁴ 2006 Quadrennial Defense Review (QDR) Report, Feb 2006

⁵ Department of Defense Directive (DoDD) 7045.20, Sep 2008

Focus Integration Team (FIT)

The C2OTM FIT Core was comprised of five people from USJFCOM's Joint Architecture Branch and Special Operations Command, Joint Forces Command (SOCJFCOM). The FIT Core has been partnered with U.S. Special Operations Command (USSOCOM) and the United States Marine Corps (USMC) from February 2008 to the present to ensure collaboration and engagement with C/S/As. The FIT has many stakeholders across the C/S/As that meet collaboratively to pursue solutions to C2OTM problems. Figure 1 (below) depicts the C2OTM FIT stakeholder engagement. FIT meetings occur on a biweekly schedule.

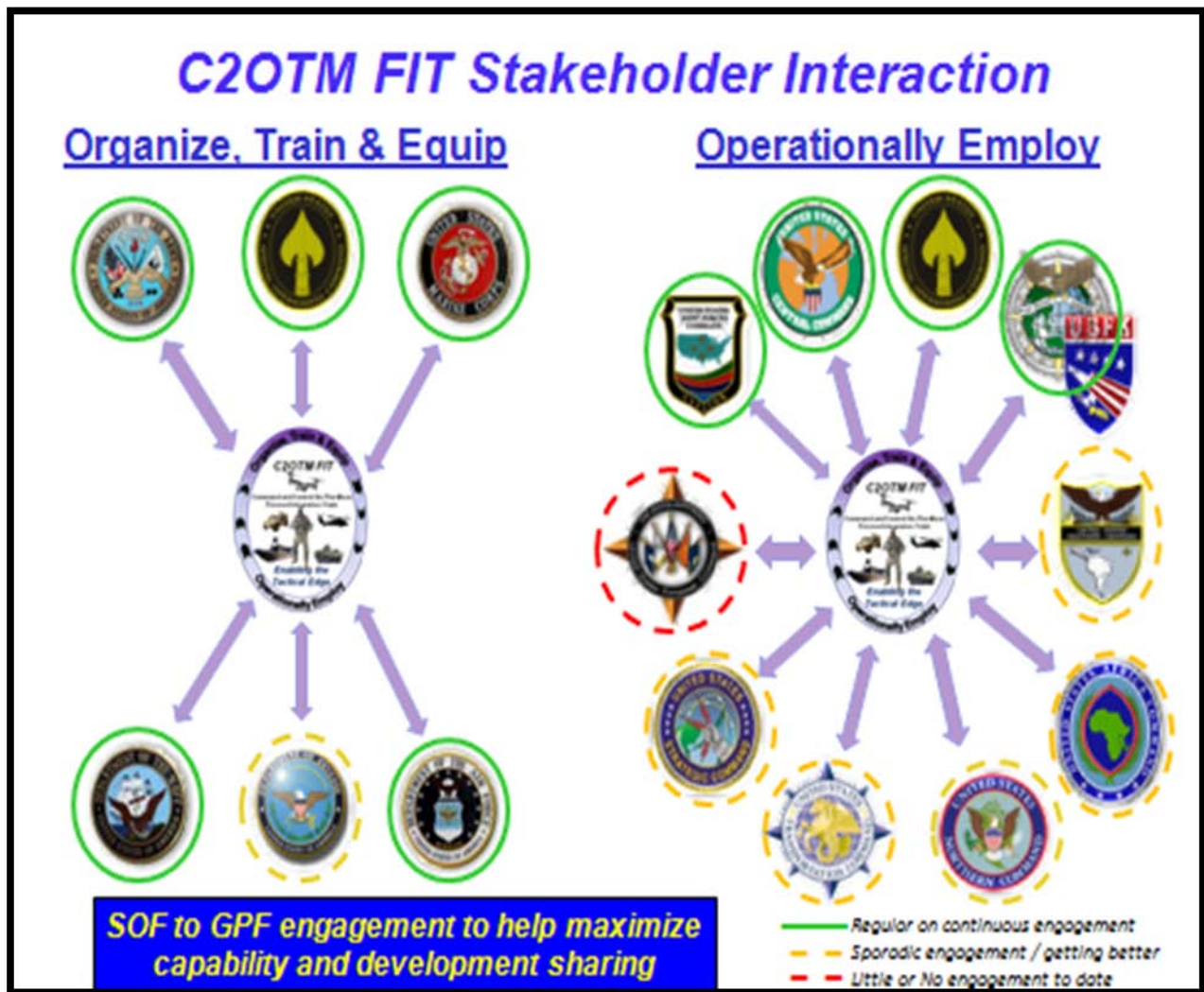


Figure 1. Depiction of C2OTM FIT stakeholder engagement

The FIT was tasked to address two problem statements from different forums. The first was the Deployable C2 problem statement; “DOD elements develop and field unique C2 systems intended to enable sharing of situational awareness at the tactical-operational execution level; these systems provide the ability to plan, adapt, synchronize, and execute operations. The inability of many of these systems to integrate raises risk of mission failure in an increasingly complex Joint warfighting environment.” This problem statement was endorsed in February 2008 by the Deputy’s Advisory Working Group or DAWG, which is chaired by the Deputy Secretary of Defense and the Vice Chairman of the Joint Chiefs of Staff (previously known as the “Group of 12”, that represents the senior most panel of civilian and military leaders within the Pentagon).

The second was a problem statement approved in November 2008 by the C2 Senior Warfighter Forum (SWarF), which is a collaborative body (generally consisting of Combatant Command Deputy Commanders) that organize, analyze, prioritize, build consensus and make decisions from the joint warfighters’ perspective on complex capability, resource and standards issues. The problem statement was US Central Command (USCENTCOM) C2OTM Problem Statement; “The lack of synchronized multi-layered, enduring C2 capability, which includes ground, aerial and space components, precludes consistently reliable C2 for mobile and static forces. A disjointed approach to meeting established and emerging C2 requirements resulted in a variety of planned and fielded capability solutions that have not been integrated, funded, or programmed to meet enduring needs. A long term solution that integrates fielded capabilities with funded future programs is needed. Joint DOTMLPF [Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities] and policy standards must be developed to support a multi-layered, enduring C2 capability for mobile and static forces.”⁶

To provide better support to the warfighter, the first thing the FIT accomplished was to jointly define C2OTM for all stakeholders for all stakeholders to achieve better solutions for both Special Operations Forces (SOF) and General Purpose Forces (GPF).

C2OTM Defined

Command and Control On-the-Move represents the capability to maintain SA and make timely and informed decisions while non-stationary (i.e., moving from place to place). It includes the capability to collaborate, communicate, and monitor joint/multinational/combined/interagency operations through an arrangement of personnel, equipment, communications, and procedures in a

⁶ Central Command [CENTCOM] C2 Senior Warfighter Forum [SWarF], Nov 2008

decentralized environment over extended ranges and in complex operational environments. C2OTM provides leaders with the ability to plan, direct, coordinate, assess, and control forces and operations while moving anywhere within the operational environment.⁷

Once agreed upon and approved by all forums, the FIT used the definition as the basis to begin writing a Concept of Operations (CONOPS) and an Initial Capabilities Document (ICD). As these documents were drafted, they were staffed following the Chairman Joint Chiefs of Staff Instruction (CJCSI) 3170.01G, 01 March 2009, Joint Capabilities Integration and Development System (JCIDS) process. The final hurdle for approval was the Joint Requirements Oversight Council (JROC) which is a forum that is designated to review all documents of programs designated as high interest by the JROC. It also supports the acquisition review process in accordance with law (10 U.S.C. 181).

Once completed, the C2OTM CONOPS and ICD defined the joint required capabilities to execute C2OTM and identified the gaps that were an impediment to achieving the C2OTM capability. This is documented through a numbered and dated Joint Requirements Oversight Council Memorandum (JROCM). JROCM 201-09 signed Dec 2009, approved the C2OTM ICD and designated USJFCOM as Lead Component for C2OTM.⁸

Required Capabilities (RC)

The C2OTM FIT's analysis for the ICD was based upon the Command and Control, Joint Integrating Concept (C2-JIC), the Marine Air Ground TASK FORCE (MAGTF) C2 ICD, the Joint Command and Control (JC2) Capability Based Assessment (CBA), and numerous Service and USSOCOM systems and capabilities documents. After detailed analysis, seven common required capabilities were derived from these sources that are needed to allow leaders to execute C2 functions while on-the-move. These required capabilities are all encompassing. There are Service and lower-echelon requirements, as well as, form factor (human factor) requirements that are incorporated into these high-level requirements. There are Service and lower echelon requirement, as well as, form factor (human factor) requirements that would be incorporated into these high-level requirements. In addition to the lower-level requirements, the need for a secure, net-centric environment for the transmission of C2 information and direction is a must that is being addressed and will be used to

⁷ This definition for C2OTM was derived from the following sources: Command and Control Joint Integrating Concept (JC2 JIC); Command and Control Joint Capabilities Document (JC2 JCD); Initial Capabilities Document (ICD) for Marine Air-Ground Task Force (MAGTF) C2, 23 July 2007; Dismounted Urban Tactical Communications Assessment, v.98, 30 December 2008; Irregular Warfare Center Deployable C2 Desktop Analysis, 04 March 2008; Joint Systems Integration Command (JSIC); and The Battle Command Essential Capabilities (BCEC) White Paper, 08 October 2008, TRADOC Capabilities Manager – Battle Command, Ft. Leavenworth, KS. The definition was approved and validated in the C2OTM Concept of Operations and Initial Capabilities Documents

⁸ Joint Requirements Oversight Council Memorandum (JROCM) 201-09, Dec 2009

positively affect C2OTM capabilities. With that in mind the seven required capabilities are as follows with definitions of each from the C2 JCD:

RC-1 Exercise Leadership: This is the ability to exercise authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of a mission. Command leadership is the art of motivating and directing people and organizations into action to accomplish missions. Commanders must be able to exercise effective leadership of an interdependent joint force in rapidly changing scenarios involving complex distributed, simultaneous or sequential operations, often with other agencies and nations. Unity of effort and the authority and accountability of the commander must be preserved.

RC-2 Develop and Maintain Shared Situational Awareness and Understanding: This capability includes the ability to access a COP presenting current and forecast information on adversary and friendly forces, neutral elements, the environment and geospatial information. The “picture” is built through access to both processed and raw data from sensors, analysts and other sources, and through collaborative analysis and assessment of this data. Situational awareness, transformed into knowledge through synthesis, experience, and collaboration, enables situational understanding.

RC-3 Communicate Commander’s Intent and Guidance: Commander’s intent is a concise expression of the operational purpose and desired end state. As the impetus for the planning process, it may also include the commander’s assessment of the adversary commander’s intent and an assessment of acceptable operational risk. In the Net-Centric collaborative environment, the commander’s intent must be shared early and often to enable parallel planning and self-synchronized execution.

RC-4 Plan Collaboratively: This capability involves an effects-based approach that directly ties offensive actions to campaign objectives, drawing on global resources and considering global consequences. Planning must be conducted with the collective knowledge of the decisions and plans of others to produce coherent integration. Planners must be able to focus on exploiting critical adversary vulnerabilities and must consider friendly critical capabilities and potential collateral damage. Parallel, distributed, collaborative planning capabilities and improved assessment tools are needed to compress process timelines. However, collaboration does not imply decision making by committee or consensus. The ability to assess the suitability of a plan through wargaming and mission rehearsal prior to execution is also needed.

RC-5 Synchronize Execution Across All Domains: Effective planning is an essential means of achieving synchronized action, provided the plan remains appropriate to the situation and is executed properly. However, in keeping with the adage that “no plan survives contact with the enemy,” the commander must be able to achieve synchronization when operations are not executed as planned. This can be done through centralized redirection, as in the past, or in a decentralized manner through self-synchronization of subordinate forces. The latter is the preferred method for future C2, but this approach may not always be feasible or appropriate. The commander must have the ability to employ

whichever method of synchronization is appropriate to the situation. Self-synchronization requires subordinates to have a clear understanding of the commander's intent, shared situational awareness and operational trust, good communications and the ability to act without detailed direction from above.

RC-6 Monitor Execution, Assess Effects, and Adapt Operations: This capability builds upon Capabilities 3 and 4 in particular. Commanders need the ability to maintain situational awareness, assess plan execution effectiveness and rapidly update plans by identifying alternative Courses of Actions (COAs) and redirect forces as circumstances change. Commanders and their staffs must have visibility over friendly unit decisions and capabilities, and the ability to monitor and react to changes in adversary status. Planners must be able to predict desirable and undesirable attack consequences, and anticipate how effects may propagate throughout an adversary's system. The ability to respond rapidly and effectively to changing circumstances will enable commanders to maintain the initiative.

C2OTM Gaps

The gaps identified come from most command, control, communications, computers, (C4) systems and capabilities that are individually developed by the Services or USSOCOM. This development has historically produced gaps in the ability to extend command and control while on-the-move horizontally across mission partners and vertically down to the lowest echelons within joint and combined organizations. While joint tactics, techniques, and procedures (TTPs) or materiel solutions do exist to allow accessibility by some on-the-move users, these tend to be ad-hoc, temporary fixes. In order for C2OTM to enable operational interoperability among all Services, SOF, agencies and mission partners, six high level gaps were identified, derived from multiple sources and must be addressed.⁹ Supporting concerns for each gap are included:

GAP 1: Non-existent or Limited Ability to Use C2 Services in a DIL Environment While On-The-Move:

Concern 1-Limited transport capability across the DIL environment. There is a need for better use of available capacity or information development with DIL users in mind. The attributes associated with this Concern apply to the needs of air, land, or sea environments.¹⁰ Commanders must have the ability to employ powerful, pervasive, real-time horizontal and vertical and information sharing and collaboration capabilities enabling operations forward and leader centric presentation of actionable information accessible down to the lowest tactical levels of command.¹¹

⁹ JROCM 047-08, MAGTF C2 ICD, 26 Feb 2008; C2 JCD, 2006; BCEC Essential White Paper, 2008; Joint Warfighting Challenges, Joint Urgent Operational Needs; C2 Vision, 2009; SOCOM Lessons Learned, Interoperability Assessment (Mitre Study)

¹⁰ Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 8

¹¹ Command and Control Joint Capability Document, 12 September 2008, p 39

Concern 2-Limited C2 ability for forces operating beyond line of sight (BLOS), and on-the-move (OTM). C2OTM users need the ability to operate effectively at the tactical edge.¹²

GAP 2: Limited Ability to Maintain and Share SA While On-The-Move:

Concern 1-Lack of data (Meta) standards, (waveform) transport standards, and network standards. Users of C2 services and applications from differing Services and organizations cannot access information or do not understand the intent of the information received. The information must be available on relevant systems, in user defined formats, using common data standards and protocols without losing fidelity.¹³

Concern 2-Lack of capabilities to rapidly assess, identify, neutralize and share information with mission partners. C2OTM users must be able to operate and survive across the ROMO and within all environments.¹⁴ Concern 3-Subordinates do not possess the same level of SA as their superiors. This lack of tactical context makes it difficult for them to understand or appreciate the full meaning of their superior's intent and/or guidance. The ability to grasp the commander's guidance and apply it to operations is dependent on the user having better SA.¹⁵

GAP 3: Lack of Ability for Leaders to Provide Accurate and Timely Intent to Subordinate Units and Mission Partners While On-The-Move:

Concern 1-Mission partners lack accurate and timely receipt of commander's intent and shared situational awareness. Accurate and timely receipt of commander's intent allows mission partners to synchronize. Accuracy requires the information to be complete, precise, reliable, error-free and understood. Timely requires that the unit receives the information in time to affect operations.¹⁶

Concern 2-There is a limited ability for mission partners to understand commander's intent. The Concern arises from the number of and the differences between lexicons used by coalition forces and mission partners. Lack of a standardized lexicon greatly reduces the ability to both relate to and understand information across the force. This Concern identifies the need for a common language to facilitate communication between mission partners.¹⁷

GAP 4: Inability to Plan Collaboratively While On-The-Move:

Concern 1-Lack of or limited development and implementation of effective planning processes and policies. The absence of such processes and policies produce significant shortfalls in: (1) ability to collaborate with mission partners, (2) ability to collaborate across Multi-Level Security (MLS) domains,

¹² This issue was previously documented in two MCCL Initial Observation Reports, FSSG and MLC Communications, October 2003, and (Force Service Support Group) FSSG Communications (OIF II) SECRET, December 2004. Repeat citation in Report on Combat Service Support (CSSE) Commanders Lessons Learned Conference 15-17 August 2005.

¹³ Marine Air Ground Task Force Initial Capability Document, 26 February 2008, 26 February 2008, p 5

¹⁴ Army Capabilities Integration Center, Warfighter Challenge 4 and 26

¹⁵ Command and Control Joint Capability Document, 12 September 2008, p 35

¹⁶ Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 5

¹⁷ Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 6

(3) ability to share resources and information across networks, and (4) use of common lexicon and vocabulary.¹⁸

Concern 2-There are limited collaborative planning applications that provide access to relevant and fused information (geospatial, intelligence, and commercial) while on-the-move. The ability to collaborate with mission partners is essential because it enables many other C2 capabilities. Since decisions and applicable information vary greatly between users, collaborative planning tools must allow for customization and filtering of information based upon user needs.¹⁹

Concern 3-Procedures to enable access to relevant and fused information are not automated and limit planning while on-the-move. Access to this information is restricted to a need-to-know basis. The absence of automated negotiation capabilities corresponding to a user's access rights, as determined by the joint force commander as part of task organization, precludes the user from accessing relevant information in a timely fashion. Given the connectivity challenges of the DIL environment and the time sensitivity associated with operations executed at the lower echelons, the option to seek manual approval is not practicable.²⁰

Concern 4-Planning with mission partners is difficult due to the limited development and implementation of effective common planning processes and policies with specific shortfalls in: (1) integration of intelligence products, (2) planning in a synchronized environment (including adaptive planning) while on-the-move.²¹

GAP 5: Limited Capability to Share Information With Mission Partners While On-The-Move:

Concern 1-Lack of or limited development and implementation of effective planning processes and policies. The absence of such processes and policies produce significant shortfalls in: (1) ability to collaborate with mission partners, (2) ability to collaborate across Multi-Level Security (MLS) domains, (3) ability to share resources and information across networks, and (4) use of common lexicon and vocabulary.²² C2OTM users must be able to continuously gather and track information in order to support tactical decision-making by providing a continuous assessment of current and future operations.

Concern 2-There is limited ability to facilitate the sharing of knowledge among mission partners. There are specific shortfalls in: (1) awareness of information available and information requirements, (2) awareness of knowledge assets (subject matter experts (SME's), organizations, etc.), (3) coordination process between mission partners, (4) establishing working relationships and adjusting as necessary for changing operational needs with appropriate organizations, (5) fundamental planning between military and host

¹⁸ Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 9

¹⁹ Command and Control Joint Capability Document, 12 September 2008, p 28 and 39

²⁰ Command and Control Focus Integration Team Writing Conference, Jun 09

²¹ Net-Centric FCB Integrated Priority List, Fiscal year 08-13; Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 18.

²² Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 9

nation, (6) expertise at lower organization levels to operate independently in the area of operation and across Range of Military Operations (ROMO). Leaders must understand and address this Concern before the establishment of task organizations and partnerships.²³

Concern 3-Lack of means to communicate effectively with all mission partners. There has been limited development in a joint context for a baseline or standard for interoperable access and information sharing of C2 capabilities while on-the-move.²⁴

Concern 4-Lack of standard protocol for information transmittal and receipt. Standard information technology (IT) protocols allow DOD to transmit and receive information globally to any organization with access and a need to know. This function will allow leaders to communicate seamlessly within the command structure and with other outside agencies (e.g., multinational partners, nongovernmental organizations (NGOs), and non-state actors) while on-the-move.²⁵

GAP 6: Lack of Common Interoperability Standards for C2OTM:

Concern 1-Lack of technical standards that promote agile, service-seeking, interoperability across systems. With no requirement for enterprise interoperability standards for C2OTM, command and control systems and supporting applications are developed with unique capabilities and integration specifications. Service capabilities have often been designed with desirable on-the-move or command and control functionality, but no two were designed to seamlessly share information with each other.²⁶

Concern 2-Users of C2 services and applications from differing Services and organizations cannot access information or do not understand the intent of the information received due to the lack of data (Meta) standards, (waveform) transport standards, and network standards. The information must be presented on different systems in user defined formats using common data standards and protocols without losing fidelity.²⁷

Concern 3-Lack of standard protocol for information transmittal and receipt. Standard information technology (IT) protocols allow DOD to transmit and receive information globally to any organization with access and a need to know. This function will allow leaders to communicate seamlessly within the command structure and with other outside agencies (e.g., multinational partners, nongovernmental organizations (NGOs), and non-state actors) while on-the-move.²⁸

²³ Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 10

²⁴ Joint Command and Control (JC2) Capability Portfolio Management (CPM) Quick Turn Capabilities Based Assessment (CBA) Functional Needs Analysis (FNA) For Program Review 2009 (PR 09 v.1), Department of Defense, 24 July 2007, DOTMLPFP Analysis - Doctrine Recommendations

²⁵ Command and Control Joint Capability Document, 12 September 2008, p 32

²⁶ DAWG Endorsed Deployable C2 Problem Statement, Feb 08

²⁷ Marine Air Ground Task Force Initial Capability Document, 26 February 2008, p 5

²⁸ Joint Command and Control, Joint Capability Document, p 32

Table 1 (below) depicts the correlation between the seven required capabilities identified and the six gaps identified in the C2OTM ICD. An “X” in the box depicts a correlation/applicability between the gap and required capability. The priorities shown in the last row of the table were developed based upon stakeholder input and a determination of which gaps, if closed, would have the greatest impact on achieving C2OTM requirements.

Gap and Required Capability Analysis						
Capability to Gap Relationship for C2OTM	GAP 1: Nonexistent or Limited use of C2 Services in a DIL Environment while OTM	GAP 2: Limited ability to maintain and share SA while OTM	GAP 3: Lack of ability for leaders to provide accurate and timely intent to subordinate units and mission partners while OTM	GAP 4: Inability to plan collaboratively while OTM	GAP 5: Limited ability to share info with Mission Partners while OTM	GAP 6: Lack of common interoperability standards for C2OTM
RC-1: Exercise Leadership		X	X	X	X	X
RC-2: Develop and Maintain shared SA and Understanding	X	X		X	X	X
RC-3: Communicate Intent and Guidance	X	X	X		X	X
RC-4: Plan Collaboratively	X	X	X	X	X	X
RC-5: Synchronize Execution across all Domains	X	X	X	X	X	X
RC-6: Monitor Execution, assess Effects, Adapt Ops	X	X			X	X
RC-7: Leverage Mission Partners		X	X	X	X	X
Derived Priorities	Medium	High	Medium	Medium	High	High

Table 1. Gap and Required Capability Analysis

Evolutionary Development of Capabilities

The recommendation to identify evolutionary capabilities that may be present in existing systems and to identify capabilities that provide the greatest impact to the warfighter was the ICD end state and is the overall goal of the C2OTM FIT. This is a sound recommendation; however, there are several organizations and processes to conduct evaluations, testing and certifications. This is why we still have the issues of today; there is no authoritative body that can approve all of what is needed. There may be a different way to work this issue.

A new concept; Capability Feasibility Examination/Assessment (CFE/A)

CFE/A would assist by identifying and becoming a more cohesive process, by which requirements are managed, new technologies to meet these requirements are exposed and evaluated, tested and certified for interoperability. Once capabilities are mature enough, they are then approved to enter the theater of operation where they are needed to meet warfighter requirements. The concept of CFE/A has been socialized in many forums, at many levels with representatives from the C/S/As, C2OTM FIT stakeholders, and Industry partners. All who have seen the concept agree that the CFE/A process could/would improve integration.

How would this work? The process would start with a review of current “stove-piped” processes followed by a call to C/S/As, academia, industry and national labs to identify what new technologies are being developed to address a particular gap. Once these are identified a desktop analysis would need to be completed. The results would be evaluated by using tech demonstrations, modeling & simulation for scalability, experimentation in both the lab and in the field for proof of concept, followed by operational and interoperability assessments.

The following questions would need to be answered or resolved; what is the maturity of technology or capabilities, what are associated risks, is it expandable and interoperable with Programs of Record (PORs) and can it be fast-tracked for critical capabilities (how fast can it be produced and put into the warfighter’s hands).

A C2OTM reference architecture (an authoritative source of architecture information that guides and constrains solutions by providing rules, principles, capabilities, and architectural elements for a domain, together with a common vocabulary, and sets of technical standards/specifications) needs to be developed to provide architecture products that can be used to inform POM guidance for the Military Services and Special Operations Forces units that are currently developing on-the-move capabilities for Commanders and Leaders at the tactical edge. The C2OTM capability is focused at the tactical edge; however, it will also support the operational level for those commands that

need C2OTM capabilities. The C2OTM Reference Architectures would consist of Capability, Operational, Systems, and Technical Views.

This Joint Capability Technology Demonstration (JCTD) like project would be conducted in one year, preferably in six months or less. A JCTD is a demonstration of the military utility of a significant new technology and an assessment to clearly establish operational utility and system integrity. These demonstrations assess the military utility of new capabilities, accelerate maturation of advanced technologies, and provide insight into non-materiel implications that normally take three years to complete.

Any CFE/A would have to support a combatant commander Integrated Priority List (IPL). Combatant commanders annually submit capability needs prioritized across Service and functional lines that define capability shortfalls that limit combatant commander assigned mission accomplishment. This information would be used while assessing mitigation strategies to meet the combatant commander's needs. An example; USJFCOM IPL #3; USJFCOM / 3 / Joint Command and Control (C2) for Joint Distributed Operations (JDO) Called for Areas for Investigation/Development "Conduct a capability feasibility examination/assessment (CFE/A) with emergent C2 On-The-Move technologies to determine scalability, applicability and acceptability to units operating at "the tactical edge."

This concept would also look at and be nested with several other combatant command 13-18 IPLs to provide greater utility to developers, commanders, leaders, and the warfighter.

Desired Outcome

Coordinated C2OTM capability delivery supporting the execution of warfighter functions that leads to an operational outcome that will enable information sharing and operational interoperability among all Services, Special Operations Forces, Agencies and Mission Partners.²⁹ It will enable on-the-move users (ground, air, and maritime) to perform C2 functions within flexible command arrangements and in complex terrain across the Range of Military Operations (ROMO). These operations will be "among the people" rather than "around the people".³⁰ As such, it will support modular, dispersed forces operating over extended ranges, often in austere and urban environments or maritime and littoral operations at multiple security levels. C2OTM capabilities will support C2, net-centric (NC), and battlespace awareness (BA) information requirements by seamlessly connecting on-the-move users. The desired effect is to reduce the user's dependency on fixed operations centers and static infrastructures that do not allow Leaders the flexibility to conduct effective C2 while on-the-move supported by continuous connectivity to the surface, aerial and space layers.

²⁹ Capstone Concept for Joint Operations, (Washington: Headquarters Joint Chiefs of Staff, Jan 09), p. 25

³⁰ Field Manual 7-0, Training, (Washington: Headquarters Department of the Army, Dec 08), 1-3

APPENDICES A

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APPENDICES B

ACRONYM LIST

AOR	Area of Operations
ARCIC	Army Capabilities Integration Center
BA	Battlespace Awareness
BCEC	Battle Command Essential Capabilities
BLOS	Beyond-Line-of-Sight
C2	Command and Control
C4	Command, Control, Communications and Computers
C2ID	Command and Control Integration Division
C2OTM	Command and Control On-The-Move
CBA	Capabilities Based Assessment
CENTCOM	Central Command
CFE/A	Capability Feasibility Examination/Assessment
CJCS	Chairman of the Joint Chiefs of Staff
COA	Course of Action
CONOPS	Concept of Operations
COP	Common Operational Picture
CPM	Capability Portfolio Management
DAWG	Deputy's Advisory Working Group
DCR	DOTMLPF Change Recommendation
DIL	Disconnected, Intermittent, and Low-Bandwidth
DOD	Department of Defense
DoDD	Department of Defense Directive
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel and Facilities
FAA	Functional Area Analysis
FIT	Functional Integration Team
FNA	Functional Needs Analysis
FSA	Functional Solutions Analysis
GIG	Global Information Grid
ICD	Initial Capabilities Document
IPL	Integrated Priority List
IT	Information Technology
JC2	Joint Command and Control
JCA	Joint Capability Area
JCD	Joint Capabilities Document
JCIDS	Joint Capabilities Integration and Development System
JCTD	Joint Capability Test Demonstration
JDO	Joint Distributed Operations
JIC	Joint Integrating Concept
JROC	Joint Requirements Oversight Council

JROCM	Joint Requirements Oversight Council Memorandum
MAGTF	Marine Air-Ground Task Force
MLS	Multi-Level Security
NC	Net-Centric
NGO	Nongovernmental Organization
OPLAN	Operations Plan
OPORD	Operations Order
POM	Program Objective Memorandum
RC	Required Capability
ROMO	Range of Military Operations
SA	Situational Awareness
SME	Subject Matter Expert
SOCJFCOM	Special Operations Command, Joint Forces Command
SOCOM	Special Operations Command
SOF	Special Operations Forces
SWarF	Senior Warfighter Forum
TCM-BC	TRADOC Capabilities Managers for Battle Command
TCM-NS	TRADOC Capabilities Managers for Network and Services
TTP	Tactics, Techniques and Procedures
USG	US Government
USJFCOM	United States Joint Forces Command
USMC	United States Marine Corps
USSOCOM	United States Special Operations Command

APPENDICES C

GLOSSARY

Accessibility - The ability of all levels of command (strategic, operational and tactical) to pull or push relevant data and information that are the basis for shared situation awareness. Additionally, access to a standardized joint application tool set from garrison to forward deployed locations will drive ability to increase decision-making capabilities supporting rapid, efficient, effective command and control. [C2 JIC]

Accuracy - Conforming exactly to fact or truth. A system with this attribute provides error free (or within a range of acceptable error) measurements or data via credible, dependable, and reliable sources. Accuracy and trust may exist due to prior performance and/or specific integrity assurance measures that have been adopted. [C2 JIC]

Adaptive Planning (AP) - The joint capability to create and revise plans rapidly and systematically, as circumstances require. Adaptive Planning occurs in a networked, collaborative environment, requires the regular involvement of senior leader, and results in plans containing a range of viable options.

Agility - The ability to respond effectively and in a timely manner to changing circumstances. Agility includes both “flexibility” and “responsiveness.” [C2 JIC]

Capabilities-based planning - A planning methodology that identifies and provides capabilities that the joint warfighter needs to address a range of challenges. [DODD 7045]

Capability - The ability to achieve a desired effect under specified standards and conditions through a combination of means and ways across doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) to perform a set of tasks to execute a specified course of action. [DODD 7045.20]

Capability Portfolio Management - The process of integrating, synchronizing, and coordinating Department of Defense capabilities needs with current and planned DOTMLPF investments within a capability portfolio to better inform decision making and optimize defense resources. [DODD 7045.20]

Capability Portfolio Manager (CPM) - The civilian and military co-leads accountable for the execution of capability portfolio management activities for a defined portfolio. [DODD 7045.20]

Capability Portfolio Strategic Plan - The CPM's long-range plan to synchronize, integrate, and coordinate efforts related to capability investments to meet joint warfighter and supporting defense entity needs. These plans address portfolio scope, portfolio objectives, dependencies with other portfolios, processes and plans, performance targets and metrics, and risk considerations. [DODD 7045.20]

Collaboration - Joint problem solving for the purpose of achieving shared understanding, making a decision, or creating a product across the Joint Force and mission partners. [NCE Joint Functional Concept]

Combat Identification - The process of attaining an accurate characterization of detected objects in the Joint battlespace to the extent that high confidence, timely application of military options and weapons resources can occur. (CID MA ICD, 19 Mar 01)

Command and Control (C2) - The exercise of authority and direction by a properly designated commander over assigned and attached forces and resources in the accomplishment of the mission. [JP 1-02, modified to reflect current JROC approved/DAWG endorsed JCA language.]

Commander's Intent - A concise expression of the purpose of the operation and the desired end state that serves as the initial impetus for the planning process. It may also include the commanders' assessment of the adversary commander's intent and an assessment of where and how much risk is acceptable during the operation. [JP 5-00.1]

Completeness - Having all components, parts, or steps critical to complete an operation. Complete information enables timely, appropriate decision making. [C2 JIC]

Connectivity - The ability to provide the needed types of communications to the warfighter. Connectivity includes geographic coverage (physical geometry between the Earth, the antenna beams of the satellite, and the user terminal populations and capacity (throughput, accesses, and protective features).

DOD C2 - DOD C2 is a Department-wide C2 capability comprising information integration and decision-support services, systems, processes, and capabilities that enable the exercise of authority and direction over assigned and attached forces, operating in a net-centric, collaborative information environment. [DODD O-5100.30]

Disconnected, Intermittent, Low bandwidth (DIL)

Disconnected - Connectivity is lost for a sufficient period that the condition becomes apparent to the user, effectively requiring operation from local data and applications and requiring significant re-sync upon reconnection.

Intermittent - Connectivity is lost for short periods of time, but the effect is not functionally apparent to the user in terms of behavior of the application (assuming that the application is designed to operate with intermittent connectivity).

Low Bandwidth - Connectivity may be good, but below a level of throughput that would support effective remote usage of a capability (low bandwidth and latency issues). For purposes of this ICD, "low bandwidth" is defined as 64 kilobytes per second (kbps) or less.

Global Information Grid - The globally interconnected, end-to-end set of information capabilities, associated processes, and personnel for collecting, processing, storing, disseminating and managing information on demand to warfighters, policy makers, and support personnel.

Information Assurance - Measures that protect and defend information and information systems by ensuring their availability, integrity, authentication, confidentiality, and non-repudiation. This includes providing for restoration of information systems by incorporating protection, detection, and reaction capabilities.

Interoperability - The ability of systems, units or forces to provide data, information, materiel and services to and accept the same from other systems, units or forces and to use the data, information, materiel and services so exchanged to enable them to operate effectively together. IT and NSS interoperability includes both the technical exchange of information and the operational effectiveness of that exchanged information as required for mission accomplishment. Interoperability is more than just information exchange. It includes systems, processes, procedures, organizations, and missions over the lifecycle and must be balanced with IA. (CJCSI 6212.01E, 15 December 2008).

Joint Command and Control (JC2) - For the purpose of this Directive, joint C2 is the exercise of authority and direction by the Combatant Commander, and designated others, that support force-level planning, execution, monitoring, and assessment of joint and multinational operations for the Joint Force Commanders, Component Commanders, and the Joint Planning and Execution Community. Joint C2 includes cross-Service C2 capabilities, infrastructure, programs, and processes. It also includes the capability to extend to multinational forces. (Note: Joint C2 is also the name of a family of programs that provide these C2 capabilities to the Combatant Commands at

the level of Commander of Joint Task Forces.) [DODD O-5100.30, January 5, 2006]

Mission Partners - Those entities not under the commanders' direct authority that is participating in the mission. Some examples include, but are not limited to, supported/supporting commands, non-DOD agencies such as the Department of State or CIA, multinational partners, host nation civil authorities, international organizations, and nongovernmental organizations (NGOs). [DOD C2 Strategic Plan, 18 December 2008]

Nonlinear - Not in sequence, dependent on activities. Characteristics include invisible, individual, imbedded, interconnected, instructional, imbalanced, indigenous, intention, and involved.

Operational Proponent - The lead advocate for operational capability needs. Provides advice and assessments to decision-makers and/or governance bodies on capability needs including joint operational oversight of implementation and synchronization across DOTMLPF, capability prioritization, policies and investments to support and influence strategic direction for capabilities, and related tasks. [DOD C2 Strategic Plan, 18 December 2008]

Operational Trust - The level of trust that is required (not just desired) from each person and earned from each entity (person, object, system) to accomplish an endeavor. Complex operations using interdependent forces require a level of trust in order to gain operational efficiency and effectiveness. Trust is defined as a bet that an entity, which you cannot control, will meet expectations that are favorable to your cause. Operational trust refers to a variety of perspectives including (but not limited to): commander/subordinate, subordinate/commander, peer/peer, operator/equipment and warfighter/tactics. [C2 JIC]

Proponency - The roles, responsibilities, activities, and actions performed by the Operational Proponent.

Relevance - Importance or applicability to the situation at hand. The degree to which something is related to or useful to a specific system or event. [C2 JIC]

Resilient - Capable of recovering quickly from or adjusting to damage, malfunction, or change. Ideally, systems with this attribute are designed to function at their normal operational standard upon recovery. Organizations or systems with few critical failure points and multiple paths have a higher a degree of this attribute than organizations and systems with several critical failure points and one path. [C2 JIC]

Responsiveness - Readily reacting to or recovering from changing situations and conditions in real-time and near-real-time. The effective use of responsive and resilient planning, execution, and assessment enables rapid deployment or redirection of assets when various “windows of opportunity” occur. Ideally, systems with this attribute are designed to function at their normal operational standard upon recovery from or reaction to changing situations and conditions. [C2 JIC]

Robustness - Full operational functionality due to great strength, durability, survivability, interdependency, resiliency, a distributed nature, or a combination thereof. Organizations and systems with this attribute can function during a disturbance; provide surplus capability to improve service reliability and quality; recover from or adjust to malfunctions or changes; and disperse resources performing services throughout a large area. Organizations and systems with this attribute can operate in several environments and perform effectively across a range of conditions, situations, and missions. Since these systems do not have a single point of failure, any degradation occurs gracefully prior to full system restoration. [C2 JIC]

Security - A condition that results from the establishment and maintenance of protective measures that ensures a state of inviolability from hostile acts or influences. (*Joint Publication 1-02*) Security includes preventing loss, destruction, exploitation, or denial of use of information or of a system by establishing, maintaining, and implementing protective measures and risk management.

Senior leaders - Senior leaders are the DOD and national leadership including the President of the United States, Vice President of the United States, the Secretary of Defense, the Deputy Secretary of Defense, the Chairman of the Joint Chiefs of Staff, the combatant commanders, joint task force commanders, joint force component commanders, and leadership’s immediate senior advisors, as appropriate. [*Adapted from DODD S-5100.44*]

Simplicity - Simplicity applies to C2 across DOTMLPF, markedly focused on functionality and avoiding unnecessary complexity (both primary and secondary complications). Simplicity facilitates direct access to relevant information, clearness of thought, efficient command structures, and common functional C2 processes. From a materiel aspect simplicity is the quality or state of few elements, an intuitive interface, enabling easy, quick instruction. Simplicity does not mean a lack of advanced solutions or capability stagnation. [C2 JIC]

Speed - The appropriate pace of tasks and decision making. At times, the appropriate speed is rapid. When deliberate methodical actions are required, a slower speed may be required. To obtain the appropriate speed of command

subordinate forces must be enabled to synchronize actions among themselves, without restrictive direction from above.

Stakeholder - Individuals and organizations that are actively involved in the project, or whose interests may be positively or negatively affected by execution of the project or project completion. They may also exert influence over the project and its deliverables.

Suitability - The degree to which a plan, decision or action is appropriate for the task or situation. Suitability extends beyond mere feasibility to an assessment that the plan, decision or action is likely to be effective for the task or situation.

Synchronization - The ability to execute multiple related and mutually supporting tasks in different locations at the same time or sequential, thus producing greater effects than executing each task in isolation.

Tactical Edge - An environment in which users may find they are operating in conditions in which their C2 systems are disconnected, have intermittent connectivity and/or operating with low bandwidth (at or below 64kbps).

Timeliness - Occurring at a suitable or opportune moment; well-timed. Timeliness is situation dependent. It reflects the relationship between the age of an information item and the tasks or missions it must support. [C2 JIC]

Understanding - Having the capacity for rational thought or inference, and the ability to comprehend the meaning and importance of focus areas the commander designates and the direction of his intent. Having the ability to grasp the commander's guidance and apply it to operations. SA enables situational understanding – knowing what the enemy is doing and why he is doing it. [C2 JIC]

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