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14. ABSTRACT

Communications are the threads that tie the MAGTF together and enable the combat power of its Marines. Digital communications are the next step in warfighting evolution and the interoperability problems that plagued communications for decades will become exponentially worse if not addressed through unity of command and unity of effort. The Marine Corps lacks the ability to provide interoperable communications capabilities and convergent solutions for its entire MAGTF because separate organizations are responsible for developing, acquiring, fielding and using its communications systems. Marines must develop a culture that embraces technology and encourages its leaders to think innovatively about the future. The Marine Corps needs a single empowered organization and a current and convergent digital communications strategy to evolve the MAGTF digitally.
A balanced solution based on DOTMLPF that targets Marine organizations, strategy and culture is required to evolve the digital MAGTF and ensure the Marine Corps is the best possible fighting force for future environments.

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Communications, Digital, Interoperability, MAGTF, Evolution, Culture, Innovation, Strategy, Organization, Future

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MASTER OF MILITARY STUDIES

THE MISSIONARY WORK OF EVOLVING THE DIGITAL MAGTF

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

MAJOR R. BRIAN ASHFORD, USMC

AY 09-10.

Mentor and Oral Defense Committee Member: Dr. Paul Gelpi
Approved: _____
Date: 19 April 2010 _____
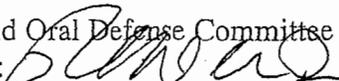
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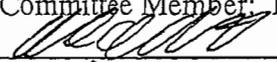
EXECUTIVE SUMMARY

Title: The Missionary Work of Evolving the Digital MAGTF

Author: Major R. Brian Ashford, United States Marine Corps

Thesis: The Marine Corps needs to evolve a coherent digital communications strategy in order to posture the MAGTF for future environments.

Discussion: Communications are the threads that tie the MAGTF together and enable the combat power of its Marines. Digital communications are the next step in warfighting evolution and the interoperability problems that plagued communications for decades will become exponentially worse if not addressed through unity of command and unity of effort. The Marine Corps lacks the ability to provide interoperable communications capabilities and convergent solutions for its entire MAGTF because separate organizations are responsible for developing, acquiring, fielding and using its communications systems. Marines must develop a culture that embraces technology and encourages its leaders to think innovatively about the future. The Marine Corps needs a single empowered organization and a current and convergent digital communications strategy to evolve the MAGTF digitally.

Conclusion: A balanced solution based on doctrine, organization, training, materiel, leadership and education, personnel and facilities that targets Marine organizations, strategy and culture is required to evolve the digital MAGTF and ensure the Marine Corps is the best possible fighting force for future environments.

DISCLAIMER

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ACRONYMNS AND ABBREVIATIONS

ACE	Aviation Combat Element
BLOS	Beyond Line of Sight
C2	Command and Control
C3	Command, Control and Communications
C4	Command, Control, Communications and Computers
C4I	Command, Control, Communications, Computers and Intelligence
CAS	Close Air Support
CD&I	Combat Development and Integration
CE	Command Element
CJCS	Chairman of the Joint Chiefs of Staff
CNR	Combat Net Radio
COI	Community of Interest
COTS	Commercial Off-the-Shelf
DAAI	Digitally Aided Aviation Integration
DACAS	Digitally Aided Close Air Support
DASC	Direct Air Support Center
DASC(A)	Direct Air Support Center (Airborne)
DC/A	Deputy Commandant for Aviation
DOD	Department of Defense
ESC	Executive Steering Committee
FAC(A)	Forward Air Controller (Airborne)
FMV	Full Motion Video

FSCC	Fire Support Coordination Center
GCE	Ground Combat Element
GPS	Global Positioning System
HF	High Frequency
HQMC	Headquarters Marine Corps
IOC	Initial Operational Capability
ISR	Intelligence, Surveillance and Reconnaissance
IT	Information Technology
JCAS	Joint Close Air Support
JFAC(A)	Joint Forward Air Controller (Airborne)
JFC	Joint Force Commander
JSF	Joint Strike Fighter
LCE	Logistics Combat Element
LOS	Line of Sight
MCDP	Marine Corps Doctrinal Publication
MAGTF	Marine Air Ground Task Force
MCCDC	Marine Corps Combat Development Command
MCSCP	Marine Corps Service Campaign Plan
MCWL	Marine Corps Warfighting Laboratory
MFTR	Memorandum for the Record
MIDS	Multi Information Distribution System
MIRC	Microsoft Internet Relay Chat
MISTC	MAGTF Integrated Systems Training Center

NCDWG   Net-Centric Data Working Group

NCE   Network Centric Environment

NCO   Network Centric Operations

NTISR   Non-Traditional Intelligence, Surveillance and Reconaissance

PDA   Personal Digital Assistant

RMA   Revolution in Military Affairs

SATCOM   Satellite Communications

SIPRNET   Secret Internet Protocol Router Network

TECOE   Training and Education Center of Excellence

UHF   Ultra High Frequency

USMC   United States Marine Corps

VHF   Very High Frequency

VOIP   Voice Over Internet Protocol

VMF   Variable Message Format

PREFACE

I became involved with digital communications while working as an AH-1W instructor at Marine Aviation Weapons and Tactics Squadron One in Yuma, Arizona. Problems in military communications have existed for centuries, but it has taken over two years for me to realize the scope and severity of the digital interoperability problems now facing the Marine Corps. It is my hope that the discussion and potential solutions offered herein will help form the foundation of the strategy necessary for the Marine Corps to achieve its future warfighting potential.

I would like to thank the staff members from the Command and Staff College who provided me with steerage through this project and their time throughout this year: Dr. Paul Gelpi, for his mentorship through this process; Dr. Ed Erickson, Dr. Douglas Streusand, Lieutenant Colonel Loretta Vandenberg, and Lieutenant Colonel Bjornar Lunde for their contributions and advice; and Rachel Kingcade for being able to find just about anything.

I would also like to thank the many Marines who are doing the hard and sometimes unpopular work required to evolve the MAGTF. They provided their contributions in the forms of inspiration, collaboration and dedication: Lieutenant General George J. Trautman, Brigadier General Robert F. Hedelund, Lieutenant Colonel Scott Creed, Lieutenant Colonel Chris Delong, Lieutenant Colonel Dean Ebert, Major Tom Campbell, Major Douglas Glover, Staff Sergeant Nathan Jacobsen and Dr. Charles Nickerson.

Most of all, I would like to thank my wife Katie, daughters Mia and Abby and son Ben for the support, encouragement and patience that made this project possible.

THE MISSIONARY WORK OF EVOLVING THE DIGITAL MAGTF

INTRODUCTION

As the hardware of war improves through technological development, so must the tactical, operational, and strategic usage adapt to its improved capabilities both to maximize our own capabilities and to counteract our enemy's.[1]

-MCDP-1, *Warfighting*

Communications interoperability is at least a 45 year old problem for the Department of Defense (DOD). The recent explosion of digital communications and information technologies magnifies the interoperability problem and threatens the relevance of all existing and emerging Marine systems. The greatest obstacles on the road to the digital Marine Air Ground Task Force (MAGTF) are lack of unifying digital leadership, culture of aversion to technology and dysfunctional acquisition behaviors within the DOD. The Marine Corps must evolve a coherent strategy for the development, acquisition, fielding and use of digital communications systems in the MAGTF in order to posture for future environments.

The first step in framing interoperability problems is to define the concept of communicating and the context of digital communications. The DOD defines "communicate" as any means or method to convey information of any kind from one person or place to another.[2] "Digital Communications"[3] are communications and information passed through electronic signals, consisting of voice[4], video[5] and data;[6] although no formal Joint or DOD definition of digital communications exists. Digital communications interoperability challenges every element of the American force structure but for the Marine Corps, designing the solution must be a cooperative effort, integrating all components of the MAGTF.

Communications are the ultimate enablers of Marines and their combat capability; the thread that ties the MAGTF together and makes command and control possible. Marine Corps problems with digital communications are not technological; they are organizational and require

solutions based on doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF). Today, the different elements of the MAGTF focus separately on materiel solutions to digital connectivity, but the Marine Corps requires collaborative non-materiel solutions if it is to remain the Nation's "force of choice"[7] in the Twenty First Century. Communications technologies are evolving at an unprecedented rate and failing to understand their potential will have an adverse impact on Marine combat capability. The Marine Corps must look at all the possibilities digital communications can bring with the same spirit of vision and innovation that led it to develop amphibious landing doctrine before World War II.

BACKGROUND

Our reading of past cases of transformation suggests that change is often triggered by the recognition of a pressing strategic or operational problem that cannot be handled through improvements to the existing force, but rather requires a new approach.[8]
                                        -Mahnken and FitzSimonds, *The Limits of Transformation*

In 1965, the Special Subcommittee on Tactical Air Support of the House Armed Services Committee studied Close Air Support (CAS) in Vietnam and called the United States Air Force's inability to talk to the United States Army a "communications fiasco."[9] The result was a 1967 Department of Defense Directive (Directive 4630.5, January 28, 1967) designed to force the services to coordinate and cooperate in order to establish and maintain compatibility through joint requirements under the umbrella of an overall command, control and communications (C3) architecture.[10] In spite of the directive, the Joint staff established neither Joint requirements nor an overarching C3 architecture and the services failed to cooperate. In 1985, frustrated by nearly two decades of aversion to change, the Senate Armed Services Committee forced revision to the failed interoperability directive by threatening to restrict funds to communications equipment programs.[11] Over the next two decades, computers, cellular telephones and the internet drove

numerous revisions of DOD directives and accompanying service level policies but not a renewed interest in interoperability.

With the rapid expansion of the internet came the pervasion of the term "network" and the development of concepts and terms like "net-centric environment" and "net-centric operations". The DOD focused on the development of the internet and lost sight of the larger concept of communications networks. As a remedy, it began the development of the Global Information Grid,[12] a single unifying architecture for information communication and collaboration but the services still developed philosophies that placed emphasis on the acquisition of physical systems and not the corresponding evolution of their users.[13] Net-centric was not supposed to mean that the internet would be at the center of all future operations; rather that networks of redundant and collaborative communications would enable future operations.

Communications policy flowed from the DOD in published directives, instructions and memorandums; from the Joint staff in instructions and from the Marine Corps in orders and messages, but cooperation was not enforced. From 1985 to 2006, the eruption of communications technologies increased the flow of policy and muddled the requirements for interoperability. For the Marine Corps, management of communications belonged to C4 but they lacked effective enforcement capability for the entire MAGTF, particularly in the aviation element and in areas controlled through Navy acquisition commands. Marine Corps communications interoperability problems were identical to those of the larger DOD structure because both lacked a single unifying strategy.

Realization

In 2006, Headquarters, United States Marine Corps (HQ, USMC or HQMC) highlighted a problem on the Joint Strike Fighter's (JSF) roadmap to Initial Operational Capability (IOC).

The F-35 "Lightning II", JSF, is supposed to be a fully networked and digitally interoperable fifth-generation aircraft that will revolutionize the way Marines think of aircraft and what they can do. The JSF program briefs depicted all of the elements, agencies and nodes of the MAGTF and their communications and connectivity pathways. In each depiction, the JSF was a central hub of information, with multiple lightning bolts emanating from it representing the different ways it could communicate.[14] The realization for HQMC was that those nodes, agencies and elements were not developing, acquiring or fielding systems capable of communicating with the JSF.[15] Marines realized that their revolutionary aircraft, designed from the ground up to take advantage of integrated and interoperable digital communication architectures, would only be able to communicate effectively with other JSFs because the Marine Corps had no overarching MAGTF strategy to develop digital communications coherently. In order for the JSF to revolutionize Marine warfighting as intended, the Marine Corps needed unified MAGTF leadership and required a common approach to digital communications and connectivity.

The first attempt to unify efforts came in 2007, when Lieutenant General George J. Trautman III, USMC Deputy Commandant for Aviation (DC/A) issued a Memorandum for the Record (MFTR) detailing his plan to move the MAGTF forward digitally. His vision is of an Aviation Combat Element (ACE) that is network-enabled and digitally interoperable. Lieutenant General Trautman's ACE is capable of fusing command and control (C2), sensor and weapons information and communicating voice, video and data.[16] He envisions a future where Marine Corps digital communications strategy will integrate all MAGTF elements in a way that is consistent with, and supportive of, the Joint Force Commander. DC/A's MFTR once again identified the need for a comprehensive MAGTF plan and provided the starting point to bring the necessary elements onboard. Marines set the target date for MAGTF digital integration and

interoperability to 2012, the same year the F-35B Joint Strike Fighter will achieve Initial

Operational Capability (IOC) with the Marine Corps.[17]

MAGTF Digital Community of Interest

In early 2008, to capitalize on the momentum of the MFTR, HQMC Aviation formed the

MAGTF Digital Community of Interest (COI) to educate all MAGTF elements of the

requirements for exchanging digital communications and information. In February 2008, the

first MAGTF Digital COI meeting took place in China Lake, California, and included

approximately one hundred representatives from all corners of the MAGTF and acquisition

world. At the July 2008 Variable Message Format (VMF) Summit, the Marine Corps presented

its vision of Digitally Aided CAS (DACAS) and its roadmap to a wider capability described as

Digitally Aided Aviation Integration (DAAI). In November 2008, the first MAGTF Digital

Interoperability Demonstration took place in China Lake, California and, for the first time,

ground and air nodes ran specific missions or "threads" to look at integration and interoperability

issues across the available MAGTF digital structure. The role players included the Air Officer,

Fire Support Coordination Center (FSCC), Direct Air Support Center (DASC), Direct Air

Support Center (Airborne) (DASC(A)), Forward Air Controller (FAC), AV-8B, AH-1W, F/A-

18D, F/A-18F and JSF all playing their parts using the full complement of developed ground and

air digital communications systems. The Digital COI stopped meeting as a stand-alone entity in

early 2009 and from that point forward, its meetings coincided with other events like the JCAS

Symposium, JFAC(A) Conference and VMF Summit.

The creation of the Digital COI at the MAGTF level was a good sign and positive first

step but the fact that it never became more than a COI is a symptom of the greater MAGTF

digital problem. Its role was to act as a conduit to identify and rectify specific issues, keep key

personnel informed of on-going digital efforts and define the common way ahead for the

MAGTF. A few bright and motivated individuals are putting forth efforts to evolve the digital

MAGTF; working as digital missionaries doing hard and sometimes unpopular work because

they have the vision to see how important it is to the future of the Marine Corps. Digital

communications are not a short-term integration issue; rather they are a key part of the future

MAGTF.

STATE OF THE DIGITAL MAGTF

The end state is a "born joint," common, scaleable, modular MAGTF C2 capability, seamlessly
employable on the land and at sea, that enhances the lethality and effectiveness of the MAGTF
across the range of military operations through better decision-making, collaboration, and
shared understanding.[18]

<div align="right">-USMC Command and Control Vision Statement</div>

The aviation vision is for a network-enabled and digitally-interoperable expeditionary aviation
combat element postured to execute responsive, persistent, lethal and adaptive full-spectrum
operations as directed by the MAGTF or joint force commander.[19]

<div align="right">-USMC Aviation Vision Statement</div>

Thirty months after issuing his MFTR, Lieutenant General Trautman graded the Marine

Corps on its digital communications progress. He gave Marines a grade of D+ to C- but said

they had done better with the MFTR than they would have without it.[20] The MFTR gave the

Marine Corps a push in the direction of progress but the work of taking the MAGTF digital and

making it interoperable is arduous. For decades, the Marine Corps followed the joint lead and

developed policies, orders and directives for communications interoperability but failed to follow

through with MAGTF cooperation. Each MAGTF element has its own vision, but evolving a

unified MAGTF concept requires a unifying MAGTF solution.

The Marine Corps Service Campaign Plan (MCSCP), developed from *Marine Corps*

Vision and Strategy 2025, "provides the framework and direction to develop and maintain

proficiency in core competencies in order to meet combatant commanders' requirements and posture for the future."[21] In the tasks for the Deputy Commandants of Combat Development and Integration (CD&I), Aviation and C4, the one that stands out, and the only mention of communications, is the task for DC/C4 to develop a "Marine Corps Network and Communications Strategy".[22] The Marine Corps already has an *Integrated Communications Strategy*[23] but it is more of an Integrated Network Strategy and makes little mention of communications beyond the physical network of the internet. It describes information technology goals and enterprise objectives that support a network strategy, but it lacks the vision of a larger communications strategy that encompasses the networks as tributaries. Without clear digital leadership, it is impossible for the Marine Corps to formulate a coherent strategy to evolve communications at the MAGTF level. The Marine Corps must overcome its ambiguous organizational responsibilities, its aversion to the culture of technology and the prohibitive DOD acquisition mechanisms in place if it is to evolve the digital MAGTF.

Absence of a Coherent MAGTF Strategy

The joint force of 2020 will use superior information and knowledge to achieve decision superiority, to support advanced command and control capabilities, and to reach the full potential of dominant maneuver, precision engagement, full dimensional protection, and focused logistics.[24]

-*Joint Vision 2020*

The Marine Corps does not have a current and coherent strategy for the development, acquisition, fielding and use of digital communications for four primary reasons. First, the Marine Corps wrote its current order "Intraoperability and Interoperability of Marine Corps Tactical C4I Systems" (MCO 3093.1C)[25] on June 15, 1989. The Marine Corps lacks a unifying entity responsible for the development, acquisition, fielding and use of digital communications across the MAGTF in part because the Interoperability Policy Board established by that order

twenty-one years ago never materialized. Second, no single organization is responsible for

MAGTF digital evolution, so each organization watches its counterparts to see what they are

going to do about the problem. While they all may agree about the severity and importance of

the problem, they do not have the manpower, resources or authority to solve problems beyond

their own realms. Third, service culture works against Marines when it comes to the need to

embrace technology like digital communications. Marines believe more fervently than any other

service that theirs is committed to innovation but believe the least that technology will play a part

in that innovation.[26] Lastly, current acquisition behaviors are prohibitive and especially costly

when applied to rapidly evolving connectivity technologies like digital communications.

Cultural Aversions

Marines value technology the least of any service.[27]

It is hardly surprising that Air Force and Navy officers are more enthusiastic than Army and Marine Corps officers about the ability of information-age systems, doctrine, and organizations to change the character and conduct of warfare.[28]
                                        -Mahnken and FitzSimonds, *The Limits of Transformation*

The arrival and dissemination of digital communications technology in the Twentieth

Century changed things so fundamentally that there is absolutely no going back.[29] Today's

young Marines were born into a digital world where voice, video and data move simultaneously

and at the speed of light throughout the battlefield. Society itself breaks down upon lines

between "digital natives" and "digital immigrants"; those born into the world of computers,

cellular phones and the internet and those who adapted to the new technologies.[30] The Marine

Corps of the twenty-first century, still dominated by "digital immigrants," is much less attracted

to technological solutions to warfighting problems than previous generations.[31]

Some Marines might say that the Marine Corps has a 234 year history of conducting

amphibious operations but, in truth, amphibious doctrine came about prior to World War II as a

result of a handful of innovative thinkers. At the time, many in the Marine Corps resisted the development of amphibious capability because they worried technology would allow systems to usurp individual Marines as the dominant weapons on the battlefield. Digital communications are a part of present and future warfare and Marines must encourage the innovative thinking of their "digital natives" in order to capitalize on their ability to see problems and solutions through a lens not available to previous generations of Marines. The Marine Corps must avoid becoming a service that clings "to established ways of war, and to combinations of technology, organizations, and personnel systems that have come to acquire value in and of themselves--even if they are no longer entirely functional."[32] Digital communications offer tremendous capabilities to those bold enough to integrate them at every level. The Marine Corps must breed an innovative culture[33] that not only accepts technology but also maximizes its possible applications.

Acquisition Behaviors

At the strategic level, DOD's processes for identifying warfighter needs, allocating resources, and developing and procuring weapon systems—which together define DOD's overall weapon system investment strategy—are fragmented and broken.[34]

It should not be necessary to take extraordinary steps to ensure needed capabilities are delivered to the warfighter on time and within costs.[35]

-Government Accounting Office Report, September 25, 2008

Digital communications are disruptive innovations[36] that require new approaches to development and acquisition, but acquisition behaviors in the DOD have not changed over the last several decades. Programs often begin without critical resource knowledge and result in delayed products that are over cost and under capable.[37] The Marine Corps acquires capabilities through both Marine Corps Systems Command (MARCORSYSCOM) and Naval Air Systems Command (NAVAIRSYSCOM or NAVAIR), separate and distinct organizations whose chains

of command do not intersect. Marines have all the documented acquisition issues of the larger

DOD structure with the added friction of two service level acquisition processes to marry and no

entity responsible for both.

The 2010 Quadrennial Defense Review (QDR) highlighted technology's ability to

outpace the acquisition process by dedicating a section to the need to develop a rapid acquisition

capability.[38] A frustrated General James Cartwright, USMC, Vice Chairman of the Joint Chiefs

of Staff, spoke to the Navy's attitude toward the acquisition of technologies by saying, "the Navy

needs to learn to stop building code and tools and cyber on the rules associated with building

aircraft carriers."[39] General Cartwright's frustration echoes in the QDR as the DOD wrestles

with the development and application of emerging technologies. If the Marine Corps is going to

evolve its MAGTF capabilities, it has to evolve its acquisition processes to work together. The

first step is developing the cultural inertia that will convince all Marines of the importance of the

technology and of the need to change.[40] The close second step in evolving the acquisition

processes is identifying the entity that will tie them together for the USMC and publishing its

strategy to do so.

EVOLVING THE DIGITAL MAGTF: A SOLUTION IN DOTMLPF FORMAT

*Attaining that goal requires the steady infusion of new technology and modernization and
replacement of equipment. However, material superiority alone is not sufficient. Of greater
importance is the development of doctrine, organizations, training and education, leaders, and
people that effectively take advantage of the technology.[41]*

-Joint Vision 2020

Digital communications are the natural evolution of communications and require an

evolutionary approach to their development, acquisition, fielding and use. Communications

interoperability was a problem for the Marine Corps long before the technology revolution of

computers, cellular telephones, and the internet and communications technology continues to expand and change at an unprecedented rate. The Marine Corps needs adaptable and flexible solutions that mandate an interoperable digital MAGTF. If Marine solutions are not adaptable, the complexity and diversity of future conflicts will render them obsolete. If Marine solutions are not flexible, the Marine Corps will find itself constrained to narrow ranges of effectiveness and slow to respond to the changes in future warfare.[42]

It is not enough to write about where the Marine Corps is going in the Twenty First Century; Marines must be specific about how they are going to get there. Following a Capabilities Based Assessment (CBA), the Joint Capabilities Integration and Development System (JCIDS) mandates an analysis of doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) in the identification of non-materiel solutions.[43] The following DOTMLPF analysis suggests the basis for a Marine Corps digital communications capabilities strategy.

Doctrine

Our integrated, combined arms doctrine will prove as relevant in future contingencies as it has throughout our history.[44]

-Marine Corps Vision and Strategy 2025

Joint Vision 2020 depicts information superiority focused through innovation as the basis for full spectrum dominance of the Joint force.[45] For the Marine Corps, doctrine for full spectrum dominance must begin with the MAGTF and include the U.S. Navy. *Marine Corps Vision and Strategy 2025* describes a force "versatile in capabilities and innovative in mindset"[46] but does not speak specifically about how it is going to get there. Both documents speak broadly of the need to dominate all forms of communication and information but without strategic details. Marines must begin by treating networks as subsets of their larger communications

architecture. Net-centricity must be the description of an operating style that refers to the Marine Corps' ability to network its communications systems together cohesively. To meet the six core competencies laid out in *Marine Corps Vision and Strategy 2025*,[47] Marines must weave today's digital communications together with tomorrow's future concepts to create the capabilities that will shape their doctrine.

In order to remain the Nation's force in readiness,[48] the Marine Corps must integrate developed and emerging technologies across the full spectrum of digital communications to provide truly global situational awareness. Every Marine should have the capability to communicate, regardless of location or activity. The "strategic Corporal"[49] must have a variety of redundant tools available to him to transmit or receive voice, video and data information. A squad leader in Afghanistan must be able to tie-in digitally to the Marines on either side of him and his Battalion headquarters, the Carrier Battle Group (CBG) sourcing his Joint Tactical Airstrike Request (JTAR) and the artillery battery firing in support of his unit. Marines must utilize digital communications to gain and maintain advantageous situational awareness in order to fight in any clime and place in the Twenty First Century.

Marines must apply digital communications to every aspect of their air-ground combined arms force.[50] All MAGTF missions overlap to some extent, so digital communications in one mission area requires digital communications in all areas. Marine aircraft must be able to communicate digitally with each other as well as the ground units they support. Ground and logistics combat Marines must be able to communicate and share information from Marine-to-Marine, vehicle-to-vehicle, element-to-element and beyond. Every link in the fires chain needs a robust digital communications capability to replace those actions that are not value-added when done by humans, providing an unbroken digital thread from target location to clearance of fires

to target engagement and Battle Damage Assessment (BDA). The Marine Corps does not have a "one bomb, one target" digital fires mentality, it has a "one bomb, seven rockets, fifteen artillery rounds, one thousand machine gun rounds and a helicopter full of angry Marines to flex-cuff the survivors" mentality.[51] In concert with joint and multinational forces, the Marine Corps must acquire and maintain digital systems that are interoperable across all elements of the MAGTF and enhance its capabilities as the nation's premier air-ground combined arms force.[52]

Marine Corps and Navy forces must work together to identify gaps in capability and field common solutions that ensure compatibility with each other and with Joint and Coalition partners. From forward positions and aboard naval ships, Marines must be able to gather and utilize information from any source, at any time and from any corner of the globe. Digital communications allow Marines to seamlessly transition from forward naval presence to any operating environment while instantaneously sharing information. As future amphibious doctrine develops, the Navy and Marine Corps will rely on strong and flexible digital architectures to enable their operations.

Every materiel and non-materiel solution the Marine Corps develops has to work in concert with all Marines, Joint Forces, members of the Interagency and our coalition partners. In challenging warfighting environments, digital communications will give Marines the simple, redundant means necessary to dominate the battlespace of their choosing. Digital communications allow all forces to "speak" the same language, as long as all fielded gear meets common protocols and specifications. The Marine Corps must develop, acquire and field digital systems that are interoperable, joint and integrated in order to lead and enable its future activities.

Organization

To build the most effective force for 2020, we must be fully joint: intellectually, operationally, organizationally, doctrinally, and technically.[53]

<div align="right">

-Joint Vision 2020

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The Marine Corps needs a single organization to lead and unify its efforts to evolve the digital MAGTF. Marine Corps Combat Development Command (MCCDC), Marine Corps Command, Control, Communications and Computers (C4), NAVAIRSYSCOM and MARCORSYSCOM are the four organizations playing the prominent roles in the development, acquisition and fielding of Marine digital communications systems. On paper, responsibility for communications in the MAGTF belongs to C4, but no single organization has been able to break down the bureaucratic barriers between the elements of the MAGTF. Marines need an organization capable of executing adaptable and flexible processes to provide digital communications solutions to every element of the MAGTF. The Marine Corps must look at the existing organizational structures in place and determine whether they are capable of driving the coherent development, acquisition, fielding and use of digital systems across the MAGTF or if new structure is required.

Before it may move forward, the Marine Corps needs a detailed look at exactly where it is on the path to a digital MAGTF. It must begin by looking at what, if any, strategy exists within its major elements and set its first goal as the development of a current, coherent and all-encompassing MAGTF digital communications strategy. Joint doctrine and directives on communications drive Marine Corps orders and directives, but formal cooperation is not enforced. In order to develop the road ahead, the Marine Corps must first clearly identify what each of its organizations is doing with regard to digital communications and compare those findings with expected responsibilities. With roles and responsibilities clearly established, the

next step will be a collaborative effort to combine the separate element processes into a holistic MAGTF approach to digital communications. Once the Marine Corps lays out the foundation for its digital strategy it must determine whether an existing Marine organization is capable of executing that strategy for the MAGTF as a whole or if a new organizational structure must evolve. Lastly, the organization responsible for MAGTF digital communications must determine what it will look like and how it will work and relate to its contributing elements.

A single Marine organization can provide digital communications the unity of command and effort they require. The Marine Corps is not lacking policy to guide its communications effort, but it lacks an organization with the authority and unity of effort to cohere MAGTF communications. Marines must begin by collaboratively developing the overarching communications strategy called for in the MCSCP and replacing the existing *Integrated Communications Strategy*. Marines must then rewrite MCO 3093.1C "Intraoperability and Interoperability of Tactical C4I Systems" and update its goals and organizational names, roles and responsibilities. The Marine Corps must reestablish the Interoperability Policy Board called for in MCO 3093.1C and revitalize its membership, processes and outputs. The Net-Centric Data Working Group called for in the more recent MCO 5231.3 "Marine Corps Data Strategy" must expand to include members from every element of the MAGTF. The Marine Corps wrote these two orders more than twenty years apart, but both shape the digital communications efforts across the MAGTF.

The Marine Corps needs an organization capable of reaching holistic solutions because it cannot afford to develop, acquire or field digital communications that are not interoperable across the MAGTF. The mission of NAVAIRSYSCOM is to provide full life-cycle support of naval aviation aircraft, weapons and systems.[54] The mission of MARCORSYSCOM is

acquisition and sustainment of systems and equipment used to accomplish the Marine Corps'
warfighting mission, or simply, everything a Marine can "drive, shoot or wear."[55] The two
commands could be complimentary but lack the formal mechanisms and strategy to work
together. While the DOD is working on "a far reaching set of (acquisition) reforms,"[56] Marines
and their Navy counterparts need to focus on reforming practices within their control, most
notably developing organizational structure capable of coordinating MAGTF capabilities and
solutions that reach across both Navy and Marine Corps acquisition communities. Only through
a single organization and comprehensive MAGTF strategy can the Marine Corps converge the
digital communications efforts of its two disparate acquisition systems.

The Marine Corps should utilize the Marine Corps Studies System[57] to study its evolution
to the digital MAGTF and determine the correct organizational structure to get it there. Through
the formal study process, Marines can compare the state of digital communications today to the
goals put forth in *Marine Corps Vision and Strategy 2025* and determine how to attain them.
The study should use Marine digital communications requirements, capabilities and goals to
define the criteria of its organizational needs. The Marine Corps needs a unified organizational
command and unified effort to formulate a comprehensive plan and turn it into a coherent
strategy to guide the evolution of the digital MAGTF.

Training

*Realization of the full potential of these changes requires not only technological improvements,
but the continued evolution of organizations and doctrine and the development of relevant
training to sustain a comparative advantage in the information environment.*[58]
                                                                    -Joint Vision 2020

As digital technology permeates the battlefield, the Marine Corps must look for every
opportunity to capitalize on technology to train and empower the individual Marine. When
digital systems with new capabilities replace their older, non-digital predecessors, Marines need

appropriate training to employ those systems efficiently and effectively. Utilizing both MAGTF Integrated Systems Training Centers (MISTCs) and Training and Education Centers of Excellence (TECOEs), Marines should train with digital communications equipment from the most basic tactical level through to the most complicated operational level. The key for leadership will be showing junior and senior Marines how their systems fit into the larger digital strategy of the MAGTF and then training them in the detailed integration of their particular systems. Marines must use both real and virtual training technologies to develop Tactics, Techniques and Procedures (TTPs) for digital communications and find ways to improve efficiency, effectiveness and interoperability across the MAGTF and Joint force. Technological training and readiness will allow Marines to exploit digital communications to dominate the battlespace.

Materiel

The company requires voice, data and surveillance (video) fused into a single common operating picture, in order to support centralized and distributed architectures.[59]
<div align="right">

-A Concept for Enhanced Company Operations
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"Materiel" in a non-materiel solution (DOTMLPF) is restricted to commercial items, non-developmental items or systems from existing materiel programs.[60] Gaps in capability identified by Capability Based Assessments (CBAs) may require materiel solutions, non-materiel solutions or combinations of both. Marines must continue to look for dual-use (commercial and military) C4I capabilities and maximize their application to existing gaps in capability. The Marine Corps organization responsible for its digital future must ensure each potential CBA solution is in line with and contributive to the larger MAGTF digital strategy.

Marines must continue to pursue situational awareness enhancing capabilities in the form of Commercial Off-The-Shelf (COTS) materiel solutions whenever possible. For example, an

individual with a modern Personal Data Assistant (PDA) or mobile handheld device can communicate using voice, video or data from almost anywhere in the world. He can send and receive text messages, images and video. His PDA uses Global Positioning System to constantly monitor his location and provide relevant information about his environment (traffic, weather and events). Some PDAs have more than ten thousand applications available to their users, many for little or no fee. Imagine the power of an individual Marine on the battlefield with a handheld device of similar capabilities. He could send and receive voice, video and data relevant to his GPS derived location. His device would keep his higher headquarters constantly aware of his location and status. His device would allow him to view the most recent Intelligence, Surveillance and Reconnaissance (ISR) images and videos of his location while on the move. Imagine his device was as affordable for the Marine Corps as commercial devices are for private citizens.

Leadership and Education

The pace of technological change, especially as it fuels changes in the strategic environment, will place a premium on our ability to foster innovation in our people and organizations across the entire range of joint operations.[61]

-Joint Vision 2020

Marine Corps thoughts and ideas about the availability, distribution and use of information have to change. From the Commandant of the Marine Corps to the "strategic Corporal"[62] to the recruit in training, Marines must embrace the culture of technology and incorporate it at every level of future strategy. Revolutions in warfighting require open-minded approaches to innovation and a willingness to change existing paradigms. The Marine Corps must cultivate a climate of innovation in the Twenty First Century that will, "encourage individuals both to generate new ideas and to remain in the service to help them come to fruition."[63] The Marine Corps must develop and reward innovative thinking or its emerging

concepts will become extensions of current ones instead of true innovations.[64] Marines cannot be afraid of new technology or unwilling to do the hard work required to learn to use that technology effectively. The Marine Corps will continue to emphasize the role of the individual Marine in future combat, but must embrace the use of new technology to give each Marine the greatest possible capabilities.

Personnel

The nation that will insist upon drawing a broad line of demarcation between the fighting man and the thinking man is liable to find its fighting done by fools and its thinking by cowards.
           -Colonel Sir William Francis Butler, *Charles George Gordon*, 1889

  The Marine Corps must aggressively "develop innovative leaders"[65] at every level who understand digital technologies and their impact on the battlefield. The Marine Corps must seek, billet and promote Marines with the spirit of vision and innovation required to capitalize on digital communications. The Marine Corps must first identify the personnel responsible for the development, acquisition, fielding and use of digital communications throughout the MAGTF and invest in their futures through programs like the Special Education Program and the Advanced Degree Program. Manpower should capitalize on that investment by assigning those individuals across the spectrum of operational units, acquisition workforce, joint exchanges and headquarters billets in order to put their vision and recently acquired tools to work. Technology will never prepare Marines to fight in the next battle without fearless thinkers who view preparation as a mindset and digital communications as dominant tools. With the right personnel in place, Marines today can look at digital communications the same way their predecessors looked at amphibious operations before World War II and see how they can, should and will make the Marine Corps better.

Facilities

It is incumbent on the operating forces and combat development community to work together to identify the capability gaps, clearly define the operational requirements, and then work tirelessly to develop the right solutions.[66]

-A Concept for Enhanced Company Operations

As the MAGTF acquires and fields digital systems, its installations and facilities must allow innovators to test new ideas and discover what is possible[67] while providing the best integrated training for all Marines. Facilities that use digital communications should literally break down the walls between the different elements of the MAGTF. MAGTF training facilities will allow elements to train and work together, regardless of their actual locations. A squad leader from Camp Pendleton could work with Radio Battalion at Camp Lejeune and a deployed EA-6B squadron simultaneously. The organization responsible for MAGTF digital communications may require new facilities, but existing and planned facilities will only be required to incorporate them. Digital communications will enable integration of MAGTF elements at every level of the Marine Corps for the first time in history. Marines must ensure their facilities make best use of all the capabilities digital communications offer to maximize training opportunities and provide tactical communications for ongoing operations.

CONCLUSION

Warfare is not "network centric". It is either "people centric" or it has no centre at all.[68]

-Giffin and Reid, Information Age Transformation

The Marine Corps needs to develop innovative leaders who are encouraged to think about its future or it risks becoming a technologically irrelevant force. It is imperative that Marines embrace the technology available to them, seek ways to use it to their advantage and study the potentials of future capabilities. They must see digital communications as an exciting and

necessary part of their future, limited only by their imaginations. The individual Marine will always be the most important element of the MAGTF but digital communications represent a technological opportunity that the Marine Corps must understand and exploit in order to remain the Nation's "force of choice"[69] in the Twenty First Century.

Evolutions in digital communications complicate the 45 year old problem of communications interoperability for the U.S. armed services. The DOD tried for almost half a century to achieve interoperability in its communications systems to fulfill the needs of its forces but without large-scale success.[70] The problems will become exponentially worse if the Marine Corps is not able to find adaptable and flexible solutions that apply to its entire MAGTF. Evolving the digital MAGTF for the Twenty First Century is hard work, but a coherent strategy, carried out by unified leadership, that utilizes all the aspects of the DOTMLPF process, will ensure its success. A single empowered organization must take unified command of digital communications across the MAGTF and be responsible for the development, acquisition, fielding and use of all communication and information capabilities. The Marine Corps must develop, publish and disseminate digital strategy and doctrine that encompasses and directs the MAGTF and every individual Marine. Marines must focus on solutions and capabilities that leverage their naval character and work with the Navy to make the Marine Corps the best fighting force for any possible future environment.

NOTES

[1] Headquarters U.S. Marine Corps, *Warfighting*, MCDP-1, (Washington, DC: U.S. Marine Corps, June 20, 1997), 17.

[2] DOD Dictionary of Military Terms, http://www.dtic.mil/doctrine/dod_dictionary/ (accessed January 4, 2010).

[3] Maj R.B. Ashford, Digital Communications defined for reference by author. No common Joint or DOD definition of Digital Communications exists.

[4] Voice communications primarily take place over Combat Net Radio (CNR), but can travel through other means (ex. Multifunctional Information Distribution System (MIDS)). Most United States Marine Corps (USMC) ground systems, helicopters and fixed-wing aircraft communicate via voice through radios utilizing Ultra High Frequency (UHF) and Very High Frequency (VHF) waveforms. While versatile, (capable of single-channel, multi-channel, plain text and secure waveforms), both UHF and VHF communications are limited in distance to Line of Sight (LOS). A fixed-wing aircraft at 20,000 feet over desert terrain may communicate for hundreds of miles, but in comparison, a helicopter at 200 feet may only be able to communicate within a few miles of its position. Most USMC CNR systems are capable of LOS communications, but comparatively few are capable of communicating Beyond Line of Sight (BLOS). The most common BLOS communications utilize either High Frequency (HF) radio, Satellite Communications (SATCOM) or Voice over Internet Protocol (VOIP).

[5] Full Motion Video (FMV) can transmit communications, information or both and is widespread among Joint and USMC platforms. Video can move through various means, but most commonly through LOS links in specified frequency bands directly from user to user. LOS is the primary limiter of the direct downlinks, but they also rely on the power output of the transmitter and antenna design of the receiver. Some platforms utilize BLOS video transfer via SATCOM or internet. Regardless of transmission medium, the single greatest restriction to FMV is bandwidth available, both for the transmission itself and its subsequent distribution.

[6] Data communications pass through nodes, networks and computers, but may also pass through traditional voice and video pathways. Variable Message Format (VMF) over CNR is the Joint standard for data communications in the conduct of Air-to-Surface and Surface-to-Surface fires and is the most prevalent digital communications capability in Marine Aviation. MIDS, also known as Link-16, is the Joint standard for Air-to-Air communications, but the only USMC non-Command and Control (C2) asset to utilize it is the F/A-18 Hornet.

[7] Headquarters U.S. Marine Corps, *Marine Corps Vision and Strategy 2025*, (Washington, DC: U.S. Marine Corps, June 30, 2008), 6.

[8] Thomas G. Mahnken, and James R. FitzSimonds, *The Limits of Transformation: Officer Attitudes Toward the Revolution in Military Affairs*, (Newport, RI: Newport Papers, 2003), 106.

[9] Government Accountability Office. *Interoperability: DOD's Efforts to Achieve Interoperability Among C3 Systems* (Washington, DC: Government Accountability Office, Apr 27, 1987), 20.

[10] GAO, *Interoperability*, 22.

[11] GAO, *Interoperability*, 22.

[12] Department of Defense, *Global Information Grid Architectural Vision: Vision for a Net-Centric, Service-Oriented DOD Enterprise*, (Washington, DC: DOD CIO, June 2007), 1.

[13] LtGen William S. Wallace, *Network Enabled Battle Command*, (Military Review, May/June 2005), http://usacac.army.mil/CAC/milreview/download/English/MayJun05/wallace.pdf, (accessed April 11, 2010), 2.

[14] BGen C.R. Davis, (September 26, 2006). *F-35 Lightning II Program Brief* [PowerPoint Slides]. Retrieved from JSF website: http://www.jsf.mil/downloads/documents/AFA Conf-JSF Program Brief -26 Sept 06.pdf (accessed January 12, 2010).

[15] LtCol Creed, CO MWHS 3, telephone conversation with author, August 26, 2009.

[16] Headquarters U.S. Marine Corps, *Memorandum For The Record: Marine Aviation Digital Systems Interoperability*, (Washington, DC: U.S. Marine Corps, August 29, 2007), 1.

[17] Delong, Maj C.F., *MAGTF Digital Community of Interest (COI)*, October 10, 2008.

[18] Headquarters U.S. Marine Corps, *MAGTF Command and Control Concept of Operations*, (Washington, DC: U.S. Marine Corps, January 9, 2007), 2.

[19] Headquarters U.S. Marine Corps, *FY2010 Marine Aviation Plan*, (Washington, DC: U.S. Marine Corps, October 1, 2009), 4-2.

[20] LtGen Trautman, USMC DC/A, interview with author, October 27, 2009.

[21] Headquarters U.S. Marine Corps, *United States Marine Corps Service Campaign Plan 2009-2015*, (Washington, DC: U.S. Marine Corps, December 9, 2009), 1.

[22] *MCSCP 2009-2015*, 12.

[23] Headquarters U.S. Marine Corps, *Integrated Communications Strategy, v2.5*, (Washington, DC: U.S. Marine Corps C4, June 4, 2009).

[24] Headquarters, Joint Chiefs of Staff, *Joint Vision 2020*, (Washington, DC: Joint Staff, May 30, 2000), 10.

[25] Commandant of the Marine Corps, *Intraoperability and Interoperability of Marine Corps Tactical C4I Systems*, MCO 3093.1C, June 15, 1989, http://www.marines.mil/news/publications/Documents/MCO%203093.1C.pdf, (accessed February 12, 2010).

[26] *Limits of Transformation*, 88.

[27] *Limits of Transformation*, 17.

[28] *Limits of Transformation*, 109.

[29] Marc Prensky, "Digital Natives, Digital Immigrants." On the Horizon, October 5, 2001. http://www.marcprensky.com/writing/Prensky-Digital Natives, Digital Immigrants - Part1.pdf (accessed January 12, 2010).

[30] "Digital Natives, Digital Immigrants".

[31] *Limits of Transformation*, 3.

[32] *Limits of Transformation*, 3.

[33] *Marine Corps Vision and Strategy 2025*, 3.

[34] Government Accountability Office. *Defense Acquisitions: Fundamental Changes Are Needed to Improve Weapon Program Outcomes* (Washington, DC: Government Accountability Office, Sep 25, 2008), 1.

[35] GAO, *Defense Acquisitions*, 15.

[36] LtGen Trautman interview with author, October 27, 2009. Term coined by Clayton Christensen.

[37] GAO, *Defense Acquisitions*, 3.

[38] Secretary of Defense, *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, February 1, 2010), 80.

[39] Dan Taylor, "Cartwright: Navy's Need to Centralize Everything Hurts Warfighter," *Inside the Navy*, 9 March 2009.

[40] Cartwright, *Inside the Navy*.

[41] *Joint Vision 2020*, 3.

[42] Colin S. Gray, *Recognizing and Understanding Revolutionary Changes in Warfare: The Sovereignty of Context*, (Carlisle, PA: Strategic Studies Institute, Feb 2006), 39.

[43] Chairman of the Joint Chiefs of Staff, *Joint Capabilities Integration and Development System*, Instruction 3170.01G, March 1, 2009, A-1.

[44] *Marine Corps Vision and Strategy 2025*, 21.

[45] *Joint Vision 2020*, 6.

[46] *Marine Corps Vision and Strategy 2025*, 6.

[47] *Marine Corps Vision and Strategy 2025*, 9-10. USMC six core competencies:
1. The Corps conducts persistent forward naval engagement and is always prepared to respond as the Nation's force in readiness.
2. The Corps employs integrated combined arms across the range of military operations, and can operate as part of a joint or multinational force.
3. The Corps provides forces and specialized detachments for service aboard naval ships, on stations, and for operations ashore.
4. The Corps conducts joint forcible entry operations from the sea and develops amphibious landing force capabilities and doctrine.
5. The Corps conducts complex expeditionary operations in the urban littorals and other challenging environments.
6. The Corps leads joint and multinational operations and enables interagency activities.

[48] *Marine Corps Vision and Strategy 2025*, 9.

[49] General Charles C. Krulak, "The Strategic Corporal: Leadership in the Three Block War," Marines Magazine, January, 1999, 1.

[50] *Marine Corps Vision and Strategy 2025*, 8.

[51] Maj R.B. Ashford, *Voice and Digital Ops Through a CAS Mission* [PowerPoint Slides], (July 29, 2008), original quote from Major Douglas Glover.

[52] *Marine Corps Vision and Strategy 2025*, 8.

[53] *Joint Vision 2020*, 2.

[54] NAVAIRSYSCOM mission statement, http://www.navair.navy.mil/index.cfm?fuseaction=home.display&key=9E99EE24-2F3D-4E23-A0C1-A54C18C3FFC8 (accessed January 4, 2010).

[55] MARCORSYSCOM mission statement, http://www.marcorsyscom.usmc.mil/aboutus/ (accessed January 4, 2010).

[56] *Quadrennial Defense Review*, 77.

[57] Commandant of the Marine Corps, *Marine Corps Studies System*. MCO 3902.1D, September 25, 2008, 1, http://www.marines.mil/news/publications/Documents/MCO%203902.1D.pdf (accessed February 12, 2010).

[58] *Joint Vision 2020*, 8.

[59] *Enhanced Company Operations*, 5.

[60] *Joint Capabilities Integration and Development System*, GL8.

[61] *Joint Vision 2020*, 3.

[62] "Strategic Corporal," 1.

[63] *Limits of Transformation*, 3.

[64] David S. Alberts, John J. Garstka, Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, http://www.dodccrp.org/files/Alberts_NCW.pdf , DOD C4I Cooperative Research Program, 2nd edition, February 2000 (accessed April 11, 2010), 10.

[65] Headquarters, Joint Chiefs of Staff, *Capstone Concept for Joint Operations: Version 3.0*, (Washington, DC: Joint Staff, January 20, 2009), 28.

[66] *Enhanced Company Operations*, 6.

[67] Alberts, Gartska, Stein, *Network Centric Warfare*, 10.

[68] LtCol Ralph E. Giffin, Darryn J.Reid, *A Woven Web of Guesses, Canto One: Network Centric Warfare and the Myth of the New Economy*, http://www.dodccrp.org/events/8th_ICCRTS/pdf/108.pdf , DOD C4I Cooperative Research Program, 8th International C2 Research and Technology Symposium (accessed April 11, 2010), 21.

[69] *Marine Corps Vision and Strategy 2025*, 6.

[70] Secretary of Defense, *Compatibility and Commonality of Equipment for Tactical Command and Control, and Communications*, DOD Directive 4630.5, January 28, 1967.

BIBLIOGRAPHY

Alberts, David S, *Agility, Focus and Convergence: The Future of Command and Control*,
Command and Control Research Program, Vol 1, 2007,
http://www.dodccrp.org/files/IC2J_v1n1_01_Alberts.pdf, accessed November 22, 2009.

Alberts, David S., Garstka, John J., Stein, Frederick P., *Network Centric Warfare: Developing
and Leveraging Information Superiority*, DOD C4I Cooperative Research Program, 2nd
edition, February 2000, http://www.dodccrp.org/files/Alberts_NCW.pdf,
accessed April 11, 2010.

Ashford, Maj R.B. (July 29, 2008). *Voice and Digital Ops Through a CAS Mission*
[PowerPoint Slides].

C4 mission statement, https://hqdod.hqmc.usmc.mil/default.asp?View=HIGH
(accessed January 4, 2010).

Chairman of the Joint Chiefs of Staff, *Joint Capabilities Integration and Development System*,
Instruction 3170.01G, March 1, 2009.

Commandant of the Marine Corps, *Marine Corps Studies System*. MCO 3902.1D, September
25, 2008. http://www.marines.mil/news/publications/Documents/MCO%203902.1D.pdf,
accessed February 12, 2010.

Commandant of the Marine Corps, *Intraoperability and Interoperability of Marine Corps
Tactical C4I Systems*, MCO 3093.1C, June 15, 1989,
http://www.marines.mil/news/publications/Documents/MCO%203093.1C.pdf, accessed
February 12, 2010.

Davis, BGen C. R. *F-35 Lightning II Program Brief* [PowerPoint Slides]. Retrieved from JSF
website: http://www.jsf.mil/downloads/documents/AFA Conf-JSF Program Brief -26
Sept 06.pdf, accessed January 12, 2010.

Department of Defense, *Quadrennial Defense Review Report*, Washington, DC: Department of
Defense, February 1, 2010.

Department of Defense, *Global Information Grid Architectural Vision: Vision for a Net-Centric,
Service-Oriented DOD Enterprise*, Washington, DC: DOD CIO, June 2007.

Giffin, LtCol Ralph E., Reid, Darryn J., *A Woven Web of Guesses, Canto One: Network
Centric Warfare and the Myth of the New Economy*,
http://www.dodccrp.org/events/8th_ICCRTS/pdf/108.pdf , (accessed April 11, 2010),
DOD C4I Cooperative Research Program, 8th International C2 Research and Technology
Symposium.

Government Accountability Office. *Interoperability: DOD's Efforts to Achieve Interoperability Among C3 Systems*. Washington, DC: Government Accountability Office, April 27, 1987.

Government Accountability Office. *Defense Acquisitions: Fundamental Changes Are Needed to Improve Weapon Program Outcomes*. Washington, DC: Government Accountability Office, September 25, 2008.

Gray, Colin S. *Recognizing and Understanding Revolutionary Change in Warfare: The Sovereignty of Context*. Carlisle, PA: Strategic Studies Institute, Army War College, February 2006.

Headquarters, Joint Chiefs of Staff, *Joint Vision 2020*, Washington, DC: Joint Staff, May 30, 2000.

Headquarters, Joint Chiefs of Staff, Capstone *Concept for Joint Operations, version 3.0*, Washington, DC: Joint Staff, January 15, 2009.

Headquarters, Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States, JP-1, Incorporating Change 1*, Washington, DC: Joint Staff, March 20, 2009.

Headquarters, U.S. Air Force, *United States Air Force Unmanned Aircraft Systems Flight Plan 2009-2047*, Washington, DC: U.S. Air Force, May 18, 2009.

Headquarters U.S. Marine Corps, *Warfighting*, MCDP-1, Washington, DC: U.S. Marine Corps, June 20, 1997.

Headquarters U.S. Marine Corps, *Marine Corps Vision and Strategy 2025*, Washington, DC: U.S. Marine Corps, June 30, 2008.

Headquarters U.S. Marine Corps, *MAGTF Command and Control Concept of Operations*, Washington, DC: U.S. Marine Corps, January 9, 2007.

Headquarters U.S. Marine Corps, *FY2010 Marine Aviation Plan*, Washington, DC: U.S. Marine Corps, October 1, 2009.

Headquarters U.S. Marine Corps, *Amphibious Operations in the 21st Century*, Washington, DC: U.S. Marine Corps, March 18, 2009.

Headquarters U.S. Marine Corps, *Marine Air Ground Task Force Command and Control Initial Capabilities Document*, Washington, DC: U.S. Marine Corps, February 26, 2008.

Headquarters, U.S. Marine Corps, *Expeditionary Maneuver From the Sea: The Capstone Operational Concept*, Washington, DC: U.S. Marine Corps, June 25, 2008.

Headquarters, U.S. Marine Corps, *Evolving the MAGTF for the 21st Century*, Washington, DC: U.S. Marine Corps, March 20, 2009.

Headquarters, U.S. Marine Corps, *The Long War, Send In the Marines: A Marine Corps Operational Employment Concept to Meet an Uncertain Security Environment*, Washington, DC: U.S. Marine Corps, January 2008.

Headquarters, U.S. Marine Corps, *Communications Control Strategy*, Washington, DC: U.S. Marine Corps, February 4, 2010. https://hqdod.hqmc.usmc.mil/, accessed February 26, 2010.

Headquarters, U.S. Marine Corps, *Integrated Communications Strategy, v2.5*, Washington, DC: U.S. Marine Corps C4, June 4, 2009.

Headquarters U.S. Marine Corps, *United States Marine Corps Service Campaign Plan 2009-2015*, Washington, DC: U.S. Marine Corps, December 9, 2009.

Headquarters U.S. Marine Corps, *Memorandum For The Record: Marine Aviation Digital Systems Interoperability*, Washington, DC: U.S. Marine Corps, August 29, 2007.

Headquarters, U.S. Marine Corps, *A Concept for Enhanced Company Operations*, Washington, DC: U.S. Marine Corps, August 28, 2008.

Krulak, General Charles C. "The Strategic Corporal: Leadership in the Three Block War," Marines Magazine, January 1999, 1.

LtCol Creed, CO MWHS 3, telephone conversation with author, August 26, 2009.

LtGen Trautman, USMC Deputy Commandant for Aviation, interview with author, October 27, 2009.

MARCORSYSCOM mission statement, http://www.marcorsyscom.usmc.mil/aboutus/ (accessed January 4, 2010).

MCCDC mission statement, https://www.mccdc.usmc.mil/ (accessed January 4, 2010).

Prensky, Marc. "Digital Natives, Digital Immigrants." On the Horizon, October 5, 2001. http://www.marcprensky.com/writing/Prensky-Digital Natives, Digital Immigrants - Part1.pdf (accessed January 12, 2010).

Secretary of Defense, *Compatibility and Commonality of Equipment for Tactical Command and Control, and Communications,* DOD Directive 4630.5, January 28, 1967.

Sweeney, LtCol Michael M. "Blue Force Tracking: Building a Joint Capability." Strategy Research Project, U.S. Army War College, 2008. http://www.csl.army.mil/usacsl/publications/InfoAsPower3/IAP3%20-%20Section%20Two%20-%20Sweeney.pdf.

Taylor, Dan. "Cartwright: Navy's Need to Centralize Everything Hurts Warfighter," *Inside the Navy*, 9 March 2009.

U.S. Naval War College, *The Limits of Transformation: Officer Attitudes Toward the Revolution in Military Affairs*, Newport, RI: Newport Papers, 2003.

Wallace, LtGen William S. *Network Enabled Battle Command*, Military Review, May/June 2005, http://usacac.army.mil/CAC/milreview/download/English/MayJun05/wallace.pdf, (accessed April 11, 2010).