

**18th ICCRTS**

**“Mission Composeable C2 in DIL Information Environments using Widgets and App Stores”**

**Topics:**

**Topic 3: Data, Information, and Knowledge**

**Topic 4: Collaboration, Shared Awareness, and Decision Making**

**Topic 7: Architectures, Technologies, and Tools**

**Ms. Amanda George (Point of Contact) – SPAWAR SSC Pacific**

**Mr. Michael Morris – SPAWAR SSC Pacific**

**Dr. Stephanie Hsieh – SPAWAR SSC Pacific**

**Mr. George Galdorisi – SPAWAR SSC Pacific**

**Mr. Chris Raney – SPAWAR SSC Pacific**

**Ms. Angela Bowers – SPAWAR SSC Pacific**

**Mr. Charles Yetman – SPAWAR SSC Pacific**

**Space and Naval Warfare Systems Center Pacific**

**53560 Hull Street**

**San Diego, California 92152-5001**

**(619) 553-2066**

**[amanda.george@navy.mil](mailto:amanda.george@navy.mil)**

## **Abstract**

As the United States “pivots to Asia” while continuing to protect the full range of U.S. interests abroad, the Nation is facing a rising threat: a growing anti-access & area-denial (A2/AD) challenge. A key strategic goal of the United States, as highlighted in several recent strategic documents, including *Sustaining U.S. Global Leadership: Priorities for the 21<sup>st</sup> Century*, is the ability to maintain access, in the face of challenges, in all the four commons – maritime, air, space, and cyberspace. One of the primary operational challenges for the warfighter in the future is the ability to operate in a disconnected, intermittent, or limited (DIL) information environment but still be able to achieve the information flows necessary for agile command and control (C2).

Warfighters increasingly have access to integrated mobile devices to enhance their situational awareness. The Department of Defense and the Services are working to provide widget and app storefronts to disseminate applications that enable agile C2. The use of widgets and specialized apps supports the development of agile C2 systems with the capability to address some of the limitations the warfighter faces in a DIL environment. This paper will examine the value of these widgets and apps and the role this technology plays in supporting a configurable tactical C2 environment.

*“The new century brought with it a reminder that the world, in fact, is a complex, open system – constantly changing. And change brings with it uncertainty. What we really failed to recognize, is that in uncertainty and change, there is opportunity and hope.”*

*National Strategic Narrative*<sup>12</sup>

## **Perspective**

As the *National Strategic Narrative* points out, the twenty-first century has brought an era of rapid change. The rate of this change is set to continue on an upward trajectory, bringing us to a relatively unfamiliar world by 2030. This new world has been thoroughly explored by the intelligence and defense communities writ large in both the United States and around the world.

Effective response to rapidly changing circumstances necessitates agile command and control (C2) structures by which the participants, be they military or civilian, can access information, create a common operating picture, transmit needs to the various actors in the information network and receive feedback. This need has been partially addressed in the civilian world with the increasing use of mobile technology through which a company’s leadership can maintain nearly constant contact with the employees in their company and keep tabs on the changing external environment through various apps on their smart phones.<sup>3</sup> The military faces the same need to maintain agile C2 through constant, but more secure, contact internally while keeping track of a dynamic operational picture.

However, unlike much of the civilian world, the military faces additional challenges in connectivity that must be addressed in order to effectively utilize the agile C2 systems that mobile technologies have enabled. Facing Disconnected Intermittent and Limited network environments (DIL) presents an additional obstacle agile C2 in the battlespace must circumvent. Fortunately, application and widget technologies can offer a rapidly configurable C2 suite of tools that enable a warfighting unit from a single ship to a carrier strike group to rapidly switch missions and maintain agile C2.

---

<sup>1</sup>Mr. Y, *National Strategic Narrative*, (Washington D.C.: Woodrow Wilson International Institute for Scholars, 2011) 1.

<sup>2</sup> The *National Strategic Narrative* provides an overarching strategic assessment that underpins the strategic look provided in the *National Security Strategy* and the *National Defense Strategy*.

<sup>3</sup> This phenomenon is being called the Age of Mobile in the current news media. Reports on this phenomenon include: Hickins, Michael. “The Morning Download: The Age of Mobile is Upon Us” *Wall Street Journal* May 10, 2012. Accessed at: [http://blogs.wsj.com/cio/2012/05/10/the-morning-download-the-age-of-mobile-is-upon-us/?mod=google\\_news\\_blog](http://blogs.wsj.com/cio/2012/05/10/the-morning-download-the-age-of-mobile-is-upon-us/?mod=google_news_blog)

## Strategic Trends Affecting the Future of C2

The twenty-first century has ushered in a rapidly changing and increasingly complex global system. The United States is one of many players in the global arena and is continuously confronted with a wide variety of challenges ranging from terrorism to global economic shocks. As globalization accelerates, the world necessarily becomes increasingly complex. In the face of complexity and unpredictability, the United States is also facing stringent budget pressures that constrain its ability to arm itself for every contingency. As such, the U.S. Department of Defense (DoD) has placed a great premium on increasing the ability of the military to respond quickly to changing circumstances.

Analysis of the future international environment plays a critical role in the strategic analysis performed by the U.S. Intelligence Community (IC), the Department of Defense (DoD) and the Department of the Navy (DoN). The U.S. military uses the analysis of the future international environment to guide its strategy. The wealth of analysis allows the U.S. military to adjust its strategic direction as the threat environment shifts. The plethora of thoughtful and thorough analyses of the many different aspects of the future environment provides a rich field that can be mined to extrapolate future trends that the U.S. DoD has identified as shaping the global security environment.

While a comprehensive literature review is impossible to fit into less than a hundred pages, a brief synthesis of the literature reviewed provides a window on the different viewpoints provided in the wealth of analysis conducted by experts all over the world. This has been extensively described in the United States National Intelligence Council's publication *Global Trends 2030: Alternative Worlds*. The publication, drawing from a wide base of experts around the world, describes a shifting and complex international environment that will shape and be shaped by U.S. security interests. As *Global Trends 2030* states:

By 2030, no country—whether the US, China, or any other large country—will be a hegemonic power. The empowerment of individuals and diffusion of power among states and from states to informal networks will have a dramatic impact, largely reversing the historic rise of the West since 1750, restoring Asia's weight in the global economy, and ushering in a new era of “democratization” at the international and domestic level.<sup>4</sup>

Further strategic analysis of the future global environment is found throughout many DoD publications. Six unclassified publications, the *National Strategic Narrative* (APRIL 2011), the

---

<sup>4</sup> Office of the Director of National Intelligence, *Global Trends 2030: Alternative Worlds*, (Washington, D.C.: Department of National Intelligence, 2012), vi.

*National Security Strategy* (MAY 2010), the *National Defense Strategy* (JUN 2008), the *Quadrennial Defense Review* (FEB 2010), the *National Military Strategy* (MAY 2004), the *Unified Command Plan* (DEC 2008) have provided the foundation for the current U.S. defense strategy and policy. With recent events, including a rapidly shifting and increasingly uncertain domestic U.S. defense budget situation, these foundational documents have been updated by a several new publications. The *Defense Strategic Guidance* (JAN 2012), provides an update to the *Quadrennial Defense Review* to emphasize current U.S. military priorities. Along with the *Defense Strategic Guidance* the year 2012 saw the release of the Joint Operational Access Concept (JAN 2012) and the Capstone Concept for Joint Operations: Joint Force 2020 (SEPT 2012). These publications expand on the foundational strategies to provide a comprehensive look at what the Department of Defense thinks the strategic future will look like and how it will align its priorities to address that future.

While there are myriad different forces at work that will collectively shape the international defense framework, there are several strong drivers that stand out. The following six strategic drivers have been reiterated in numerous publications including a wide variety of government documents as well as a multitude of independent think tank analyses. These strategic drivers are: globalization; demographic pressures; increasing competition for scarce resources; the continued threat of proliferation of weapons of mass destruction; the emergence of new power centers; and the growing threat of failing states to threaten global security. Chart 1 characterizes how each driver is likely to affect the future international strategic environment.

Strategic Drivers
<b>Globalization will increasingly characterize the international system</b>
<b>Demographic pressures will continue to undermine stability</b>
<b>Resource concerns will come to dominate global competition</b>
<b>Emergence of new power centers will lead to a multi-polar world</b>
<b>Non-state actors' influence will continue to rise</b>
<b>Failing states will increasingly threaten global security</b>

**Chart 1**

Taken separately each of these drivers indicates that complexity and uncertainty are certain to be present within both the near- and long-term future. Taken together, these drivers represent a compelling picture of a world in which circumstances will rapidly shift in unpredictable ways.

As the world becomes “a global multipolar one with gaps in national power continuing to narrow between developed and developing countries,”<sup>5</sup> the United States is facing increasing economic pressures at home. The recent cuts in the U.S. defense budget, and the strong possibility that more are forthcoming, have precipitated a vigorous strategic analysis within the defense community. The recently released documents *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense*<sup>6</sup> and *Defense Budget Priorities and Choices*<sup>7</sup> lay out the United States’ military response to fiscal pressures at home and uncertainty abroad. *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense*—otherwise known as the Defense Strategic Guidance (DSG)—notes that “the global security environment presents an increasingly complex set of challenges and opportunities to which all elements of U.S. national power must be applied.”<sup>8</sup> As such, despite budget pressures:

For the foreseeable future the United States will continue to take an active approach to countering these threats by monitoring the activities of non-state threats worldwide, working with allies and partners to establish control over ungoverned territories and directly striking the most dangerous groups and individuals when necessary.<sup>9</sup>

The United States will perform this task in part by being selective about committing its forces. The DSG states “our forces must be capable of deterring and defeating aggression by an opportunistic adversary in one region even when our forces are committed to a large--- scale operation elsewhere.”<sup>10</sup> This is a change from the previous “two-war doctrine” in which the United States maintained the capability to fight two full-scale wars simultaneously. The *Defense Budget Priorities and Choices* states, “this strategic precept puts a premium on self- and rapidly-deployable forces that can project power and perform multiple mission types.”<sup>11</sup>

---

<sup>5</sup> Office of the Director of National Intelligence, *Global Trends 2025*, vi.

<sup>6</sup> Department of Defense (DoD), *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense* (Washington, D.C.: Department of Defense, 2012).

<sup>7</sup> Department of Defense (DoD), *Defense Budget Priorities and Choices* (Washington D.C.: Department of Defense, 2012).

<sup>8</sup> Department of Defense (DoD), *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense* (Washington D.C.: Department of Defense, 2012), 1.

<sup>9</sup> Department of Defense (DoD), *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense* (Washington D.C.: Department of Defense, 2012), 1.

<sup>10</sup> DoD, *Sustaining U.S. Global Leadership*, 1.

<sup>11</sup> Department of Defense (DoD), *Defense Budget Priorities and Choices* (Washington D.C.: Department of Defense, 2012), 7.

The Department of the Navy has acknowledged the future strategic landscape and responded with a number of documents that address the future in naval terms. The U.S. Maritime Strategy, *A Cooperative Strategy for 21st Century Seapower* (CS-21), provides the strategy for U.S. maritime forces to adapt to the changing future landscape. CS-21 points out that “seapower protects the American way of life”<sup>12</sup> as “90% of the world’s commerce travels by sea; the vast majority of the world’s population lives within a few hundred miles of the oceans; nearly three quarters of the planet is covered by water.”<sup>13</sup> The 2010 *Naval Operations Concept*, which implements the maritime strategy laid out in CS-21, emphasizes the importance of sea power, as “naval forces provide the ideal means in such a security environment to accomplish a wide variety of missions conducted independently or in concert with joint, interagency, international and non-governmental partners that share the United States’ interest in promoting a safe and prosperous world.”<sup>14</sup>

### **“Pivot to Asia”**

As the United States faces this complex future with a finite amount of resources, the Nation has made the choice to focus on a few specific areas. As the DSG explains:

U.S. economic and security interests are inextricably linked to developments in the arc extending from the Western Pacific and East Asia into the Indian Ocean region and South Asia, creating a mix of evolving challenges and opportunities. Accordingly, while the U.S. military will continue to contribute to security globally, *we will of necessity rebalance toward the Asia-Pacific region* [emphasis in the original].<sup>15</sup>

As the United States “pivots to Asia” it confronts a number of unique challenges to operating in the area. The U.S. military has now turned its innovative energies towards addressing these challenges both operationally and with new technologies. One challenge in particular, that of anti-access and area-denial, has garnered the spotlight in the defense community. Our past has shown us that in the military realm:

The traditional way of war for the US and NATO allies depends on achieving information superiority to identify targets, employ precision-guided weapons, and maintain effective command and control. The ability of a future adversary to deny

---

<sup>12</sup> Department of the Navy, Department of the Navy U.S. Marine Corps, The United States Coast Guard, *A Cooperative Strategy for 21st Century Seapower* (Washington, D.C.: Department of Defense 2007), 1.

<sup>13</sup> Department of the Navy, Department of the Navy U.S. Marine Corps, The United States Coast Guard, *A Cooperative Strategy for 21st Century Seapower*, 1.

<sup>14</sup> Department of the Navy, Department of the Navy U.S. Marine Corps, The United States Coast Guard, *A Naval Operations Concept* (Washington, D.C.: Department of Defense 2010).

<sup>15</sup> Department of Defense (DoD), *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense* (Washington D.C.: Department of Defense, 2012), 1.

or mitigate that information advantage—including through widening the combat to outer space—would have a dramatic impact on the future conduct of war. China’s development of capabilities to counter US information superiority in a future conflict is an example of this type of competition.<sup>16</sup>

The capability to counter U.S. information superiority in future conflict is one aspect of a defensive strategy known as anti-access and area-denial (commonly called A2/AD). China is not alone in addressing U.S. information superiority with A2/AD capabilities. The Joint Operations Access Concept (JOAC) notes:

Due to three major trends - the growth of antiaccess and area-denial capabilities around the globe, the changing U.S. overseas defense posture, and the emergence of space and cyberspace as contested domains - future enemies, both states and nonstates, see the adoption of anti-access/ area-denial strategies against the United States as a favorable course of action for them.<sup>17</sup>

Thus any potential adversary in Asia or elsewhere is likely to look to A2/AD strategies. With China and other nations developing anti-access and area-denial capabilities, the U.S. has turned to how to address them. In his letter introducing the DSG, the United States President Obama emphasized that the United States “will continue to invest in the capabilities critical to future success” which includes those that enable “operating in anti-access environments.”<sup>18</sup>

As the United States transitions out of a Cold War mentality that dominated military spending in the mid-twentieth century, new threats take center stage. This change in military strategy has been mapped out in two comprehensive studies by the Center for Strategic and Budgetary Assessments (CSBA): *Why AirSea Battle?*<sup>19</sup> and *AirSea Battle: A Point-of-Departure Operational Concept*.<sup>20</sup> Together these studies lay out the changed threat environment confronting the United States as well as a strategy to address it. In the first, *Why AirSea Battle?*, Andrew Krepinevich describes the Cold War threat environment the United States has faced. He states, “In the decade or so following the Soviet Union’s collapse the U.S. military’s power-projection capabilities in defense of the nation’s interests were effectively unchallenged.”<sup>21</sup> This has changed, however, as “several states, notably China and Iran, are strenuously working to raise precipitously over time- and perhaps prohibitively- the cost to the United States of

---

<sup>16</sup> Office of the Director of National Intelligence, *Global Trends 20230: Alternative Worlds*, (Washington, D.C.: Department of National Intelligence, 2012), 69.

<sup>17</sup> Department of Defense (DoD), *Joint Operational Access Concept* (Washington D.C.: Department of Defense, 2012), 3.

<sup>18</sup> Department of Defense (DoD), *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense* (Washington D.C.: Department of Defense, 2012), 1.

<sup>19</sup> Andrew Krepinevich, *Why AirSea Battle?* (Washington, D.C.: Center for Strategic and Budgetary Assessment, 2010).

<sup>20</sup> Jan Van Tol, et. al., *AirSea Battle: A Point-of-Departure Operational Concept* (Washington, D.C.: Center for Strategic and Budgetary Assessment, 2010).

<sup>21</sup> Krepinevich, *Why AirSea Battle?* p. vii.



projecting power into two areas of vital interest: the Western Pacific and the Persian Gulf.”<sup>22</sup> The CSBA has proposed that the U.S. focus on an ASBC in order to meet these new threats.<sup>23</sup>

ASBC has been institutionalized in the joint U.S. Navy and Air Force, Air Sea Battle Office. According to the “Air Sea Battle Concept Summary” released by the Air Sea Battle Office, “the ASBC centers on networked, integrated, attack-in-depth to disrupt, destroy and defeat (NIA-D3) A2/AD threats.”<sup>24</sup> The ASBC relies upon a close integration of the Navy and Air Force in order to address the specific anti-access/area-denial threats posed in the Western Pacific Theater of Operations (WPTO).

The increased focus on the Asia Pacific in the DSG indicates that it will be increasingly important for the U.S. Army and the U.S. Air Force to work with the U.S. Navy and Marine Corps to fully implement the AirSea Battle concept. This necessitates increased requirements for unclassified enclaves in interagency command and control (C2) to support the increasing COCOM need to incorporate non-traditional and non-governmental organizations in operations across the full range of military operations. In addition to increasing burden-sharing in a number of ways, the U.S. Navy must focus on technology that will increase its agility. The U.S. Navy will be frequently called upon to execute a variety of missions, often on short notice. Agile systems would allow the U.S. Navy to better support counterinsurgency, counterterrorism, major regional contingencies, and major theater war. Agile C2 is necessary to respond effectively to a myriad of potential situations.

To enable effective maritime superiority and maintain global maritime awareness, the U.S. Navy has made information a “main battery” of its arsenal. Information, when networked across joint, allied, and coalition forces enables commanders with the ability to create a cooperatively-created common operating picture—to better able to see what is over the horizon faster than the adversary. As noted in the U.S. Navy’s 2010 *Vision for Information Dominance*:

[T]he Navy will create a fully integrated C2, information, intelligence, cyberspace, environmental awareness, and networks operations capability and wield it as a weapon and instrument of influence.<sup>25</sup>

Enhancing its proficiency at operating within the information domain will also allow the Navy to: better respond to a rapidly changing battlespace as it takes advantage of advanced IT and networks; develop a global enterprise through network centric operations and command and control (C2); and elevate the use of information as a main weapon alongside traditional weapons.

---

<sup>22</sup> Krepinevich, *Why AirSea Battle?* p. 7.

<sup>23</sup> See Jose Carreno, Thomas Culora, Captain George Galdorisi, U.S. Navy (Ret), and Thomas Hone, “What’s New about the AirSea Battle Concept” *United States Naval Institute Proceedings*, August 2010 for an excellent discussion of the ASBC.

<sup>24</sup> “Air Sea Battle Concept Summary” [http://www.navy.mil/submit/display.asp?story\\_id=63730](http://www.navy.mil/submit/display.asp?story_id=63730)

A key challenge in an A2/AD is the ability for commanders to gain the information they have come to rely on in a networked and integrated environment for agile command and control. As the *Capstone Concept for Joint Operations: Joint Force 2020* points out:

Digital technology is also profoundly altering command and control within our own military and between military and civilian leaders. Just as commanders now have greater connectivity with their subordinates, national command authorities will enjoy extensive visibility of joint operations, changing how military and political leaders relate as operations unfold.<sup>26</sup>

When adversaries are able to reduce the ability of the U.S. to rely on its networked communication tools for command and control, the ability of the United States to operate is severely degraded. The key will be for commanders and their subordinates to focus on innovative ways to use the tools they will have available in information environments that may be disconnected, intermittent, or limited due to adversaries A2/AD capabilities. As Admiral Robert Willard noted in his seminal article in the *U.S. Naval Institute Proceedings* article “Rediscovering the Art of Command and Control.”

Frequently these days, commanders tinker with new technologies such as chat rooms, three-dimensional graphics, and web sites and call that command and control. The immense power of all those tools will go to waste until we master the whole of C2 and understand precisely where and when the tools play in the commander's decisions and responsibility to control the fight.<sup>27</sup>

Admiral Willard’s point is even more important *today* as commanders are likely to have DIL environments and therefore must understand what tools will be necessary for any given situation and must be able to agilely respond to shifting environments.

### **Agile C2**

Before we explore the future of Command and Control (C2) agility and how it can be achieved in DIL environments, one must first define what C2, and what agile C2 is. In the CCRP publication, *Understanding Command and Control*, Alberts and Hayes note that command and control “is about focusing the efforts of a number of entities (individuals and organizations) and

---

<sup>26</sup> Joint Chiefs of Staff, *Capstone Concept for Joint Operations: Joint Force 2020* (Washington D.C.: Department of Defense, 2012), 2.

<sup>27</sup> Willard, Robert. “Rediscover the Art of Command and Control” *U.S. Naval Institute Proceedings* (Annapolis, MD: U.S. Naval Institute, 2002).

resources, including information, toward the achievement of some task, objective, or goal.”<sup>28</sup> More specifically, command and control is defined as:

The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. Also called C2.”<sup>29</sup>

Network Centric Warfare (NCW) harnesses the technologies of the Information Age to “[generate] increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness...and a degree of self-synchronization.”<sup>30</sup> Network Centric Warfare is defined as “the concept of linking all aspects of warfighting into a shared situation awareness and understanding of command intent so as to achieve a unity and synchronicity of effects that multiplies the combat power of military forces.”<sup>31</sup> Dr. Norman Friedman best summarizes the advantages of a robustly-networked force this way:

Creating effective tactical pictures makes systems work, and it supports a new kind of warfare. The better the picture, the more efficient the operation...Picture-centric approaches are attractive because they justify reducing the numbers of ships or airplanes or troops or weapons...Overall, networking can make individual units more lethal if they are equipped to take advantage of it... [and] by widely distributing the tactical picture networking can give individual lower-level commanders more autonomy and can thus make for more flexible and effective—and rapid—operations.<sup>32</sup>

Since the concept of NCW was introduced, the military has been moving to implement it with varying degrees of success. As Dr. David Alberts points out in his book *The Agility Advantage*,

---

<sup>28</sup> David S. Alberts and Richard E. Hayes, *Understanding Command and Control* (Washington, D.C.: DoD Command and Control Research Program, 2006), p. 32.

<sup>29</sup> Department of Defense (DoD), *Department of Defense Dictionary of Military and Associated Terms*, (Joint Chiefs of Staff: 2008): <http://www.dtic.mil/doctrine/jel/doddic/data/c/01078.html>.

<sup>30</sup> David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority* (Washington, D.C.: DoD Command and Control Research Program, 2002), 2.

<sup>31</sup> Edward A. Smith, *Effects Based Operations: Applying Network Centric Warfare in Peace, Crisis, and War* (Washington, D.C.: DoD Command and Control Research Program, 2002), 48.

<sup>32</sup> Norman Friedman, *Network-Centric Warfare* (Annapolis, MD: Naval Institute Press, 2009), pp. 240-242. For a concise history of the development of network-centric warfare in the U.S. Navy and follow-on efforts see Loren Thompson, *Networking the Navy: A Model for Modern Warfare* (Arlington, VA: Lexington Institute, 2003): <http://www.lexingtoninstitute.org/library/resources/documents/NavalStrikeForum/networking-the-navy-model-for-modern-warfare.pdf> and Lorn Thompson, *Netting the Navy* (Arlington, VA: Lexington Institute, 2008): <http://www.lexingtoninstitute.org/library/resources/documents/Defense/netting-the-navy.pdf>.

“the transformational power of NCW lies in the extent to which changes in means, limits, and self are made. As it turned out, the practice of NCW has fallen far short of its theoretical limits.”<sup>33</sup> Dr. Alberts goes on to explain:

With the acceptance of NCW as a transformational idea, the U.S. and other military institutions undertook efforts to upgrade their information structures. They sought to replace point-to-point links and information stovepipes (silos) with a more networked information environment. In the decade since the theory of NCW was introduced, policies promoting widespread information sharing have been adopted, although these policies have not been aggressively enforced. As a result, some holes are being punched in silos and some collaborative processes have been introduced.<sup>34</sup>

Militaries, the U.S. military included, remain “largely industrial age organizations with information age capabilities”<sup>35</sup> as they lack an NCW approach to command and control. As Dr. Alberts explains, “unless there are significant changes in how an organization approaches command and control, the promise of NCW will remain unrealized.”<sup>36</sup>

A focus on agility is necessary to overcome the information age challenges military institutions face. A key aspect of NCW is the fact that:

NCW (Network centric warfare) implies command and control structures and processes that are highly adaptable. This means that they will need to be modular, be able to incorporate new actors rapidly and efficiently, employ reachback and reachout as part of their natural C2 functions, be able to make decisions very rapidly when decisively engaged, be able to retain control of the pace of battle when the time is available to develop richer understandings and approaches to success, and also be able to forecast and recognize changes in the battlespace quickly.<sup>37</sup>

Agility, however, can address this issue in a timely and economical way. As NCW is adopted, commanders and their subordinates are collaborating and sharing information in order to create a natural, agile C2 process.

---

<sup>33</sup> David S. Alberts, *The Agility Advantage* (Washington, D.C.: DoD Command and Control Research Program, 2012), 65.

<sup>34</sup> Alberts, *The Agility Advantage*, 65.

<sup>35</sup> Alberts, *The Agility Advantage*, 136.

<sup>36</sup> Alberts, *The Agility Advantage*, 136.

<sup>37</sup> David S. Alberts and Richard E. Hayes, *Power to the Edge* (Washington, D.C.: DoD Command and Control Research Program, 2005), 158.

Agility is a word that can, and does, mean many things to many different people. For the purposes of this paper the definition of agility is based on the research done in the *Agility Advantage*. The six components of agility as defined in *Agility Advantage* are “responsiveness, robustness, flexibility, resilience, adaptability, and innovativeness.”<sup>38</sup> While an agile entity may incorporate more than two at any given time, “at least two of these components are needed for an entity to exhibit or manifest agility in a particular circumstance. Different combinations of these will come into play as circumstances change.”<sup>39</sup> Simply put, the definition of agility used in this paper is that “agility is the capability to successfully cope with changes in circumstances.”<sup>40</sup> In practice, “agility is not a way of reducing problem difficulty, but rather a way of dealing with the combined effects of the presence of complexity and uncertainty.”<sup>41</sup>

As the U.S. faces the uncertain, rapidly changing security environment described in its strategic documents, “[a]gility is increasingly becoming recognized as the most critical characteristic of a transformed force, with network-centricity being understood as the key to achieving agility.” Today, agility is no longer “merely an *attribute* of the C2 system,”<sup>42</sup> instead “military establishments have recognized that ability considerations must *permeate* the mission capability package, operational concept, or force.”<sup>43</sup> (emphasis in original)

### **A Technology to Enable Agile C2: Widget & App Stores**

One recent innovation, both in the technology and its operational use, is the growing importance of widgets and applications offered to the warfighter through a widget storefront. The use of widgets and apps increases the agility of a military unit, be it a commander in a command center or a sailor deployed on a cruiser. Through widgets and specialized apps the warfighter can easily access data to increase situational awareness as well as connect rapidly with a command center. They provide the command center and the warfighter the ability to rapidly adapt their information sources to their information needs. The widgets, each providing tailored information and services, can be composed in a variety of ways for the warfighter to tailor the specific information that is needed, while culling the information that is unnecessary for the task at hand.

Currently, the C2 systems for warfighters are hard-coded to perform a single mission. Each ship or unit is outfitted with the C2 information and tools that are applicable to the mission that it is deployed to do. If there is enough room, then alternate tools may be loaded, but given the

---

<sup>38</sup> Alberts, *The Agility Advantage*, 65.

<sup>39</sup> Alberts, *The Agility Advantage*, 65.

<sup>40</sup> Alberts, *The Agility Advantage*, 66.

<sup>41</sup> Alberts, *The Agility Advantage*, 61.

<sup>42</sup> David S. Alberts and Richard E. Hayes, *Power to the Edge* (Washington, D.C.: DoD Command and Control Research Program, 2005), 126.

<sup>43</sup> David S. Alberts and Richard E. Hayes, *Power to the Edge* (Washington, D.C.: DoD Command and Control Research Program, 2005), 127.

information storage constraints in any deployment, be it naval or expeditionary, there is finite space for additional C2 tools not tailored to the current mission. Basically, the current process puts as many capabilities in one bag as can fit and sends the units out to perform within that bag of capabilities requiring different units to have different fixed sets of capabilities and to be constrained to those actions only. Thus the warfighters face the challenge that their C2 abilities are limited by the tools that they deploy with. This limitation constrains the warfighters' ability to quickly change missions without returning to base. Widget and app offered in a storefront combined with an afloat cloud environment will enable a any warfighting unit to change its C2 capabilities to respond to changing mission requirements, without necessitating a return to its base.

The wave of the future is to provide composeable capabilities for all units. Emerging needs, codified in the DoD's strategic documents require the U.S. to continue to provide for a shrinking military and an expanding global need. As the DSG states, "[w]henever possible, we will develop innovative, low-cost, and small-footprint approaches to achieve our security objectives, relying on exercises, rotational presence, and advisory capabilities."<sup>44</sup> (emphasis in original) The idea of composeable warfighter is not new, however, it is possible today. The ability to provide Widgets, applications, application bundles, and services on demand to the warfighter to reconfigure the mission capabilities, will allow commanders to change mission parameters of any unit. The unit in turn would be able to turn off and turn on capability packages as required meeting mission requirements. This innovative approach will enable agile C2 even in a DIL environment and as a mission set evolves.

The major enabler of this is the ability to expose and discover these capabilities by the warfighter. Storefronts on enterprise and deployed networks provide the ability to instantiate software and platform as a service is key element to providing the composeable mission capability.

These devices are innovative in that they also provide warfighters with the ability to provide pertinent data to the central command center thereby increasing the total situational awareness. The DoD and the military services are currently working to provide widget and app storefronts to disseminate applications. The storefronts will enable the developers of the widgets and apps to be more responsive to user needs by allowing them to field innovative products tailored to current needs quickly. DoD has only started to make inroads within this environment with several Programs of Record (POR) embracing widgets and other mobile technologies, hoping to enhance warfighter situational awareness and access to information. Unfortunately, the Defense Acquisition System has not adapted to this new environment, making it difficult to field these technologies rapidly to meet emergent requirements.

---

<sup>44</sup> Department of Defense (DoD), *Sustaining U.S. Global Leadership: Priorities for 21<sup>st</sup> Century Defense* (Washington D.C.: Department of Defense, 2012), 3.

## **Ozone Widget Framework (OWF)**

### *What is a widget?*

Widgets are lightweight, single-purpose web-enabled applications that users can configure to their specific needs. Widgets can provide summary information or a limited view into a larger application and can be used alongside related widgets to provide an integrated view as required by the user.

### *OWF*

The Ozone Widget Framework (OWF) is a platform that offers infrastructure services to simplify the development of workflows and presentation-tier application integration. It is also a layout manager for the operation of widgets on a single web page. Widgets, which are web applications that can be installed and executed in a web browser, display information or provide dynamic content from a backend or local service. Just like any widget framework, OWF supplies the structure and templates for creating widgets providing users with the capability to develop, share, and operate widgets. Unlike a standard browser window, OWF allows users to load and operate multiple widgets within a single webpage rather than opening multiple browser windows or tabs to display more than one widget. This allows users to view a great amount of information on a single browser interface. From an intelligence analyst's standpoint, the OWF provides a means to conveniently search, access, and display intelligence data on a single display. Furthermore, the OWF allows the user to adapt their information flows, by adding, deleting or modifying the loaded widgets, in miniscule amount of time. In under a minute, an OWF operator can change the information they have access to allowing the user to agilely adjust to any changing circumstance.

OWF allows users to load widgets, select a layout type called a dashboard layout, and customize the arrangement of the widgets within the dashboard. OWF supports multiple dashboard layouts including desktop, tabbed, portal, and accordion. The desktop layout allows users to arrange and drag widgets anywhere within the browser window much like a desktop application on a standard operating system desktop. The tabbed, portal, and accordion layouts fix the widget positions in the browser, but users are able to select which widgets are assigned to the fixed locations creating a customized display. The dashboard layout and arrangement of widgets is saved when a user logs out of the OWF so the next time the account is accessed the entire layout is maintained. Thus, a user could have a dashboard specifically targeted to address multiple scenarios; this moves the operator away from the stovepiped information system.

The OWF, originally developed and sponsored by the National Security Agency (NSA) as a Government Off-The-Shelf (GOTS) solution, is now Government Open-Source Software (GOSS) with a collaborative software development model. The OWF GOSS Program is responsible for the maintenance of OWF and Ozone Marketplace (OMP) software releases. The OWF GOSS board, comprised of members from NSA, ODNI, DoD, CIA, DISA, SPAWAR, NRO, and INSCOM,<sup>45</sup> can distribute development priorities to any government agency or

---

<sup>45</sup> The OWF GOSS board includes members from: the Office of the Director of National Intelligence (ODNI), the Central Intelligence Agency (CIA), the Defense Information Systems Agency (DISA), Space and Naval Warfare

program requesting the source code for either its own use or for updating. These agencies are encouraged to submit software patches and feature enhancements to improve the baseline code and benefit the community of projects utilizing the OWF and OMP. The OWF also provides a suite of application programming interfaces (APIs) that give widget developers the ability to further their web applications using inter-widget communication, user preferences, and internationalization. Each API is written in JavaScript so that widgets can be built in a large variety of web technologies. Therefore, widgets can be written in the JavaScript capable technology of the developer's choice. The ability of each agency to customize their APIs further allows for quick responsiveness.

## **Widgets in Action**

The power of widgets and apps to provide agile C2 is being recognized across the DoD. The recognition of the power of these apps is driving a push to change the acquisition structure of these products to allow them to be fielded in a responsive manner. The Navy's Program Executive Office for Command, Control, Computers, Communications and Intelligence (PEO C4I) located at the Space and Naval Warfare Systems Center (SPAWAR) is actively working to implement a storefront and a widget acceptance process through which widgets can be fielded through an already existing program of record and thereby reach the user in a timely fashion. Command and Control and Intelligence widgets as well as the Ozone Market Place (OMP) provide examples of this embrace of widgets. These C2 widgets when fielded provide agile C2 capabilities in response to emergent warfighter requirements.

### *Command and Control and Intelligence Widgets*

Several communities within DOD have embraced the OWF and widgets. GCCS-J I<sup>3</sup> has been actively developing widgets for naval commands (I3 Common Geospatial Display Widget, I3 Vessels of Interest Widget, I3 Maneuver Unit Widget, I3 Latest DMOB Equipment Widget, I3 Naval Activity Widget, I3 Channel List Widget, I3 Blue Forces widget, I3 AOB widget, I3 Recent Activity Widget, I3 Targeting Widget, I3 Weather Observation Widget, I3 Weather Forecasting Widget). The Distributed Common Ground System – Army (DCGS-A) has created a suite of widgets for their users. The Defense Intelligence Information Enterprise (DI2E) has selected OWF for use within its development. The Joint Command and Control Common User Interface (JC2CUI) has selected OWF as one of its two common clients.

### *Ozone Market Place (OMP)*

The Ozone Marketplace (OMP) is a thin-client registry of applications and services similar to a commercial industry application store or marketplace. Generally, it is a directory where widgets are submitted and can be shared for others to search, access, and use. The OMP is the marketplace specific to the OWF. It can also stand on its own but is usually utilized with Ozone. The OMP is also a part of the OWF GOSS Program so it undergoes updates and new releases made by the OWF GOSS Board. From a user standpoint, the OMP is where analysts can search

---

Systems Center (SPAWAR), the National Reconnaissance Office (NRO), and United States Army Intelligence and Security Command (INSCOM).



for widgets that provide desired information and can add them to their system for use. Developers can upload their widgets to OMP and provide associated metadata, but administrators have the ability to approve or reject widgets submitted to OMP. Therefore, users can only utilize widgets once they have been approved by the administrators.

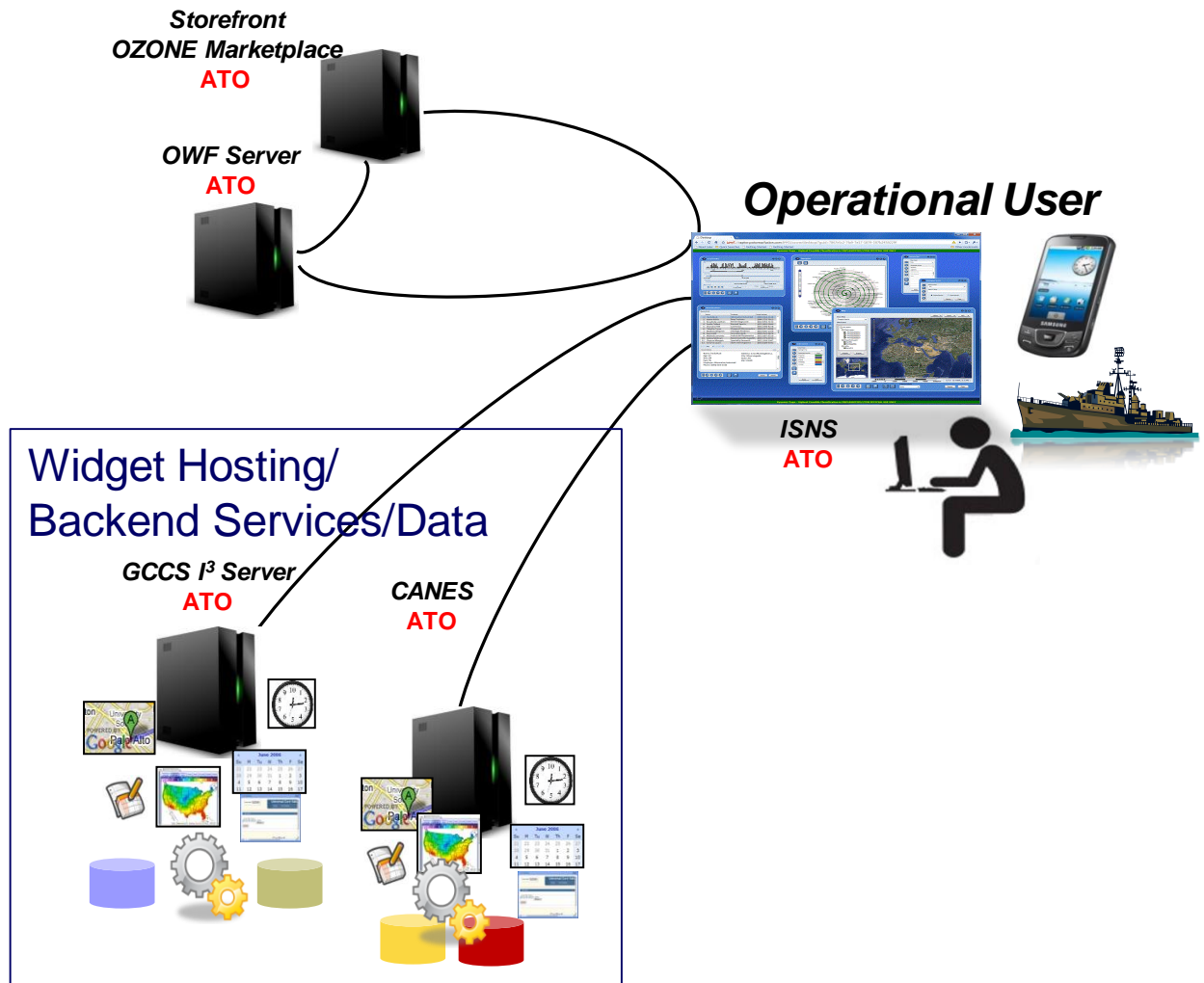
## **PEO C4I Storefront Overview**

Before new capabilities are made available to the warfighter, they must undergo developmental tests, operational tests, and a strict certification and accreditation (C&A) process. All of which can take as long as nine months, enough time for the “new” technology to become out of date and unresponsive to immediate user needs. One of PEO C4I’s FY2012 Strategic Goals is to, “[f]oster focused innovation to rapidly field relevant capabilities to meet existing and emerging war fighter needs.”<sup>46</sup> Widgets provide a technological capability to foster this rapid fielding ability and provide the potential to rapidly implement C4ISR and operational capabilities to the war fighter. Widgets are being deployed in the Navy operational environment as part of formal software builds and releases for Programs of Record (PoRs). The PEO C4I Storefront and a governance process specific to widgets submitted by an accredited PoR will reduce lead times and ensure that widgets are efficiently and securely introduced in a production environment for the warfighter.

PEO C4I Storefront architecture can decrease the infrastructure and certification and accreditation (C&A) burden on the operational user by decoupling the widget capabilities from his or her browser in the operational environment. Figure 1 depicts the Operations Architecture of the PEO C4I Storefront. An operational user can discover widget capabilities from metadata in his or her operational Storefront OZONE Marketplace which are then served from an accredited OZONE Widget Framework (OWF) server to accredited Integration Shipboard Network Service devices (e.g. desktop or a mobile device). The widget may actually be hosted in a distinct environment (e.g. CANES or GCCS-I3), as may be the backend services and data which comprise the capability. Since a widget, backend services and associated data may reside and operate completely within accredited environments and are transported over secure communications means, the accreditation burden can be greatly lessened.

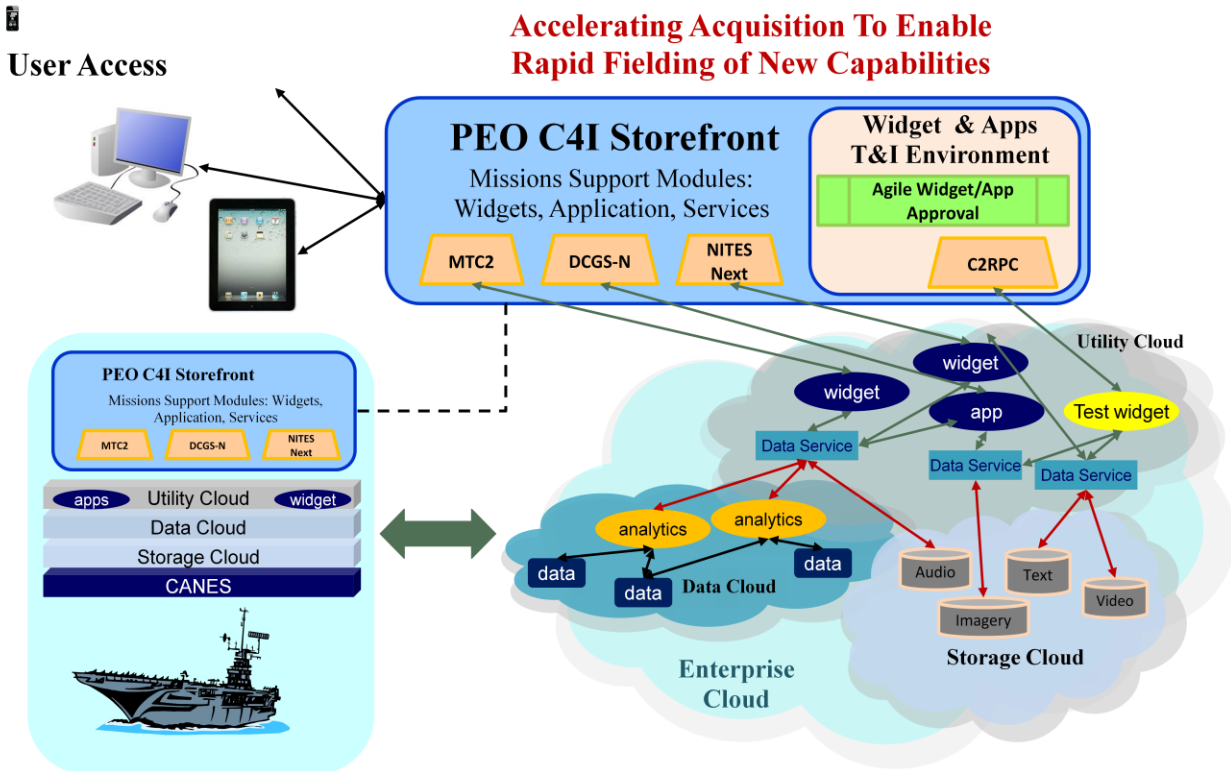
---

<sup>46</sup>*PEO C4I Strategic Plan 2012-2017*. (San Diego, CA: PEO C4I, 2011),6. Accessible at: [http://www.public.navy.mil/spawar/PEOC4I/Documents/PEO\\_C4I\\_StrategicPlan\[FY12\].pdf](http://www.public.navy.mil/spawar/PEOC4I/Documents/PEO_C4I_StrategicPlan[FY12].pdf)



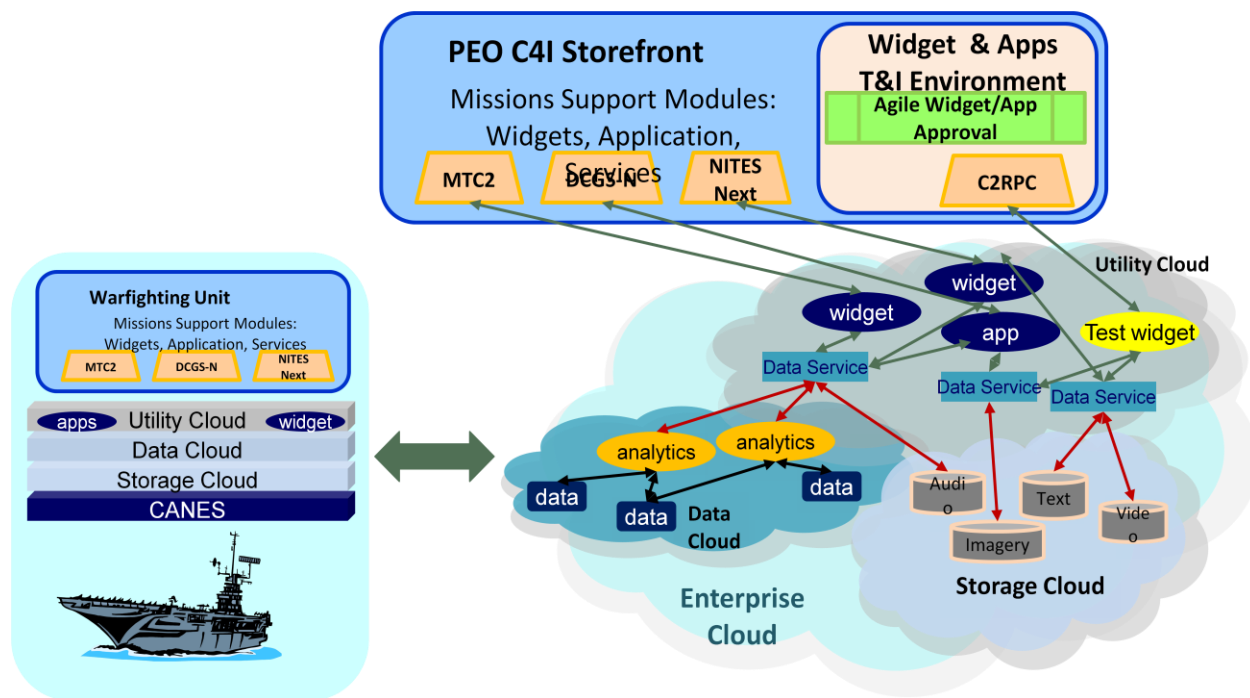
**Figure 1: Operations Architecture**

Other PEO C4I efforts to quickly deploy new technologies to the warfighter such as widget development (DCGS-N, MTC2, C2RPC, NITES-Next, etc.), migration of PEO C4I capabilities to the Cloud, and Cloud TF, will be brought together by the PEO C4I Storefront and Widget Governance Processes. They will demonstrate a unified end-to-end process for taking a widget capability through development, test, certification, approval and delivery. Figure 2 illustrates the integration of the PEO C4I Storefront and the Navy Cloud.



**Figure 2: PEO C4I Storefront Integration with the Navy Cloud**

This integration with the U.S. Navy Enterprise cloud is particularly useful for warfighters operating abroad. The enterprise cloud will contain nodes at important overseas bases which will duplicate the data and capabilities to enable increased speed of connections. A deployed battle group, such as a carrier strike group, can also act as an individual cloud providing a repository of these data capabilities. DIL networks will require the provisioning of software elements in a local repository, be it a forward base node or an afloat node like a carrier in a carrier strike group. The required updates can then be obtained periodically during sufficient bandwidth occurrences. The provisioning of the software items will allow for the changing the mission on emerging need. Commanders could then reconfigure the unit to change mission capabilities at demand. The provisioning of widgets applications and application bundles the unit has the ability to change mission apps out allowing for the multi-tasking on demand. The ability to reach the enterprise will allow for a greater set of capabilities allow for more configurations. Figure 3 illustrates how a warfighting unit can have its own utility, data and storage clouds, and thus act as its own afloat information network node.



**Figure 3: PEO C4I Storefront Integration with an Afloat Cloud**

Using the widget framework the operator is not only able to be successful but is able to maintain “success in light of changed or changing circumstances”<sup>47</sup> a key component of agile C2. The PEO C4I Storefront provides an example of how quickly widgets can be created and fielded when they are associated with an already accredited PoR. It behooves the DoD to examine its acquisition paths and to adopt widgets and associated storefronts at an accelerated pace in order to enable agile C2. The DoD must also work to establish the storefronts in order to enable deployed commanders to effectively compose their C2 capabilities even in DIL environments. As *Global Trends 2030* notes “the future world order will be shaped by human agency as much as unfolding trends and unanticipated events.”<sup>48</sup> Thus it behooves the DoD to enable its commands to be able to respond to these events with innovative approaches as exemplified by the use of widget and application storefronts described in this paper.

<sup>47</sup> Alberts, *The Agility Advantage*, 66.

<sup>48</sup> Office of the Director of National Intelligence, *Global Trends 2025*, 3.

## Conclusion

In this era of tightening budgets, looming defense spending reductions, and an ever complex national security environment, the warrior's spirit of creativity is essential. Admiral Greenert, CNO, called this out in his *Sailing Directions*:

We will address economic change by being effective and efficient. We will innovate to:

- Use new technologies and operating concepts to sharpen our warfighting advantage against evolving threats<sup>49</sup>

### *What is Innovation?*

What is innovation? The generic, Webster's dictionary definition of innovation is "the introduction of something new; a new idea, method or device." Scholars and practitioners of innovation define it in similar terms. John Kao, innovation consultant, defined innovation in his *Innovation Manifesto* as "creativity applied with intention, to create value."<sup>50</sup> Stepping back a bit, Kao defines "creativity" as "the ability of individuals, teams and organizations to generate new ideas, approaches, concepts."<sup>51</sup>

### *Why it is Important?*

Innovation is evolving to becoming a key word in the many discussions about not only rejuvenating the U.S. and world economies, but also how best to reset and rebuild a U.S. military that is capable of meeting future national security challenges. Just what power does innovation have in providing anyone or any organization with the ability to meet a future that is uncertain and dynamic?

Kao put it this way in his *Manifesto*:

...innovation enables people to adapt to the waves of disruptive change. And the rate of change is increasing. Changes brought on by new business models, by demographic and geopolitical shifts, by new and emerging technologies. **The only response to change is innovation.** (Emphasis in original)<sup>52</sup>

Innovation by its nature calls on individuals, groups, and organizations to look at things differently, creatively. As the *Innovator's Guide* puts it, a key element of innovation is

---

<sup>49</sup> Admiral Jonathan Greenert, "CNO's Sailing Directions," September 2011, [http://www.navy.mil/cno/sailing\\_direction\\_final-lowres.pdf](http://www.navy.mil/cno/sailing_direction_final-lowres.pdf)

<sup>50</sup> John Kao, *John Kao's Innovation Manifesto: 20 Precepts about Innovation* (personal copy in the authors' possession).

<sup>51</sup> John Kao, *John Kao's Innovation Manifesto: 20 Precepts about Innovation* (personal copy in the authors' possession).

<sup>52</sup> John Kao, *John Kao's Innovation Manifesto: 20 Precepts about Innovation* (personal copy in the authors' possession).

ideation—“the practice of splicing together separate thoughts to generate new ideas.” So why is innovation important? President Obama put it best in his 2011 State of the Union address.

The first step in winning the future is encouraging American innovation... What we can do—what America does better than anyone else—is spark the creativity and imagination of our people. We’re the nation that put cars in driveways and computers in offices; the nation of Edison and the Wright brothers; of Google and Facebook. In America, innovation doesn’t just change our lives. It is how we make our living.<sup>53</sup>

For the U.S. military, innovation is the key to building the joint force of the future as General Martin Dempsey, Chairman of the Joint Chiefs of Staff, noted in his keynote address at the 2012 Joint Warfighting Conference:

There are great thoughts out there, inside and outside the military, that will help us significantly innovate 20 percent of the force while reimagining how to employ the other 80 percent.<sup>54</sup>

General Dempsey further noted that the development and integration of emerging capabilities—cyber, ISR, undersea technology, and unmanned technologies—“will provide new ways to generate military power, and to do so quickly, with global reach and strategic adaptability.”

#### *Innovation and the U.S. Navy*

Innovation is nothing new to the U.S. Navy—one can trace it back to the days of sail and the innovative approaches to overcoming the early challenges of building a viable naval force of a new nation. The U.S. Navy has begun a renewed focus on innovation as noted by Admiral John Harvey, then Commander of Fleet Forces in his statement in the following passage from NWDC’s *Innovator’s Guide*:

For decades the Navy has held a comfortable advantage over adversaries. This advantage is at risk, due in part to the rising of peer nations and the proliferation of low-cost information technologies available to non-state actors. If the Navy is to hold operational advantages in future conflicts, it must be able to out-think and out-maneuver adversaries through effective innovation.<sup>55</sup>

The storefronts, widgets themselves and a cloud architecture they deploy on are innovative in that they allow the warfighter to choose what data they need, configure it with just a moment’s notice and then present a complete and tailored common operating picture to a commander or

---

<sup>53</sup> President Barack Obama, “2011 State of the Union Address” (speech, Washington, D.C., January 25, 2011), accessed April 18, 2013, <http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address>.

<sup>54</sup> General Martin Dempsey, “Remarks and Q&A at the 2012 Joint Warfighting Conference & Exposition,” (speech, Virginia Beach, VA, May 16, 2012) accessed April 18, 2013, <http://www.jcs.mil/speech.aspx?id=1698>.

<sup>55</sup> Navy Center for Innovation, *The Innovator’s Guide*, (Norfolk, VA: Navy Warfare Development Command, U.S. Navy, 2012), accessed April 18, 2013, [https://www.nwdc.navy.mil/ncoi/blog/Document%20Library/Innovator's%20Guide%20Book%20\(cover%203\).pdf](https://www.nwdc.navy.mil/ncoi/blog/Document%20Library/Innovator's%20Guide%20Book%20(cover%203).pdf).

another warfighter depending on the requirements. The use of the data that is already being collected by a vast array of ISR sensors is leveraged by the new technology of the widget storefronts. In this sense, this project could be a poster child for General Dempsey's strategy of keeping 80 percent of the old capabilities, in this case the Navy's ISR sensors, and innovating 20 percent, in this case the storefronts and widgets. Fortunately, as this project shows, innovation in the U.S. Navy laboratories and systems centers continues to bring strong capabilities to the warfighter.