

17th ICCRTS
Operationalizing C2 Agility

**“We Have an App for That:
U.S. Military Use of Widgets and Apps to Increase C2 Agility”**

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)

Ms. Angela Bowers

Mr. George Galdorisi

Dr. Stephanie Hsieh

Mr. Mike Morris

Mr. Chris Raney

Space and Naval Warfare Systems Center Pacific

53560 Hull Street

San Diego, California 92152-5001

(619) 553-2066

amanda.george@navy.mil

Abstract

With the advances in mobile technology the U.S. Department of Defense (DoD) and the military services have recently moved towards incorporating mobile devices, like smart phones, into the warfighter's arsenal to increase the efficiency of command and control (C2). The use of widgets and specialized apps has become another method through which the warfighter can easily access data to increase situational awareness as well as connect rapidly with a command center. These devices also provide warfighters with the ability to provide pertinent data to the central command center thereby increasing the total situational awareness.

Utilizing innovative information and communication technologies such as specialized widgets and apps on mobile systems supports the development of agile C2 systems. The DoD and the military services are currently working to provide widget and app storefronts to disseminate applications. This paper will draw on previous work done in looking at the efficacy of these widgets and apps and examine the steps already taken in utilizing these specialized apps, both in traditional and mobile systems, to increase the agility for the warfighter. In addition, it will provide a look ahead at the possible future of the apps given the current U.S. budgetary climate and other technological challenges they may face.

“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*¹²

As the *National Strategic Narrative* points out, the twenty-first century has brought an era of rapid change. 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 by 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.³ 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. Application and widget technologies provide the U.S. military with the opportunity to increase C2 agility at a reasonable cost. Thus the United States has the opportunity to take advantage of this change by adopting agile C2 through the use of widgets and apps and by adapting the innovative governance process that will significantly decrease the fielding time of this C2 tool.

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 globalism continues to rise, the world necessarily becomes increasingly complex. In the face of complexity and unpredictability, the U.S. 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. Government, the Department of Defense 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

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

² 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*.

³ 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

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 will provide a look at the different viewpoints provided in the wealth of analysis conducted by experts all over the world. *Global Trends 2025*, produced by the National Intelligence Council is a logical place to begin, as it is often cited by other strategic analyses. The overarching message in *Global Trends 2025* is that there are significant changes forthcoming to the international system in the future. *Global Trends 2025* states:

[T]he international system – as constructed following the Second World War – will be almost *unrecognizable* by 2025 owing to the rise of emerging powers, a globalizing economy, an historic transfer of relative wealth and economic power from West to East, and the growing influence of nonstate actors.⁴

Further strategic analysis of the future global environment is found throughout many DoD publications. Seven unclassified publications, the *National Strategic Narrative* (APRIL 2011), the *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) and the recently released *Defense Strategic Guidance* (JAN 2012), 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 emergence of new power centers; the rising influence of non-state or transnational actors; 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.

⁴ Office of the Director of National Intelligence, *Global Trends 2025*, (Washington, D.C.: Department of National Intelligence, 2008), vi.

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

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,”⁵ the U.S. 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 21st Century Defense*⁶ and *Defense Budget Priorities and Choices*⁷ lay out the United States’ military response to fiscal pressures at home and uncertainty abroad. *Sustaining U.S. Global Leadership: Priorities for 21st 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.”⁸ 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

⁵ Office of the Director of National Intelligence, *Global Trends 2025*, vi.

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

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

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

ungoverned territories and directly striking the most dangerous groups and individuals when necessary.⁹

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.”¹⁰ This is a change from the previous “two-war doctrine” in which the U.S. 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.”¹¹

The U.S. 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), is the primary response of the maritime forces to the changing future strategic landscape. CS-21 points out that “seapower protects the American way of life”¹² 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.”¹³ 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.”¹⁴

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 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.

⁹ DoD, *Sustaining U.S. Global Leadership*, 1.

¹⁰ DoD, *Sustaining U.S. Global Leadership*, 1.

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

¹² 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.

¹³ 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.

¹⁴ 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).

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.¹⁵

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.

What is C2?

Before we explore the future of Command and Control (C2) agility and the place of mobile applications, one must first define what C2 is and trace its development over the course of military history. 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 resources, including information, toward the achievement of some task, objective, or goal.”¹⁶ While Alberts and Hayes used a general notion of command and control to structure their exploration of the future nature of command and control, this paper will pull in the published definitions of the terms to guide the following discussions.

Command and control is defined as “[t]he 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.”¹⁷

From the naval perspective¹⁸ the central figure of C2 is the commander who “commands by deciding what must be done and exercising leadership to inspire subordinates toward a common

¹⁵ Department of the Navy (DoN), *Vision for Information Dominance* (Washington, D.C.: Department of the Navy, 2010).

¹⁶ David S. Alberts and Richard E. Hayes, *Understanding Command and Control* (Washington, D.C: DoD Command and Control Research Program, 2006), p. 32.

¹⁷ Department of Defense (DoD), *Department of Defense Dictionary of Military and Associated Terms*, (Joint Chiefs of Staff: 2008): <http://www.dtic.mil/doctrine/jel/doddict/data/c/01078.html>.

¹⁸ This paper explores command and control from the naval perspective. While the notions of command and control remain consistent when applied to all aspects of military endeavors, the naval experience will guide the discussions in this paper.

goal; he controls by monitoring and influencing the action required to accomplish what must be done.”¹⁹ Central to the notion of command and control is the hierarchy that allows for a central figure—a commander—to work as a cohesive unit to accomplish a goal. The establishment of a clear “chain of command” has enabled naval commanders to “cope with the uncertainty of combat and to employ military force more efficiently.”²⁰

The Dual Nature of C2

The essence of command and control is the management of uncertainty with the assumption that the victor is the one with the better approach. Naval historian Michael A. Palmer further expands on the essence of command and control in his book titled *Command at Sea: Naval Command and Control Since the Sixteenth Century*. Palmer argues that during the advancement of naval doctrine and the expansion of sea control by the dominant maritime nations of the sixteenth century, two philosophies of the application of command and control emerged. The first approach is the adoption of a centralized system of command and control to provide a clear hierarchy of authority. The second system is to accept some elements of uncertainty of warfare and decentralize command and control.²¹

The battle that best epitomizes the dual nature of command and control and continues to serve as an allegory for modern day debates over the merits of either approach is the famed battle of Trafalgar of 1805. At Trafalgar, Admiral Nelson’s decentralized approach allowed his seasoned commanders to correctly interpret his intent in the heat of battle. Admiral Nelson’s decentralized command style centered on his faith “that all of his subordinates would perceive a developing situation in the same way—that is they would have a shared situational awareness.”²² The Combined Fleet led by Admiral Villeneuve did not have the shared experience to allow for a decentralized approach to the battle and thus did not do too well in the chaos that ensued when Nelson’s fleet drove through their lines. Nelson’s victory over the combined French and Spanish fleet may have helped to save Great Britain from Napoleon but it sparked the debate over which approach to command and control offers the best naval military edge.²³ While Nelson’s decentralized model proved advantageous to the British fleet, the centralized version of command and control quickly dominated military tactics.

¹⁹ Department of the Navy (DoN), *Naval Doctrine Publication 6: Naval Command and Control* (Washington, D.C.: Naval Doctrine Command, 1995): 9.

²⁰ DoN, *Naval Doctrine*, ii.

²¹ Michael A. Palmer, *Command at Sea: Naval Command and Control Since the Sixteenth Century* (Cambridge, MA: Harvard University Press, 2005): 12-16.

²² Edward A. Smith, Jr., “Network-Centric Warfare: What’s the Point,” *Naval War College Review* 54 (2001):70.

²³ For a detailed discussion of C2 in support of the Global Maritime Partnership and also the evolution of naval communication see also: Stephanie Hszieh, George Galdorisi, Terry McKearney, and Darren Sutton, “Networking the Global Maritime Partnership,” *Naval War College Review* 65 (Spring, 2012): pp. 11-29 and Mary Chrysler, George Galdorisi, and Stephanie Hszieh, “Networking the Global Maritime Partnership” (paper presented at the 16th International Command and Control Research and Technology Symposium, Québec City, Québec, Canada June 21–23, 2011).

John F. Schmitt argued that the Western reliance on Newtonian science as the main paradigm to problem solving is the key driver in the reliance on centralized command and control.²⁴ Since then command and control has shifted between a heavily centralized model and some variant of Nelson's decentralized model—with the centralized model dominating most strategies. From the perspective of military theorists and strategists the clear and rational approach that underpins the centralized model of command and control offered the best means to control the uncertainties of war. A Newtonian approach to war allowed for military planners to rely on the scientific method to gather some semblance of control over the chaos of warfare.

Newtonian war is deterministically predictable: given knowledge of the initial conditions and having identified the universal “laws” of combat, we should be fully able to resolve the problem and predict the results. All Newtonian systems can eventually be distilled to one simple concept: cause and effect...The object of Newtonian command and control is to gain certainty and impose order—to be “in control.”²⁵

The centralized/Newtonian model was prominent in Industrial Age warfare where national lines were drawn clearly and the rules of war and engagement were fairly straight forward as great national powers dominated the political landscape. The arrival of the Information Age that is marked by the advent of the microprocessor and the information communication technologies brought about the means to bring Admiral Nelson's self-synchronizing approach to fruition. The Information Age also coincided with the growing interconnectedness of the world that has been described as the globalization of world affairs. With greater connectedness comes greater complexity as information and people have been able to move around with an ease that has never been accomplished before the invention of the jet engine.

Network Centric Warfare and C2

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.”²⁶ The center of NCW's approach is similar to Nelson's self-synchronizing command style, but on a larger scale. 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

²⁴ John F. Schmitt, “Command and (Out of) Control: The Military Implications of Complexity Theory,” in *Complexity, Global Politics, and National Security*, eds. David S. Alberts and Thomas J. Czerwinski (Washington, D.C.: National Defense University, 1997), 99-100.

²⁵ Schmitt, “Command and (Out of) Control,” 100 -101.

²⁶ 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.

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.²⁷

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.”²⁸

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*, “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.”²⁹ 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.³⁰

Militaries, the US’s included, remain “largely industrial age organizations with information age capabilities”³¹ 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.”³²

A focus on agility is necessary to overcome the information age challenges military institutions face. As described previously, the global system is likely to continue on its path towards greater complexity and uncertainty.

²⁷ 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>.

²⁸ 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.

²⁹ David S. Alberts, *The Agility Advantage* (Washington, D.C.: DoD Command and Control Research Program, 2012), 65.

³⁰ Alberts, *The Agility Advantage*, 65.

³¹ David S. Alberts, *The Agility Advantage*, 136.

³² Alberts, *The Agility Advantage*, 136.

[I]ncreased complexity and dynamics create more uncertainty, risk, and time pressures. As a result of increased uncertainty, risk, and time pressures, the problems we face become more difficult, while, at the same time, there is a need to solve these problems more quickly.³³

Agility, however, can address this issue in a timely and economical way.

Agile C2

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.”³⁴ 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.”³⁵ Simply put, the definition of agility used in this paper is that “agility is the capability to successfully cope with changes in circumstances.”³⁶ 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.”³⁷

Agile C2 Embodied in Widgets and Apps

The DoD struggles to keep up with the commercial world when it comes to delivering new software technology to its customers. By the time new solutions are delivered to the warfighter, the technology is obsolete. The software industry’s focus has evolved to include small flexible mobile code via widgets and other mobile applications (“apps” as they are normally called). Several elements within the DOD have started similar initiatives that hold the promise of reducing the “heavy lifting” required as part of the current acquisition process.

IBM’s 2006 *Global Technology Outlook* recognized the importance of a rapidly evolving software development paradigm as a driving force in web-based dynamic content and the manner in which is delivered to the user primarily through “situational applications.”

Software development is going through a rapid evolution enabled by the ubiquity and ease-of-use of the web, simple to use software, tools, and techniques, dramatic rise in computer literacy, and the development of standards around Web Services. All these forces together are giving rise to a new paradigm for the collaboration, creation, manipulation of dynamic content with the web as the

³³ Alberts, *The Agility Advantage*, 136.

³⁴ Alberts, *The Agility Advantage*, 65.

³⁵ Alberts, *The Agility Advantage*, 65.

³⁶ Alberts, *The Agility Advantage*, 66.

³⁷ Alberts, *The Agility Advantage*, 61.

platform, a.k.a. Web 2.0. The building of situational applications – applications built with just enough function to satisfy a business need, usually by business users – by mixing and re-mixing existing components are becoming more and more common. These trends will force businesses to rethink how their applications and services are designed, developed, and managed. This in turn will put the onus on IT infrastructure companies to offer new tools for development, management and integration of situational applications and services.³⁸

IBM's insight into the emerging environment of 'situational applications' and dynamic content demonstrated their predictive ability to understand forces that would significantly impact software development trends from six years ago. Since that time, the creation and use of "situational applications" throughout the private sector has exploded. More recently, the 2008 *IBM Global Technology Outlook* noted:

With the rapid rise of mobile business, companies will be able to do more than just give their employees the option to access email remotely. They will be able to give them access to critical data and applications – anywhere, anytime – because the infrastructure and security features will be there to support them.³⁹

This prediction too has come to pass, leading journalists to opine that the Age of Mobile has truly dawned.⁴⁰

The success these applications have had in the private sector can be leveraged by the warfighter in the military realm. 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. The use of widgets and specialized apps has become another method through which 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. 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.

³⁸ IBM Corporation, *Global Technology Outlook* (Armonk, N.Y.: IBM Corporation, 2006).

³⁹ IBM Corporation, *Global Technology Outlook* (Armonk, N.Y.: IBM Corporation, 2006).

⁴⁰ Mckinzie, Hamish "Web 2.0 is Over, the Age of Mobile Has Dawned" Pando Daily April 27, 2012. Accessed at: <http://pandodaily.com/2012/04/27/web-2-0-is-over-all-hail-the-age-of-mobile/>

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,⁴¹ can distribute development priorities to any government agency or 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.

Command and Control and Intelligence Widgets

Several communities within DOD have embraced the OWF and widgets. GCCS-J I³ 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

⁴¹ 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 Systems Center (SPAWAR), the National Reconnaissance Office (NRO), and United States Army Intelligence and Security Command (INSCOM).

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 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.”⁴² 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). However, the traditional method of providing software to the fleet typically does not support agile deployment of widgets.

To further Goal 2.4⁴³ in August 2011, the following two tasks were approved:

- Task 2.4.1 – Setup an application storefront on SIPRNET and JWICS for the delivery of C4I widgets.
- Task 2.4.2- Establish an Agile Widget Approval IPT to develop a business process for developing, modifying, approving and remotely deploying widgets.

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.

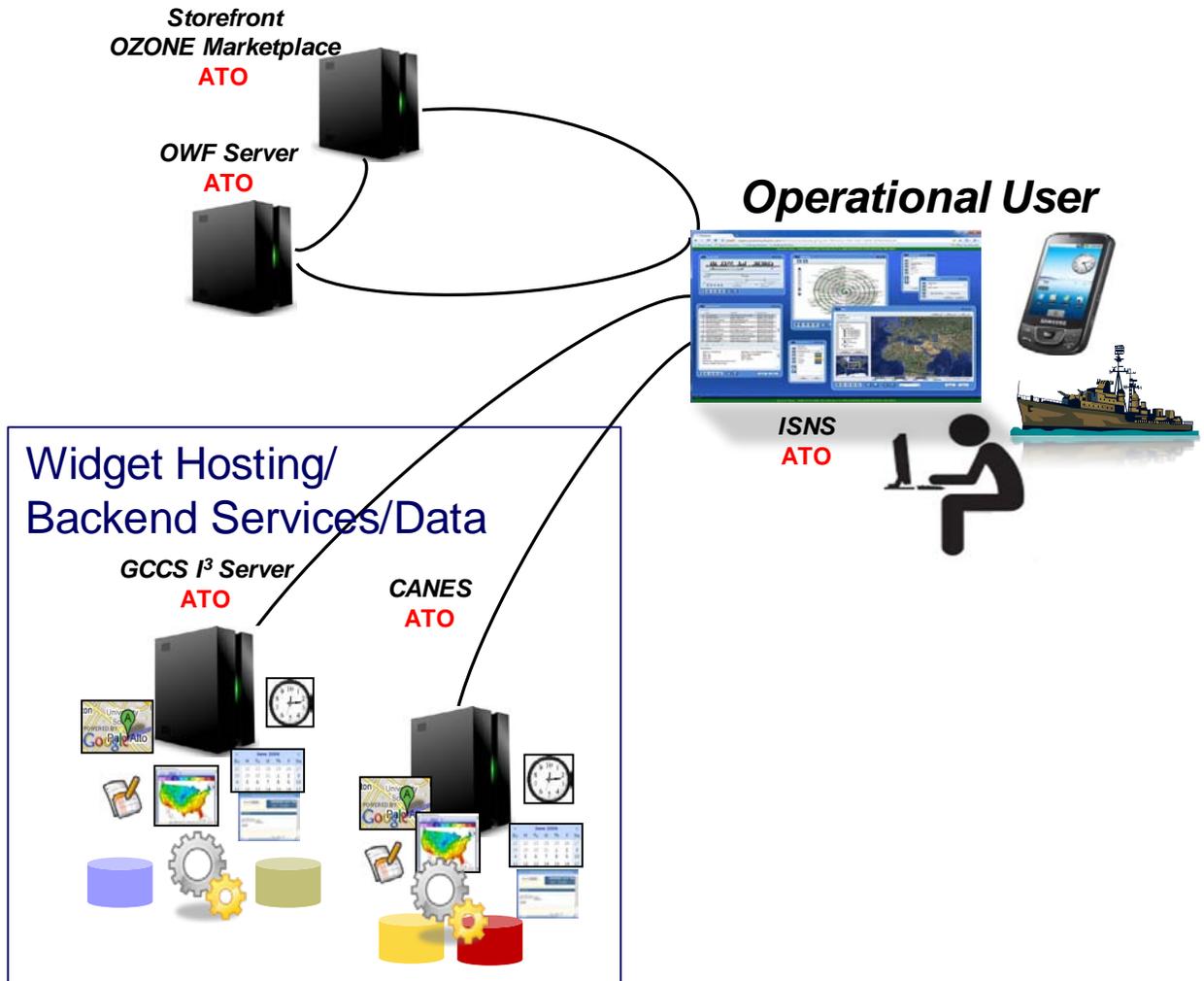
PEO C4I Storefront architecture can decrease the infrastructure and certification and accreditation (C&A) burden on the operational user by decoupling the widget capabilities from his or her browser in the operational environment. Figure 1 depicts the Operations Architecture of the PEO C4I Storefront. 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

⁴²*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)

⁴³ *PEO C4I Strategic Plan 2012-2017*, 2011, 6.

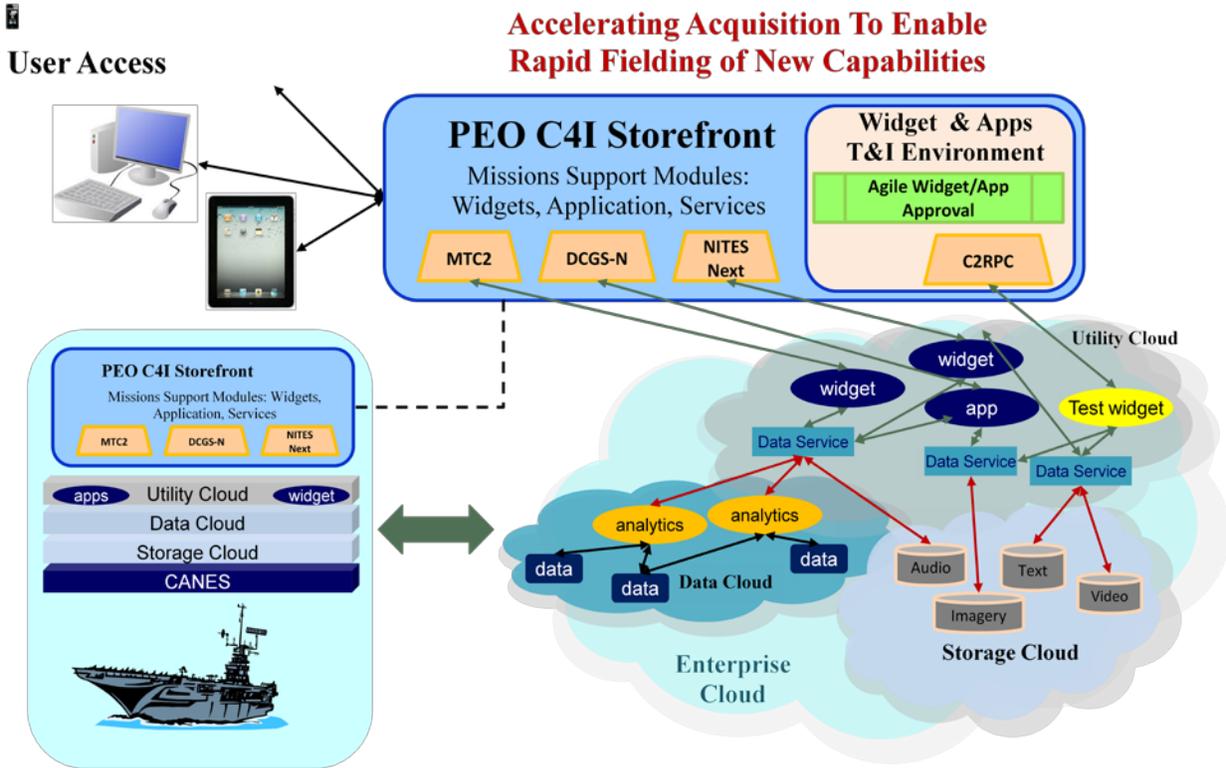
and operate completely within accredited environments and are transported over secure communications means, the accreditation burden can be greatly lessened.

Figure 1: Operations Architecture



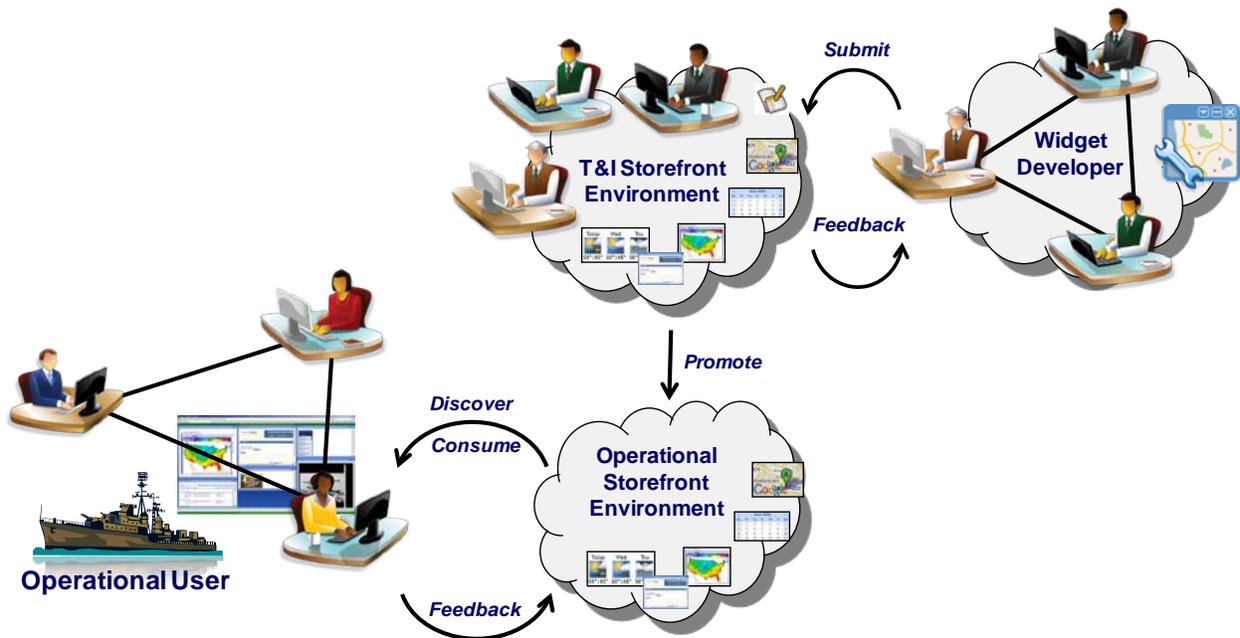
Other PEO C4I efforts to quickly deploy new technologies to the warfighter such as widget development (DCGS-N, MTC2, C2RPC, NITES-Next, etc.), migration of PEO C4I capabilities to the Cloud, and Cloud TF, will be brought together by the PEO C4I Storefront and Widget Governance Processes. They will demonstrate 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



The PEO C4I Storefront seeks to increase the speed at which new capabilities are provided to the warfighter by creating an efficient test, verification and validation process to govern widgets. Figure 3 depicts the operational concept of the PEO C4I Storefront. A widget developer produces a widget which he submits to the T&I Storefront Environment for testing. The PEO C4I Widget Test and Integration (T&I) Team provides feedback to the widget developer on improvements needed to make the widget compliant with the Operational PEO C4I Storefront standards, enforced by the Office of Designating Approval Authority (ODAA) and Commander, Operational Test and Evaluation (COMOPTEV). Upon completion of all testing, the widget is promoted to the Operational Storefront Environment. From there, the Operational User can discover the widget from a Marketplace (applications store) and consume the capability in an operational environment. Ultimately, the operational user can provide feedback about the widget to build on the existing capability or to inspire new capabilities.

Figure 3: PEO C4I Storefront Operational Concept

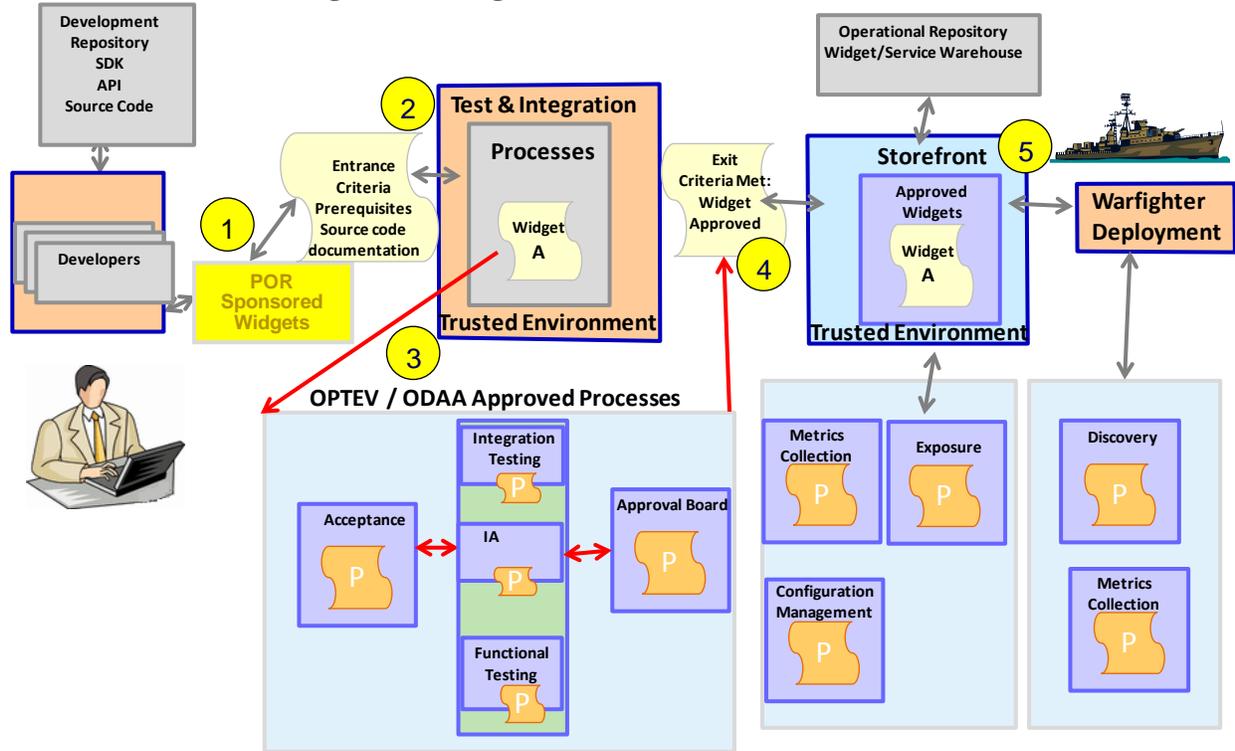


Widget Governance Tool

Widget governance is how an organization establishes and controls its processes and policies regarding widgets. It includes a system to track and record where a widget is within a widget process and checks for its compliance with existing policies. By establishing an efficient test and evaluation process to govern widgets and approve their acceptance into a marketplace, the lead time for a developmental concept to reach the warfighter can be greatly reduced.

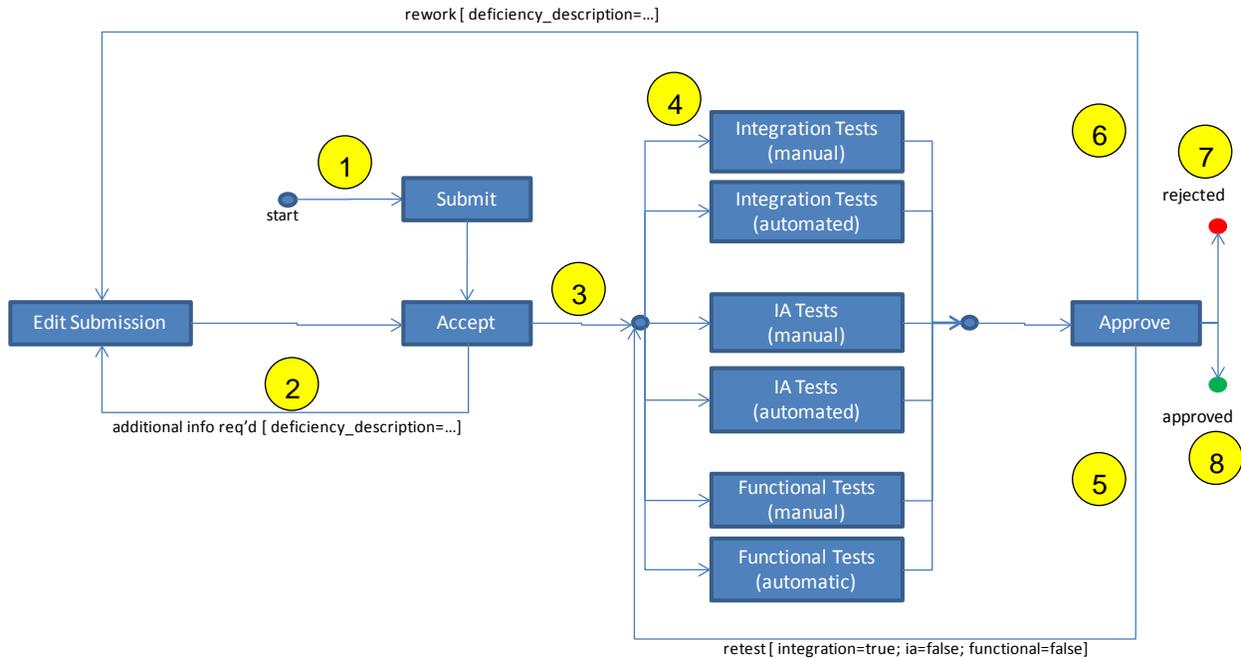
The following, described in Figure 4, is an overview of the widget governance tool that governs widgets beginning with its initial submission to the widget governance process to its acceptance into the operational environment where it becomes available for use by the warfighter.

Figure 4: Widget Governance Process Overview



Developers provide widgets to Programs of Record (PoR) which expose capabilities in a widget framework (1). The widgets must meet Entrance Criteria for introduction to the Test and Integration (T&I) environment (2), which includes the source code, descriptive metadata, configuration documentation, and developer testing results for the target production environment. Applying COMOPTEV/ODAA approved processes, the widget passes through a number of manual and automated tests to ensure suitability for the production Storefront environment (3). Upon review of the test results which verify that the widget meets the exit criteria (4), the widget is approved to be introduced into the Storefront operational environment (5) and is made readily available to the warfighter. The following, detailed in Figure 5, is a detailed process flow for the widget governance tool.

Figure 5: Detailed Widget Governance Process Flow



A Widget Submission Package (WSP) is submitted (1) which contains source code and documentation of the widget and application programming interface (API), as well as metadata describing the function, user guidance, characteristics, boundaries and deployment locations, preferred browser and system configuration, installation instructions and dependencies. Developer Functional, IA and Integration Test Reports are also included, as well as a Mobile Code risk mitigation strategy and a statement that the widget has been developed in accordance with mobile code developer’s guidance and a Security Technical Implementation Guide (STIG) report. All required components of the WSP are indexed for ready reference. If the package does not pass the Acceptance test (1), a report of deficiencies is provided and the submitter is provided the opportunity to edit and correct the submission (2). If the WSP passes the Acceptance subprocess, the package is provided for Functional, IA, and Integration Testing subprocesses in the T&I environment (3).

The Functional, IA, and Integration testing is conducted in parallel to the greatest extent possible in order to optimize testing resources and make the procession of the WSP through the process efficient (4). Functional testing will focus on the proper operation of the widget in generating the desired output in a widget as described by the PoR. Integration testing will concentrate on how well the widget performs in the Storefront environment (e.g. with the widget framework, identity management solution, etc.) and also amidst other widgets. IA testing will ensure that the widget meets OWF standards, that backend services and data inherit configuration attributes from their accredited parent environments, that information is exchanged over a secure channel, and that the widget operates in a manner which ensures an acceptable level of security. Some tests will be conducted manually by the T&I Testing Team, but automation is desired to the greatest extent possible to decrease the amount of time and manual effort required to designate a widget suitable for the operational Storefront environment.

Upon completion of the preceding tests, the results will be aggregated and compiled for the Approval Board subprocess. The Board may determine that a WSP needs to be returned to the T&I Test Team if the results did not demonstrate acceptable functional, information assurance or integration testing results (5). A widget may also be ordered to be reworked by the developers if major deficiencies exist which must be corrected prior to deployment to the operational Storefront environment (6). Additionally, a WSP may be rejected if the content rendered or output of the widget is deemed to be inappropriate or of no added value in the Storefront environment (7), or approved, making it available to the warfighter in from the production Storefront environment (8).

Federation of Application Stores

The DoD can no longer continue down its current acquisition path of providing yesterday's solutions to meet today's immediate needs. The DoD *must* modify its view of acquisition. As technology is constantly evolving and improving, the DoD struggles to keep up with the latest capabilities and hinders itself with lengthy acquisition schedules and rising costs. The current commercial trend of delivering small, lightweight mobile applications to an application store allows industry leaders to provide a consistent stream of new capabilities to its customers. The DoD, however, has struggled to adopt this notion of rapid fielding of capabilities.

The future of warfare is information superiority and speed to capability. Lightweight web applications can supply the warfighter with valuable information and can be developed in a short period time since they are comprised of a generally small amount of code. With shortened development times, immediate user needs can be addressed and satisfied more quickly. This will increase the ability of the warfighter to utilize agile C2 to address rapidly changing scenarios in the field. The reduction in time and cost to field a solution goes directly to the heart of agile C2. Widgets provided by an already accredited PoR do not need to undergo the Certification and Accreditation processes that lengthen acquisition schedules and ultimately consume costs. New widget technologies and smaller testing efforts that make them available within an application store will introduce a paradigm shift in the development and delivery of capabilities to the warfighter. 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"⁴⁴ 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.

⁴⁴Alberts, *The Agility Advantage*, 66.