OPEN BUSINESS MODEL FOR

Unmanned Aircraft Ground Control Stations

Prepared By: Office of the Under Secretary of Defense for Acquistion, Technology & Logistics
Unmanned Aircraft Systems Task Force • Interoperability – Integrated Product Team (I-IPT)

THE ASSISTANT SECRETARY OF DEFENSE
3015 DEFENSE PENTAGON
WASHINGTON, DC 20301-3015

ACQUISITION

110613

MEMORANDUM FOR SERVICE ACQUISITION EXECUTIVES

SUBJECT: Open Business Model for Unmanned Aircraft Systems Ground Control Stations

The purpose of this document is to provide Unmanned Aircraft Systems (UAS) acquisition professionals with a sound business framework which will garner significant cost savings for the Government while enhancing warfighter capability. The goals of the Open Business Model (OBM) are to target affordability and control cost growth, incentivize industry productivity and innovation, and promote real competition. These goals are directly aligned with the Department's Better Buying Power 2.0 initiatives. In the current economic environment, acquisition practices that are proprietary, stand-alone, or one-of-a-kind are inconsistent with OSD goals. Such practices are not only fiscally unsustainable, but have also resulted in a UAS portfolio which lacks interoperability.

This OBM provides a well-structured means by which traditional stove-piped UAS acquisitions can be opened up for industry to compete effectively. It will allow DoD to adopt a fundamentally new paradigm for UAS acquisitions while providing a fiscally viable and sustainable path forward that ensures our continued superiority in unmanned operations. The bottom line is that we must make business decisions that are irrefutable "wins" for the warfighter, for the Department, and most importantly for the American taxpayer who will see immense benefit, utility, and logic in our procurement decisions.

I urge all acquisition professionals to adopt and implement the tenets of this OBM as soon as practical. It is my belief in doing so that we will achieve significant life-cycle cost savings while building upon the technical quality we have achieved thus far. My point of contact is CDR J.P. Greene, john.p.greene.mil@mail.mil or (703) 695-1600.

Katrina McFarland

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Air Force

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Army

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Aviation and Missile Research Development and Engineering Center (AMRDEC), Systems Engineering Directorate

Navy

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Program Office for Strike Planning and Execution Systems (PMA 281)

Program Office for Unmanned Carrier-Launched Airborne Surveillance and Strike Program (UCLASS)

Naval Air Systems Command (NAVAIR) (Contracts 2.0, Engineering 4.0)

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SECTION I – EXECUTIVE SUMMARY

Over the past twenty years, the Department of Defense (DoD) has acquired a diverse portfolio of Unmanned Aircraft Systems (UAS) across the Military Services[1] to meet its national security needs. Newly emergent threats and evolving national security requirements are prompting the DoD to re-evaluate its entire portfolio of systems, while at the same time, seeking to reduce the total ownership costs including lifecycle sustainment costs of these systems[2]

The anticipated reduction in defense spending in concert with advances in information technology provides ample opportunity for DoD to rethink how it acquires, designs, and builds its systems. As a result, DoD is adopting and exploiting open system design principles and architectures to increase competition, foster reuse across systems, and increase interoperability. This new acquisition model requires access to multi-vendor solutions to enable rapid insertion of new technologies to counter emerging threats, avoid technology obsolescence, and decrease time to field new capabilities. DoD is adopting an Open Business Model (OBM) to support the implementation of an Open Architecture (OA) for UAS Ground Control Stations (GCS) in order to drive greater acquisition efficiencies and reduce the total ownership costs. This new model is built upon several lessons learned from the Navy's own open architecture efforts in the submarine community when it radically changed its approach to building weapon systems due to an emerging threat from an adversary in conjunction with declining budget.

Within the confines of this framework, DoD maintains a UAS portfolio of 11 Programs of Record (PoR) across the Services. Six prime integrators support this UAS GCS portfolio. These six integrators represent only a fraction of the available defense, aerospace, and software vendor market that could provide innovative solutions for UAS GCS.

The Deputy Secretary of Defense chartered the Unmanned Aircraft Systems Task Force (UAS Task Force) to facilitate collaboration across the Services and industry and address DoD-wide integration issues. The Task Force is chartered to coordinate UAS requirements, increase interoperability, shape acquisition programs to prioritize joint solutions, and develop regulatory policies and procedures. To date, the Task Force has developed a Service Oriented Architecture (SOA) for GCS using standard data models and SOA service interface definitions. The architecture will serve as a basis for acquiring, integrating, and extending the capabilities of the GCS across the UAS portfolio.

Implementation and adoption of an OBM for the GCS will leverage the collaborative innovation of numerous participants across DoD and industry permitting shared risk, maximized asset reuse, and reduced total ownership costs. There are ten components that are essential for adherence to an OBM: acquisition strategy, contracting strategy, intellectual property rights,

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[1] Military Services will be referred to as "Services" for the duration of the framework while "services" will denote either a SOA service or a GCS application.

[2] http://www.acq.osd.mil/se/initiatives/init_rtoc.html

design disclosure, strategic reuse, collaborative development, technology insertion, testing strategies, automated tools, and certification.

DoD will develop acquisition strategies across the UAS portfolio that are built on continuous competition and reuse of services within the GCS architecture. The goal is to create an environment where innovative technology providers and integrators – both large and small – can freely and openly participate in competitions for a wide range of services or system domains. There are two different integration models for the UAS GCS: (1) the Contractor Integrator Model whereby the Government acquires services from multiple contractors and one contractor serves as the integrator or (2) the Government Integrator Model whereby the Government acquires services from multiple contracts but serves as the integrator for the services.

DoD will also include open business and technical attributes as factors of evaluation for new contract awards and will incentivize Industry for adopting an open systems approach. Various contracting approaches are being considered including Indefinite Delivery/Indefinite Quantity (ID/IQ) contracting vehicles which maximize opportunities for competition and flexibility. Industry should take advantage of the multiple opportunities afforded to them via an ID/IQ contracting approach and other flexible contracts and should recognize the additional profit potential from using incentive - based contracting vehicles under this construct.

Contracts will also be structured to leverage the rights granted to the government while protecting industry's private investment in its intellectual property. The ability for DoD to exercise its IP rights is a critical enabler to support continuous competition, design disclosure, strategic reuse, and collaborative development. In support of this approach, the DoD will exercise and manage its data rights more diligently. Likewise, industry should become more knowledgeable on the rights granted to DoD and be prepared to articulate a value proposition when they choose to operate with a limited IP business model.

Another key attribute to the GCS OBM and the Department of Defense's Better Buying Power Initiative 2.0 is to eliminate redundancy within the Warfighter portfolios. Having early and often access to software and system design artifacts for which the DoD holds IP rights will help achieve this objective. DoD will open up its Research and Development (R&D) activities to drive more innovation and share design artifacts across many UAS programs to drive down costs. Companies that continue to invest in innovation and open up their R&D activities will be more competitive in the marketplace and will receive additional consideration during source selections. For industry, this attribute of the OBM will enable greater value capture, by utilizing key internal and external assets, resources, and/or positions.

Sharing design artifacts will facilitate reuse of services across the multiple, distributed UAS platforms. The reuse of services will include certification package reuse for safety critical and security management services. This reuse of certification artifacts will result in further cost and schedule savings. DoD is adopting a systemic approach to reuse with a structured plan and well-defined processes and commitments for funding, staffing, and incentives to begin integrating services into legacy UAS programs. SOA Services will be competed to bring the best technology to the Warfighter and widen the current defense industrial base. A Collaborative Development Environment (CDE) is being established by DoD to foster innovation and build an ecosystem where DoD, integrators, suppliers, and new market entrants can collaborate and leverage one another's IP, via appropriate licensing, and break down current closed IP business models.

Technology Insertion (TI) plans are being developed to evolve the GCS either incrementally or as large all-encompassing upgrades, to inject mature technology innovations into fielded systems as well as systems under development. DoD must establish a culture that regularly embraces technology refreshes in order to increase the rate at which new innovative technology is adopted without having to acquire an entirely new system. The integrator will need to work with other vendors and research institutions to champion TI and assist in the adoption of TI roadmaps into current programs.

Changes in how the DoD approaches software testing and verification are required to drive down costs. The Department is planning to adopt unit test reciprocity between the Services and Programs in addition to standards for test automation. Test reciprocity will apply to Unit Testing in an effort to reduce the number of redundant tests to be developed by the Services and Programs as they attempt to reuse services. The Task Force will follow the commercial software Industry lead in gaining test efficiencies by using a "test utility" or Next Generation Test (NGT) model. The success of the NGT model is attributed to the use of automation and predictive analytics.

Automation tools will aid in the creation, management, and requirements based testing of services. The UAS development community will start using a set of tools to automate the design processes and artifacts associated with the GCS. Any reduction in development or test time realized through the use of automation tools is time gained in fielding new capabilities to the Theater Commander at reduced cost. As the GCS community continues to evolve to where services are reused across the enterprise, the potential to increase the certification overlap between the Services exists. Granted each Service is responsible for obtaining Information Assurance (IA) and Flight Safety certification for their PoR. The goal is to have components based on Design Assurance Levels ranging from catastrophic (Level A) to non-critical (Level E), and the subsequent certification artifact reuse and disclosure become the key elements for certification overlap.

The increasing role of UAS within the twenty-first century Defense environment will drastically change the operational requirements for DoD. The shift in power among states and non-state actors will require the best technology at the best value to DoD. The establishment of OA within the UAS portfolio coupled with an OBM and increased transparency and collaboration will ensure a more efficient path to fielding capabilities for our Warfighters at significantly reduced costs. The adoption of this new model requires a dramatic cultural change by both DoD and Industry. We must strengthen our commitment to innovation and tap the ideas of many to meet tomorrow's requirements while providing greater performance for the Warfighter at better value for the taxpayer.

SECTION II – INTRODUCTION

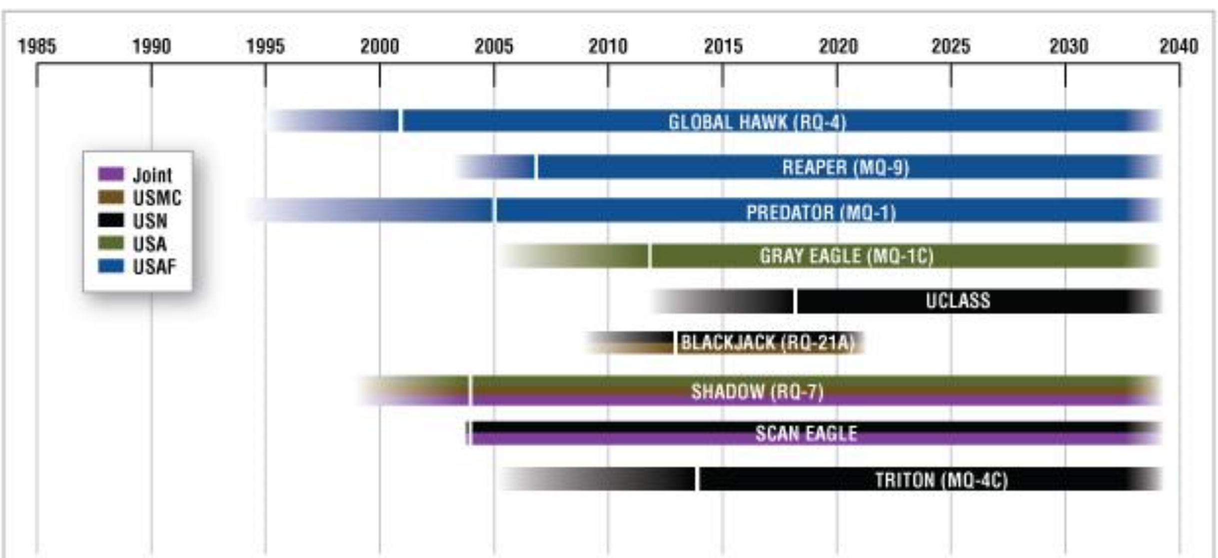
A. BACKGROUND

Since the end of World War II, DoD has been acquiring its warfighting systems through a closed, stovepipe acquisition process. These systems are obtained from an oligopoly of defense contractors resulting in expensive, monolithic systems that are challenged to interoperate to meet Warfighter needs. These systems were designed based on the technologies and architectural practices available at the time, consistent with the Defense acquisition processes in place. DoD began developing its UAS using this same acquisition approach.

Over the past twenty years, DoD has acquired a diverse portfolio of UAS to meet our national security needs. Figure 1 provides a snaphot of DoD's expansion of the portfolio through the year 2040 with programs starting in Concept Development as early as 1994. The increasing role UAS play in military operations as new and unconventional threats emerge, requires the DoD to rethink how it designs, builds, and acquires these platforms. Many systems today face interoperability issues due to proprietary interfaces and data formats, differing data models (i.e. deferring data context and meaning) and a failure to adhere to open standards that limit DoD's

Figure 1 – Timeline of Current & Planned UAS

ability to communicate and transmit data and imagery across UAS platforms and the Services.[3]



Further complicating the matter is that in many of the legacy programs in operation today, DoD does not have rights (or has not asserted its rights) to the IP in these systems. The lack of a

[3] http://www.defensenews.com/story.php?i=3907656&c=FEA&s=CVS

minimum of Government Purpose Rights (GPR)[4]; 1) limits DoD's ability to compete over the system lifecycle; 2) inhibits the Services from being able to support the system organically; and, 3) fosters an atmosphere which supports duplicative investment in technology across the Services. In the current state, this approach to acquisition for UAS programs is prohibitively expensive—a condition that is unsustainable given DoD's current budgetary climate.

The business and technical characteristics of this outdated UAS acquisition model have proven to be costly, ineffective, and unsustainable as described in Table 1 below:

Table 1 – Historic UAS Acquisition Model Characteristics

Historic UAS Acquisition Model Characteristics	
Business Characteristics	**Technical Characteristics**
• Duplicative investments across platforms • Stovepipe funding by Programs • Limited collaboration among Services • Limited data rights to system components • Limited competition throughout the lifecycle • Cost and schedule overruns • Developmental risk borne in isolation	• Closed, proprietary systems and architectures • Unpublished interfaces • Point-to-point legacy interfaces • Multiple data models across platforms • Highly integrated applications • Obsolete technology • Closed product support processes/systems

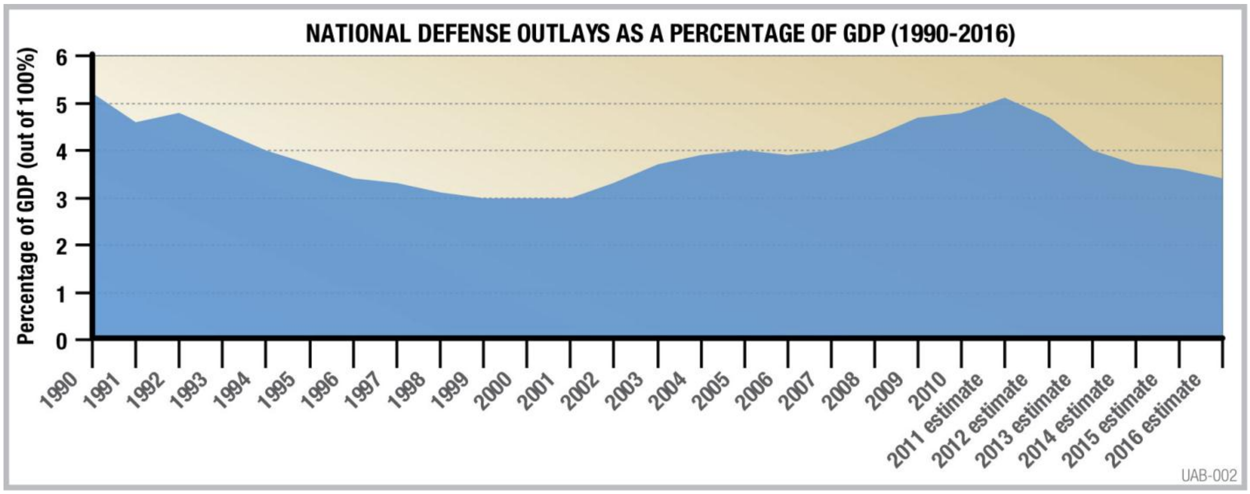
B. DRIVERS FOR CHANGE

DoD is challenged with acquiring a portfolio of systems which must include the diverse range of capabilities necessary to address emerging threats and evolving national security requirements of the twenty-first century. Further, DoD is tasked with accomplishing this feat while controlling the rising acquisition costs of these systems in addition to the increasing costs for supporting aging legacy platforms. As noted in Figure 2 below, DoD must accomplish this task in an environment with significant downward budgetary pressures.

Advances in technology over the past twenty years have provided opportunities for DoD and Industry to rethink how national security systems and other complex systems have been developed, fielded, and supported. Changing the way we acquire, design, and build UAS' is essential to establishing an environment that reduces total ownership costs, prevents vendor-lock, enables rapid insertion of new technologies, prevents obsolescence, and decreases time to field new capabilities. Our systems must be more modular, open, and agile.

[4] See Better Buying Power: Understanding and Leveraging Data Rights in DOD Acquisitions, DOD OA Working Group, March 28th, 2011, located at https://acc.dau.mil/CommunityBrowser.aspx?id=436677&lang=en-US and Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending, Under Secretary of Defense for Acquisition, Technology and Logistics, November 13, 2012, located at http://www.acq.osd.mil/docs/USD%28ATL%29%20Signed%20Memo%20to%20Workforce%20BBP%202%200%20%2813%20Nov%2012%29%20with%20attachments.pdf

Figure 2 – National Defense Outlays



DoD is at a critical point where it is transforming the model for acquiring and maintaining national security systems that adopt and exploit open system design principles and architectures. DoD can no longer afford to buy multiple UAS platforms with similar functions and capabilities across the Services. The anticipated reduction of defense spending over the next several years requires DoD and Industry to change now. Developing open systems will enable DoD to reduce the acquisition of duplicative UAS components across the Services. Open systems will help position DoD to take better advantage of emerging technologies and quickly introduce new capabilities while contributing to common systems which will enable more cost effective product support/sustainment structures and improve operator and system performance.

The Under Secretary of Defense for Acquisition, Technology, and Logistics (USD (AT&L)) outlined his vision for developing a common OA for UAS GCS in February 2009.[5] The emphasis on adopting

Case Study: Open Business Model

In 1995, the U.S. Navy faced a serious reduction in U.S. acoustic superiority impacting our ability to detect other submarines and vessels. At the same time, the Soviet Union was improving on their acoustic capabilities. This technical challenge was compounded by a reduction in program funding which required a radical change in the way the Navy built mission systems. The Program Executive Office for Submarines adopted an open architecture approach for the sonar systems and implemented many OA business and technical practices – modularized the sonar system, disclosed designs of the architecture, published interfaces, and increased competition to generate a wide range of possible solutions from many sources to address the mission challenge. This change led to the Acoustic Rapid COTS Insertion (ARCI) program to upgrade capabilities quickly.

In addition to improving sonar system performance, ARCI generated significant large cost savings across all budget allocations in a comparison of the 1983-1993 budget allocations to 1996-2006 allocations ($7.6 billion to $3.6 billion). These savings reflect a reduction in Development and Production by a factor of six and a reduction in Operating and Support costs by a factor of eight. ARCI also realized over $25 million in cost avoidance for logistics support, including over $1 million in technical manuals, over $2 million in direct vendor delivery, over $19 million in interactive, multimedia instruction, and $3 million in outfitting spares reduction.

Source: http://acquisitionresearch.net/_files/FY2009/NPS-AM-09-043.pdf

[5] http://www.c4isrjournal.com/story.php?F=4042073

OA and the expected benefits was reiterated again by the USD (AT&L) as part of his effort to drive more efficiency across DoD. This initiative, entitled “Better Buying Power 2.0”, focuses on five main areas for acquisition improvement:

- Achieve affordable programs
- Control costs throughout the product lifecycle
- Incentivize productivity and innovation in Industry and Government
- Promote effective competition
- Improve tradecraft in acquisition of services
- Eliminate unproductive processes and bureaucracy[6]

Adopting an OA approach to UAS systems “changes everything” in the words of one Industry executive.[7] The decoupling of the GCS from the Unmanned Aerial Vehicles (UAVs), in conjunction with the development of a common architecture across the portfolio and an OBM will significantly change the way DoD acquires these systems.

With conflicts being waged on multiple fronts around the world, the ability to meet evolving Warfighter mission requirements is critical. The introduction of and adherence to published standard interfaces is facilitated by the adoption of OA and enables the Services to “plug and play” components of their choosing that best fit evolving mission requirements. Participation from new firms entering this market will increase competition, which will drive innovation and lead to the development of new software applications to meet the ever-changing needs of the Warfighter.

To achieve OA, DoD is utilizing SOA principles. SOA is a business-centric systems architecture design that enables communication among services via an interface, such as XML, in an OA framework. The fundamental relationship between OA and SOA can be summarized in four main points:[8]

- OA features are likely to be found in a well-designed SOA.
- A system built to meet OA requirements is likely to facilitate the development of SOA services offered by that system at a later time.
- Certain features or subsystems of a system are not exposed by a service interface and SOA is not relevant to their design or implementation. OA is always relevant to the design and implementation of all components of a system.
- Enterprise Architecture processes support OA principles such as modularity, open standards, and interoperability, which also support SOA enterprise practices.

The increasing role of UAS in the battlefield requires the best technology at the best value be provided to DoD. DoD is adopting an OBM to support the implementation of OA for UAS GCS

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[6] http://www.acq.osd.mil/docs/USD28ATLSigned Memo to Workforce BBP13 0Nov2012 with attachments.pdf

[7] http://www.c4isrjournal.com/story.php?F=4042073

[8] Open Architecture Technical Principles and Guidelines 1.5.8, IBM, September 30, 2008

and drive greater acquisition efficiencies. The OBM described in this paper lays the framework for both Industry and DoD to adopt the principles and practices to implement an open GCS.

C. PURPOSE

This framework defines the OBM for UAS GCS and enables the Interoperability Integrated Product Team (I-IPT) to effectively communicate the new model to Industry. An OBM is an approach for doing business in a transparent way that leverages the collaborative innovation of numerous participants across the enterprise permitting shared risk, increased competition, maximized asset reuse and reduced total ownership costs, attributes which are beneficial to the GCS community.

D. SCOPE

The scope of this framework is the application of an OBM to the GCS for PoRs that comprise the Joint UAS (JUAS) Group Classification 2-5 UAS systems identified by the USD (AT&L) ADM of 11 February 2009. This portfolio includes the GCS for Scan Eagle, Shadow, BLACKJACK (RQ-21A), Predator, Gray Eagle, Reaper, Global Hawk, Fire Scout, UCLASS and the TRITON MQ-4C programs as well as future UAS programs.[9]

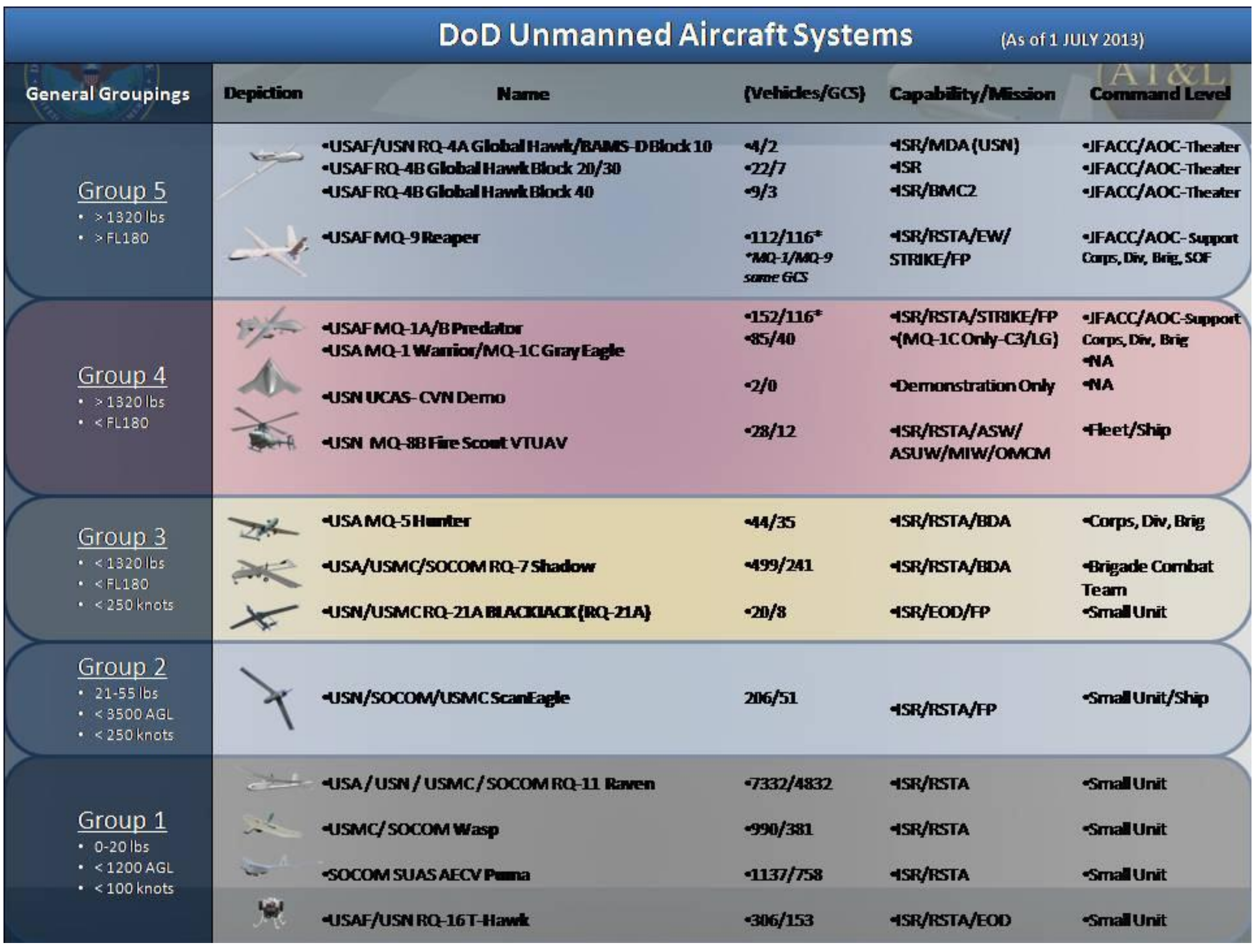
[9] Acquisition Decision Memorandum Unmanned Aircraft Systems (UAS) Ground Control Station, John Young, Under Secretary of Defense dtd 11 Feb 2009

SECTION III – CURRENT PORTFOLIO

A. PROGRAMS OF RECORD

The UAS portfolio considered for this OBM framework includes JUAS Group Classification 2-5 UAS systems identified in the USD (AT&L) ADM of 11 February 2009 and future Programs classified in Groups 2-5. Thus the programs in Figure 3 are the focus of this framework. Group One UAS programs are not included in this framework due to the fact that the Group 2-5 platforms represent a strategic national investment based on the UAV's size and range, compared to the more tactical, and significantly smaller investment, that constitute the Group One UAVs.

Figure 3 – DoD Unmanned Aircraft Systems



DoD Unmanned Aircraft Systems (As of 1 JULY 2013)

General Groupings	Depiction	Name	(Vehicles/GCS)	Capability/Mission	Command Level
Group 5 • > 1320 lbs • > FL180		•USAF/USN RQ-4A Global Hawk/BAMS-D Block 10 •USAF RQ-4B Global Hawk Block 20/30 •USAF RQ-4B Global Hawk Block 40	•4/2 •22/7 •9/3	•ISR/MDA (USN) •ISR •ISR/BMC2	•JFACC/AOC-Theater •JFACC/AOC-Theater •JFACC/AOC-Theater
		•USAF MQ-9 Reaper	•112/116* *MQ-1/MQ-9 same GCS	•ISR/RSTA/EW/ STRIKE/FP	•JFACC/AOC- Support Corps, Div, Brig, SOF
Group 4 • > 1320 lbs • < FL180		•USAF MQ-1A/B Predator •USA MQ-1 Warrior/MQ-1C Gray Eagle	•152/116* •85/40	•ISR/RSTA/STRIKE/FP •(MQ-1C Only-C3/LG)	•JFACC/AOC-Support Corps, Div, Brig •NA
		•USN UCAS-CVN Demo	•2/0	•Demonstration Only	•NA
		•USN MQ-8B Fire Scout VTUAV	•28/12	•ISR/RSTA/ASW/ ASUW/MIW/OMCM	•Fleet/Ship
Group 3 • < 1320 lbs • < FL180 • < 250 knots		•USA MQ-5 Hunter	•44/35	•ISR/RSTA/BDA	•Corps, Div, Brig
		•USA/USMC/SOCOM RQ-7 Shadow	•499/241	•ISR/RSTA/BDA	•Brigade Combat Team
		•USN/USMC RQ-21A BLACKJACK (RQ-21A)	•20/8	•ISR/EOD/FP	•Small Unit
Group 2 • 21-55 lbs • < 3500 AGL • < 250 knots		•USN/SOCOM/USMC ScanEagle	206/51	•ISR/RSTA/FP	•Small Unit/Ship
Group 1 • 0-20 lbs • < 1200 AGL • < 100 knots		•USA / USN / USMC / SOCOM RQ-11 Raven	•7332/4832	•ISR/RSTA	•Small Unit
		•USMC/ SOCOM Wasp	•990/381	•ISR/RSTA	•Small Unit
		•SOCOM SUAS AECV Puma	•1137/758	•ISR/RSTA	•Small Unit
		•USAF/USN RQ-16 T-Hawk	•306/153	•ISR/RSTA/EOD	•Small Unit

B. SUPPLIER SEGMENT ASSESSMENT

The supplier segment for the UAS portfolio can be classified as prime integrators and subsystem suppliers. The prime integrator typically provides the bulk of the UAV and GCS components while teaming with various suppliers for subsystem development. The analogy of prime integrator and suppliers is not to be confused with the practice of Lead System Integrator (LSI), the use of which has been prohibited since 2008.[10]

1. PRIME INTEGRATORS

A quick review of the UAS portfolio, illustrated in Table 2 reveals that there are only five integrators supplying UAV and GCS major components for the 11 UAS programs considered in this framework. The six integrators represent only a fraction of the available defense, aerospace, and software vendors in the marketplace.

Table 2 – Prime Integrators as of June 2011

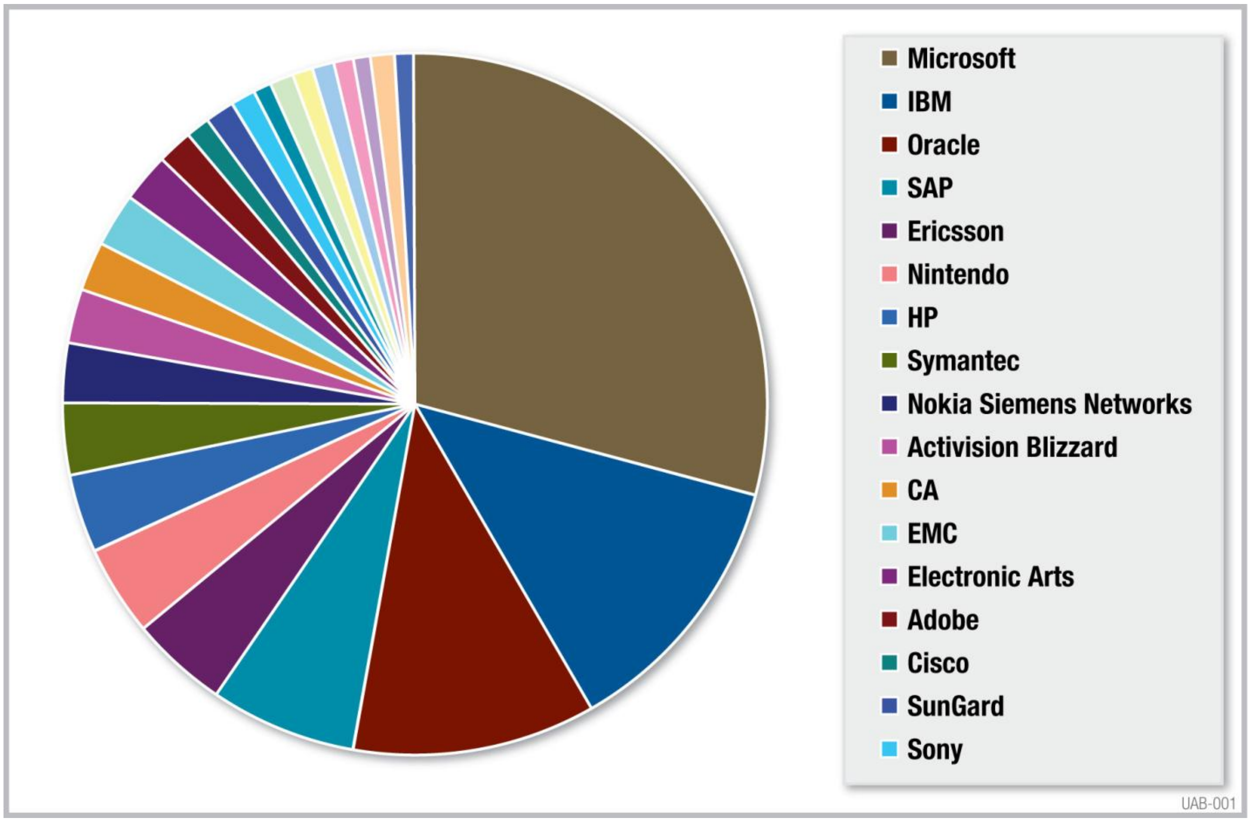
UAS	UAV	GCS
UCLASS	TBD	TBD
RQ-4 Global Hawk	Northrop Grumman	Northrop Grumman/Raytheon
MQ-4C TRITON	Northrop Grumman	Northrop Grumman/Raytheon
MQ-8B Fire Scout	Northrop Grumman	Raytheon/Northrop Grumman
RQ-7B Shadow	AAI	AAI
Scan Eagle	Insitu (Boeing)	Insitu (Boeing)
RQ-21A Blackjack	Insitu (Boeing)	Insitu (Boeing)
MQ-1 Predator	General Atomics	General Atomics
MQ-9 Reaper	General Atomics	General Atomics
MQ-1C Gray Eagle	General Atomics	AAI

Adoption of OA practices will present opportunities to increase the supplier base of the UAS portfolio; a driving initiative of Dr. Carter's to "increase the dynamic small business role in the defense market." If GCS is viewed as set of services that can operate on any platform, one could imply that software companies could compete in this marketplace versus being constrained to traditional defense companies. At present, many of the largest software companies depicted in Figure 4 do not compete in this market today.

> ***"GCS should be thought of as a software application that can operate on any platform, from consoles to handhelds"***
> ***~ RADM Bill Shannon***
> *Source:http://www.aviationweek.com/aw/jsp_includes/articlePrint.jsp?storyID=news/GCS081009.xml&headLine=Open%20Architecture%20for%20UAV%20Ground%20Control*

[10] DoD Section 802 of FY2008 National Defense Authorization Act http://www.fas.org/sgp/crs/natsec/RS22631.pdf

Figure 4 – Top 25 Global Software Companies[11]



2. SUBSYSTEM SUPPLIERS

Small to Medium Private Industry

One of the goals of the OBM is to promote competition through increasing the size of the GCS supplier market by lowering barriers to entry for small and medium sized businesses, non-profits including Federally Funded Research and Development Companies (FFRDCs), University affiliated Research Centers and

> ***Case Study: Small Businesses***
>
> ***For small businesses, participation in UCS and the UCS-WG provides a number of competitive advantages. First, is allows for visibility into the UAS force structure, and contact with UAS PoR Program officials and their Prime contractor representatives. This offers the potential for teaming opportunities and collaborative ventures. Small businesses with innovative technology have the ability to interact with a broad range of UAS stakeholders. Although marketing is not allowed, the contacts that are made are very valuable.***
>
> ***Second, and most importantly, the UCS Architecture levels the playing field for technology integration. Small business owners can wrap their innovative capabilities, developed through IRAD, SBIRs, or other R&D funding, into an UCS Architecture compliant service, and immediately be able to plug into an UCS-compliant GCS. The government's ability and desire to compete out individual capabilities will only help small businesses in the long run. It will help them market and sell their products, and it will help them build relationships with the Primes, who are still likely to be the system integrators.***
>
> ***The UCS Working Group already has a vibrant community of small business participants, and they all realize the ultimate value that this new approach to systems development and acquisition will deliver to the government, end user, and to themselves. – Neya Systems Testimonial***

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[11] http://www.softwaretop100.org/global-software-top-100-edition-2010

academic and Government labs. Increased market presence of small and medium sized businesses will increase innovation and drive down costs. As noted by Dr. Carter in his Better Buying Memo, "Small businesses have repeatedly demonstrated their contribution to leading the nation in innovation and driving the economy by their example of hiring over 65 percent of all new jobs and holding more patents than all the nation's universities and large corporations combined."[12]

The release of the Joint Architecture for Unmanned Systems (JAUS) Toolset (JTS) has encouraged small to medium sized companies such as CDL, KUTTA, RODIAN, Horizon, Meta VR Visuals, milSoft, and Aerosight to start developing GCS services. In addition, an open source community of software developers has started to address the need for Group 1 UAS control systems, resulting in QGround Control and Paparazzii[13] GCS being formed. The innovation seen in the Group 1 UAS Market needs to be continued to encourage more small and medium sized businesses to enter the GCS market.

> ***"If you bring us a UGV, USV, or UUV that's not JAUS-compliant, we're not interested".***
> ***~ VADM William Landay III***
> *Source: http://www.resquared.com/PDFs/060510A-JAUS-White-Paper.pdf*

[12] Better Buying Power: Understanding and Leveraging Data Rights in DOD Acquisitions, DOD OA Working Group, March 28th, 2011, located at https://acc.dau.mil/CommunityBrowser.aspx?id=436677&lang=en-US

[13] This is a sample of developers not necessarily an all inclusive list.

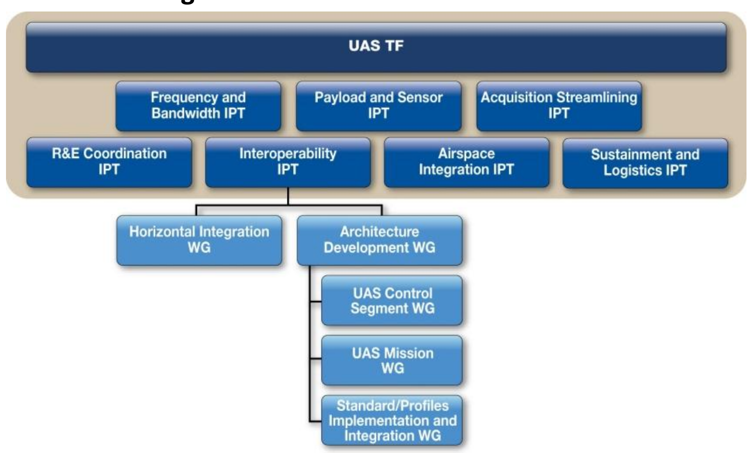
SECTION IV – THE PATH FORWARD

A. UNMANNED AIRCRAFT SYSTEMS TASK FORCE OVERVIEW

To facilitate DoD's vision for UAS, the Deputy Secretary of Defense chartered the UAS Task Force. This Task Force is providing the structure to facilitate collaboration across the Services and Industry to address Service-wide integration issues that support the maturation of unmanned aerial warfare.[14] The goals of the UAS Task Force[15] are to:

Goal 1: Coordinate and evaluate DoD UAS requirements, remaining constantly conscious of technology, cost, schedule, jointness, and interoperability imperatives.
Goal 2: Increase the operational effectiveness of DoD UAS by promoting the development and fielding of interoperable systems and networks, in coordination with key UAS stakeholders.
Goal 3: Shape DoD UAS acquisition programs to prioritize joint solutions which guarantee interoperability, efficient production, lower unit costs, decreased support costs, and increased capability.
Goal 4: Serve as the DoD's advocate for shaping the regulatory policies, procedures, certification standards, and technology development activities that are critical to the integration of DoD UAS into the airspace systems to fulfill future operational and training requirements.

Figure 5 – UAS Task Force Structure



The UAS Task Force, shown in Figure 5[16], has been chartered to coordinate critical DoD UAS issues and develop a way ahead to enhance operations, enable interdependencies, facilitate interoperability and streamline acquisition of UAS. To accomplish these objectives the UAS Task Force uses and oversees seven integrated product teams. One of the seven teams is the Interoperability Integrated Product Team (I-IPT).

Acquisition leaders across DoD have embraced this joint effort and have issued several acquisition decision memorandums and future plans mandating Programs define, develop, and deliver common components across multiple platforms. These memorandums and plans include the following:

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[14] Deputy Secretary of Defense Memorandum, "Unmanned Aircraft Systems (UAS)," 13 September 2007.

[15] Office of the Under Secretary of Defense Acquisition, Technology and Logistics, Unmanned Aircraft Systems Charter, 23 April 2010.

[16] DoD Report to Congress on Addressing Challenges for Unmanned Aircraft Systems, September 2010.

Acquisition Decision Memorandum Unmanned Aircraft Systems (UAS) Ground Control Station, John Young, Under Secretary of Defense dtd 11 Feb 2009

United States Air Force Unmanned Aircraft Systems Flight Plan 2009-2047 dtd 18 May 2009

OSD Memorandum; Better Buying Power Guidance 2.0 Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending, dtd 13 Nov 2012

Department of the Navy Unmanned Aircraft System Common Control System Acquisition Decision Memorandum, RADM W. E. Shannon, Program Executive Office Unmanned Aviation and Strike Weapon dtd 1 Jul 2011

Department of the Army Unmanned Aircraft Systems Ground Control Stations Acquisition Decision Memorandum, Major General William Crosby, Program Executive Office Aviation dtd 12 Jul 2011

RQ-4 A/B Unmanned Aircraft System Global Hawk Obligation Authority Acquisition Decision Memorandum, Frank Kendall, Acting Under Secretary of Defense dtd 21 May 2012

Case Study: UCS-WG

The UCS-WG has funded a limited number of development exercises to demonstrate the UCS architecture and illustrate the potential for Joint development of GCS capabilities. The set of Initial Work Packages (IWP) demonstrated how UCS Architecture compliant capability (e.g. U.S. Air Force Weather service) could be integrated into other Service's GCS.

The AF Weather service interfaces with AF Weather Servers to provide tactical overlays of current and forecast weather conditions. Although the service was developed by the USAF it was successfully integrated into Navy and Army GCS'. The demonstration proved the service architecture was portable and hardware independent. The AF Weather exercise resulted in:

- ***75% reduction in development and integration costs***
- ***Integration time of one - three weeks***

The typical cost for creating a GCS-specific weather service is in excess of $2M, thus making the case for only one service development effort for use across multiple GCS'.

Source: "Open Architecture Efficiencies in the Development of DoD UAS Ground Control Stations (GCS)"

B. COMMON GROUND CONTROL STATION OVERVIEW

The I-IPT is addressing interoperability deficiencies among UAS platforms and associated manned platforms by developing common processes across the Services, Combatant Commands and applicable inter-agency organizations. This I-IPT has developed a common OA for UAS Control Segment (UCS) from a joint DoD / Industry perspective. The UCS-Working Group (UCS-WG) is an open technical standards committee consisting of Industry and Government representatives from the Services, each UAS PoR, several emerging UAS programs and small businesses. The UCS-WG has defined a common UAS control station architecture based on SOA principles, standard data models and service interface definitions (see Figure 9 on page 35). The architecture is being shared with each of the Services to serve as a base for acquiring, integrating, and extending the capabilities of the control systems for UAS.[17]

This I-IPT has made significant progress in the development of this SOA architecture. UAS Control Segment Architecture Version 1.0 provided the interfaces that made the Pilot described in the UCS-WG Case Study a successes story by demonstrating the portability of services. UAS

[17] http://www.spacewar.com/reports/Northrop_Grumman_Awarded_UAS_Common_Architecture_Working_Group_Contract_999.html

Control Segment Architecture Version 2.2 provides an executable architecture that the Military Services are using to field new capabilities. The OBM described in this framework takes the successes to date to the next level by outlining the components that will support Industry-wide adoption of OA principles that "open" GCS.

C. UAS APPLICATION STORE ('APP STORE') OVERVIEW

The UAS I-IPT has built the UAS Application Store (OSD UAS App Store) to provide a centralized 'shop' for UAS mission specific applications and services to drive re-use across the Defense-enterprise (http://ucsrepository.org/home.seam*)*. The OSD UAS 'App Store' approach is akin to the commercial 'smart-phone' industry, wherein applications can be down-loaded to suit individual user taste and requirements based on UAS program needs. The OSD UAS 'App Store' will allow both government program offices and industry to post applications available for reuse and provides an opportunity for small software businesses to compete on a level playing field" with the major defense conglomerates.

Launching the OSD UAS App Store supports the "Better Buying Power" initiatives to target affordability & control cost growth; incentivize productivity & innovation in industry; and, promote real competition. The table below demonstrates how the App Store objectives support the accomplishment of these goals across the UAS community.

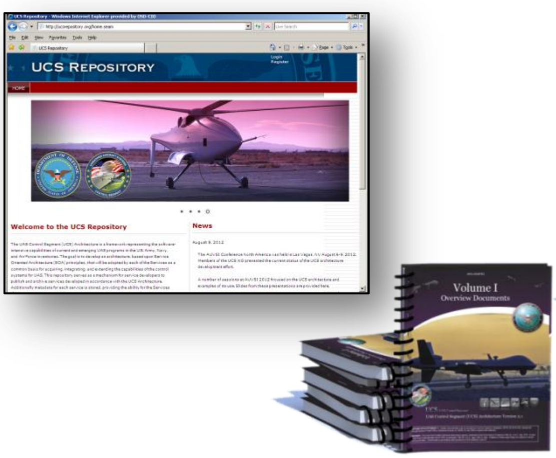


Table 3 – Better Buying Power Goals and OSD UAS App Store Objectives

Goal	OSD UAS App Store Objectives
1. Target Affordability & Control Cost Growth	• Allow Programs to reuse system components across UAS Portfolio; • Enable reuse to reduce obsolete technology and lifecycle support costs; • Provide access to pre-tested/certified software across UAS Portfolio.
2. Incentivize Productivity & Innovation in Industry	• Provide a central location for vendors to market software that can be licensed across the enterprise; • Provide a central location for users to post new App requirements to drive development; • Support software design disclosure to foster innovation and collaborate development; • Promote software reuse to reduce tech insertion cycle to field new capabilities faster.
3. Promote Effective Competition	• Integration of App Store into acquisition strategies, competition strategies, and contract structures to enhance prospects for competition for UAS GCS SOA services

Key Features of the OSD UAS App Store include:

Table 4 – Features of OSD UAS Application Store

Accessibility	• Easy accessibility by Government Program offices and qualified Industry vendors;
Navigation	• Well organized, easy to navigate, intuitive website design
Submission	• Only requires uploading of metadata for key application information – vendors are not required to provide raw source code online;
Advertisement	• Programs may advertise needs to help drive development of new applications; • Vendors may advertise any of their current SOA service offerings; • Vendors may advertise proprietary software which may require licensing agreements;
Exchange	• Buyers and Sellers negotiate their own terms --- G2G, G2B, B2B --- The App store is the marketplace to help facilitate these transactions.

SECTION V – GROUND CONTROL STATION OPEN BUSINESS MODEL

A. BUSINESS MODEL OVERVIEW

A **business model** describes the rationale of how an organization creates and captures value. The processes of the organization facilitate value creation and the capture is made possible by differentiating resource, asset, or position that can be used to create a competitive advantage.[18] In a closed paradigm, the value assigned to IP is a function of what a firm can do to innovate using its own internal expertise. In this instance, a firm is incentivized to create and maintain control over its R&D and innovation in hopes that they can create a unique "proprietary" solution that will be embraced by the marketplace. As demand for the firm's unique product increases, it gains a larger proportion of the market share and makes additional profits. Because this model is closed, the firm that invested its own resources and undertook the initial R&D risk can internalize all the profits.

According to Dr. Henry Chesbrough, the Executive Director of the Center for Open Innovation at the University of California – Berkley, **open business models (OBMs)** create value by leveraging many more ideas, stemming from the inclusion of outsider's IP, as compared to closed business models, due to their inclusion of a variety of external concepts. Simply put – organizations that are open are more receptive to new ideas and can take action on them quickly. OBMs can also enable greater value capture by using key assets not only in the company's business, but also in other companies businesses.[18]

The **GCS OBM** establishes the framework for creating an open business environment that the Services can employ to leverage the scale of DoD GCS programs to more quickly capture innovation produced by Industry, academia, and research organizations and deliver innovation to the Warfighter. This OBM will deliver the innovation through a SOA repository that the UAS community can access to download services that meet user needs. The analogous commercial version of this practice is the iPhone and Android smartphones that allow users to access the App Store and Android Market to download applications that meet user needs such as weather, GPS and mapping.

Since there are many different types of business models and conceivably many ways to design an OBM, the UAS Task Force has adopted a definition and an approach for how it will frame and operate an OBM for UAS GCS.

[18] http://sloanreview.mit.edu/files/saleable-pdfs/48208.pdf

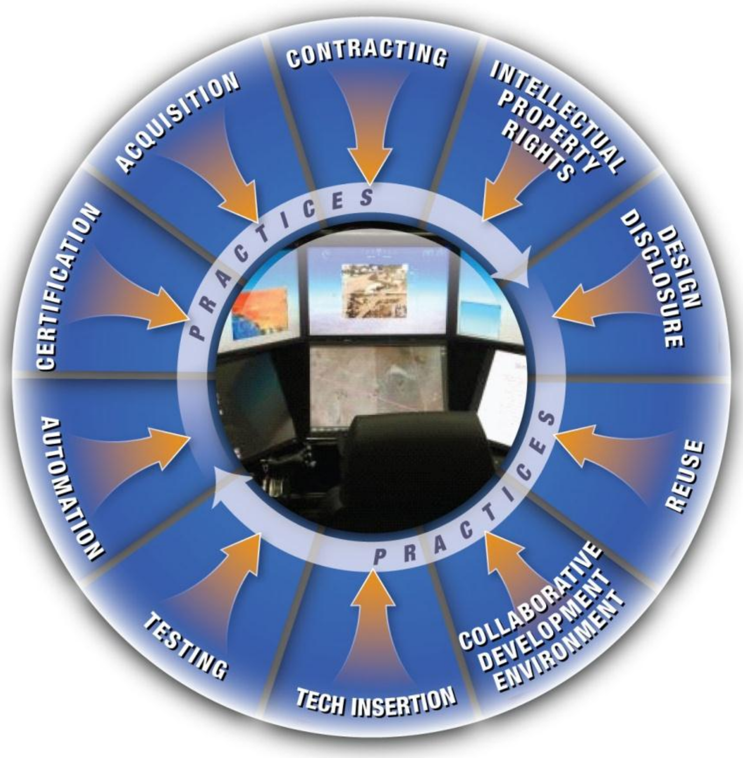
The GCS OBM is an approach for doing business in a transparent way that leverages the collaborative innovation of numerous participants across the enterprise permitting shared risk, maximized asset reuse, and reduced total ownership costs.

The GCS OBM Defined

The OBM Framework

The GCS OBM structure, depicted in Figure 6, consists of 10 enabling components; each supported by a set of business practices.

Figure 6 – OBM Framework



The enabling components are the most important part of the model – they are the defining characteristics that make the model open. The implementation of the OBM for GCS requires DoD to implement certain practices for each of the strategies. The components and practices will be defined and described in the following sections.

B. GOALS OF THE OPEN BUSINESS MODEL

The UAS Task Force is endorsing the adoption of an OBM because of the opportunity to achieve three goals that support the Warfighter, adapt to fiscal realities and align with DoD leadership policy directives. The goals of the OBM are as follows:

I. Target Affordability and Control Cost Growth
II. Incentivize Productivity and Innovation in Industry
III. Promote Effective Competition

Table 5 – OBM Goals and Objectives

Goal	Objective	Alignment to OBM Component	Warfighter Capability
1. Target Affordability & Control Cost Growth	• Reuse system components across UAS Portfolio • Reduce obsolete technology and lifecycle support costs • Reduce Test & Evaluation (T&E) across UAS Portfolio	• Reuse • Tech Insertion • Testing • Intellectual Property Rights	• Redirect GCS program savings to fund enhanced Warfighter capabilities
2. Incentivize Productivity & Innovation in Industry	• Reward contractors for adopting OA principles thru contract incentives • Disclose designs to foster innovation and collaborate development • Invigorate R&D for UAS GCS services • Reduce tech insertion cycle to field new capabilities faster	• Acquisition • Contracting & Incentives • Intellectual Property Rights • Reuse • Design Disclosure • Collaborative Development Environments	• Availability of new mission critical applications • Accelerated services fielding to counter evolving threats
3. Promote Real Competition	• Change acquisition strategies and contract structures to compete for UAS GCS services • Remove obstacles to competition by disclosing designs early and often	• Acquisition • Contracting & Incentives • Reuse • Tech Insertion • Data Management • Design Disclosure	• Access to services not previously released in the UAS marketplace

A snapshot of how the goals and objectives enhance Warfighter capabilities is captured in Table 3. The most direct route to achieving the goals and objectives is for the Services to have a joint approach and leverage the scale of DoD programs, investments and the experiential knowledge of program officials. However, actions by DoD officials alone are not enough to achieve the goals of an OBM. Industry is a major partner in DoD's effort to open GCS architecture through the use of an OBM. Each of the components of the OBM has implications for DoD and Industry and each partner can benefit from this business model transformation.

C. OBM COMPONENTS

1. ACQUISITION STRATEGY

The UAS I-IPT is committed to an Acquisition Strategy (AS) built on continuous competition and reuse of components among the entire range of UAS GCS. The I-IPT's goal is to create an environment where innovative technology providers and integrators – both large and small – can freely and openly participate in competitions for a wide range of components to solve program challenges, enhance system performance and lower total ownership costs for UAS GCS.

Background

An AS is a comprehensive, integrated plan that identifies the acquisition approach for the program. It describes the business, technical, and support strategies that the program will follow to manage program risks and meet program cost, schedule and performance objectives. The AS defines the relationship between the acquisition phases and work efforts, and identifies key program events such as decision points, reviews, contract awards, test activities, production lot/delivery quantities, and operational deployment objectives. The AS also defines the approach to provide maximum practicable opportunities to small business of all types. Further, the AS guides program execution across the entire program lifecycle – development, testing, production, and life-cycle support – and evolves over these phases. It should continuously reflect the current status and desired end point of the phase and the overall UAS GCS program.

A well articulated AS will address a wide range of issues associated with the development and sustainment of the UAS

Case Study: CANES

The Space and Naval Warfare Systems Command's (SPAWAR) acquisition of the Consolidated Afloat Networks and Enterprise Services (CANES) Common Computing Environment (CCE) exemplifies many of the OBM features which the I-IPT would like to integrate into UAS acquisitions. The CANES program seeks to enable increased efficiencies through integration of existing legacy and standalone afloat C4ISR networks by providing an adaptable, responsive, IT platform to meet rapidly changing warfighting requirements.

The primary goals of the CANES program are to:

1) Build a secure afloat network required for Naval and Joint operations;

2) Consolidate and reduce the number of afloat networks through the use of mature cross domain technologies and common computing environment infrastructure;

3) Reduce the infrastructure footprint and associated costs for hardware afloat;

4) Provide increased reliability, application hosting, and other capabilities to meet current and projected warfighter requirements; and

5) Federate Net-Centric Enterprise Services (NCES) Service Oriented Architecture (SOA) Core Services to the tactical edge to support overall Department of Defense (DoD) Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) applications migration to a SOA environment.

CANES was able to accomplish these goals by using a combination of open business and technical practices which were clearly identified as being core components of its acquisition strategy and are reflected in its approach to contracting by including open requirements as components of the program RFP.

Source: https://ecommerce.sscno.nmci.navy.mil/Command/02/ACQ/navhome.nsf/homepage?readform&db=navbusopor.nsf&whichdoc=0713C6E52C4D7BA28625751C0079AB6B&editflag=0

OBM and its related acquisition programs. In doing so, it will provide the foundation needed to clearly convey DoD's plans and intentions regarding issues that are important to a wide range of internal and external stakeholders.

Benefits

A well-reasoned acquisition strategy will benefit DoD and UAS programs by:

- Explaining how the OBM will create, promote and maintain a competitive environment throughout the program lifecycle
- Summarizing the Intellectual Property Strategy for meeting product life-cycle data rights requirements and supporting the overall competition strategy
- Laying out the steps that the Government will take to control program costs using such mechanisms as component reuse
- Discussing the use of incentives for performance and collaboration, indicating how the incentive structure will motivate contractor behavior resulting in desired cost, schedule, and performance outcomes
- Stating the UAS program's evolutionary strategy for reaching full capability.
- Articulating the details of UCS program sustainment planning
- Addressing how UAS GCS will take advantage of Small and Disadvantaged or Minority-owned businesses, including provisions necessary to protect IP and to allow for meaningful work share

Implications

Just as there are benefits to developing, articulating and adhering to an AS, there are also implications to both DoD and Industry. The implications of moving to this open model for both DoD and Industry are noted in Table 6.

Table 6 – Acquisition Implications

Implications for DoD	Implications for Industry
DoD will acquire systems that contain open business and technical attributes and will provide transparency in overall management of the UCS effort	Industry should migrate to a model that supports open business and technical practices for system development and support
DoD will shift focus to acquiring a portfolio of capabilities and incorporate SOA and UCS Architecture in future GCS	Industry should recognize greater emphasis will be placed on the acquisition of SOA services and reuse of technology
DoD will maximize opportunities for competition across the systems lifecycle	Industry should provide DoD with multiple cost/performance options for a given solution
DoD will need to be prepared to make software/hardware component selection decisions when serving as the systems integrator. DoD will also need to be prepared to effectively mitigate potential OCI concerns when industry will be serving as the systems integrator.	Industry should be cognizant of potential organizational conflict of interest (OCI) issues when serving as an integrator. Industry will need to weigh the pros and cons of competing for an integrator role vice a supplier role (either software or hardware).

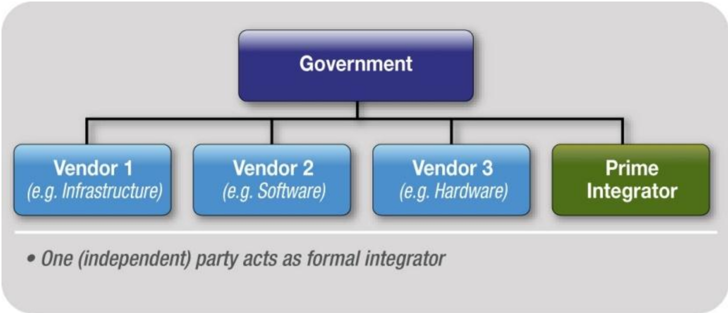
Practices

To achieve the implications noted above, both Government and Industry will adopt the following OBM practices as part of its overall AS:

Practice 1 – DoD Will Pursue an Acquisition Model Where Either DoD or Industry Will Serve as the Integrator.

A key decision which will be made in the GCS AS will be the role played by DoD in overseeing/managing the acquisition. There are currently two options which will be considered for the UAS GCS: (1) the Contractor Integrator Model, or (2) Government as Integrator Model.

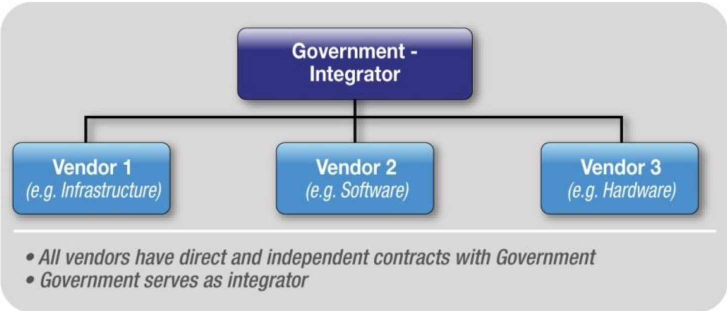
Figure 7 – Contractor Integrator Model



Under the Contractor Integrator Model, DoD acquires a system by entering into multiple contractual relationships with multiple contractors. One of these contractors serves as the prime integrator. The Prime Integrator receives products from other vendors and assembles them on behalf of the Government. This model provides the Government with the flexibility to contract with "best of breed" component providers which can be managed through an Indefinite Delivery/Indefinite Quantity (ID/IQ) contracting vehicle. Government and Industry must recognize that under this model there are potential OCI issues which must be considered and addressed to ensure fair supplier competitions.

Also, with this approach DoD can more readily conduct peer reviews to determine which best-of-breed components it will use in the system since it already has a diverse group of developers on contract operating under non-disclosure agreements. Under this model, it is easier to replace an underperforming component vendor and hire a new one since DoD has a direct contractual relationship with each vendor. It is also easier to recompete development of particular components and to keep costs under control through the threat of competition.

Figure 8 – Government as Integrator Model



The Second option is the Government as Integrator Model. This model is similar to the Prime Integrator Model in that there are multiple, independent contracts. The major difference, however, is that the Government serves as the integrator under this option. In addition to having the same advantages and disadvantages as the Prime Integrator Model, this model provides DoD with the additional control of being the integrator.

Practice 2 – DoD Will Acquire a Portfolio of UAS GCS Capabilities Through a Service Oriented Architecture.

The AS will highlight system characteristics driven by interoperability and/or joint integrated architectures including adherence to SOA and other principles as articulated in the Common UCS Architecture. Other key requirements include those related to mission capability areas and family or system-of-systems considerations. Reuse of services and components will be required by contractual provisions and encouraged through structured incentives. The Government will have increased visibility into the assets and capabilities it has or plans to acquire and will be able to better manage – and aggregate – its contracting activities.

Practice 3 – UAS GCS AS Will Specifically Require Adherence to Open Business and Technical Principles to Achieve Competition Throughout the Acquisition Lifecycle.

DoD will utilize contract vehicles that permit maximization of competition throughout the systems lifecycle and will leverage the appropriate incentive structure to implement the OBM. A comprehensive contracting strategy for UCS with specific business rules for acquisition professionals, program offices and other stakeholders to follow will be used across the Enterprise. Industry will be offered incentives to promote the use of open business and technical practices to ensure competition across the system lifecycle. These incentives will be reinforced with contractual requirements (See Appendix A for sample contractual language). To support this approach, DoD will establish a marketplace to support DoD to developer as well as developer to developer interactions through a web portal to enhance transparency between DoD and the development community. DoD will use the portal as a major vehicle to communicate with the GCS development community and to share information such as planned solicitations, Requests for Information (RFIs) and draft Requests for Proposals (RFPs).

Practice 4 – DoD Will Implement an OA Strategy.

Acquisition programs will have an OA strategy and supporting plan that addresses an appropriate (business and technical) OA end state. The OA strategy and supporting plan will provide a framework for structuring contract language that is consistent with DoD guidance for interoperability. There are numerous tools to accomplish this task; Net-Centric Enterprise Solutions for Interoperability (NESI), Open Architecture Assessment Tool (OAAT), Key Open Sub Systems (KOSS), and appendices 2 and 3 of the NOA Guidebook.

Practice 5 – Industry Should Change its Business Model From Closed to Open to Reap Greater Rewards.

Industry should accommodate DoD's intentions to use increased transparency and competition by incorporating open business and technical practices into their standard operating procedures. For example, Industry should use Open Standards development tools and techniques to create new applications, software and related artifacts. Industry should look to reuse architecture components and related materials whenever appropriate and should recognize they will be rewarded by being more favorably positioned in the competitive acquisition process for doing so. Once selected, firms that demonstrate adoption of OBM principles in carrying out their contractual responsibilities will receive incentive awards as appropriate.

Practice 6 – Industry Should Become Flexible and More Responsive to Offer a Range of Cost and Performance Combinations Providing for Multiple Market Entry Points.

Because DoD will have flexibility regarding with whom it engages to acquire its GCS and related components, it will be able to enter into contractual arrangements with many qualified vendors and developers, thus providing access to a large community of small, medium, and large businesses who can potentially provide the services required. Industry should see this as a positive signal from DoD and respond to these opportunities accordingly by offering a range of flexible solutions across a spectrum of cost and performance options. The flexibility in DoD demand should encourage niche players and also foster more opportunities for contractor to contractor agreements to solve specific DoD requirements.

2. CONTRACTING

Contracts are offered at various stages of the acquisition lifecycle, including those for system design/development, production, and sustainment. Competition occurs prior to each of these phases and/or during each of these phases. In the GCS OBM, DoD will utilize contract vehicles that permit maximization of competition throughout the systems lifecycle and will contain the appropriate incentive structure to implement the OBM. For services acquisitions, DoD will be predisposed toward Cost-Plus-Fixed-Fee (CPFF), or Cost-Plus-Incentive-Fee (CPIF) arrangements as noted in Dr. Carter's Better Buying Power memo. A comprehensive contracting strategy for GCS with specific business rules for acquisition professionals, program offices and other stakeholders to follow will be used across the Enterprise. Industry incentives to promote the practice of open business and technical practices to ensure competition across the system lifecycle will be the norm.

Background

A contract is a legally enforceable agreement between two or more parties. At DoD, the contracting process is governed by the Federal Acquisition Regulations (FAR) and the Defense Federal Acquisition Regulations Supplemental (DFARS). The contract for a UAS and its GCS is the primary enabler to achieving an OBM through a series of changes in how DoD will hold competitions and incentivize adoption of open business and technical practices across Industry. DoD's UAS leadership has noted the need to move away from a traditional closed business model where programs become vendor-locked, to an open model that permits competition and performance-based incentives throughout the systems lifecycle - two outcomes which depend highly upon the state of a program's contractual relationships with its vendors. Dyke Weatherington, Deputy Director for Unmanned Warfare in OUSD (AT&L) was quoted by the C4RSI Journal in June of 2009 stating, "[the military services must] be willing to make difficult choices and to move toward a more competitive procurement environment for GCS capability. We cannot continue to fund closed, proprietary systems that do not meet our interoperability needs."[19] Incentivizing Industry to move to this open model can be accomplished by including requisite contracting language across UAS acquisitions.

Implications

The implications of moving to this open model for both DoD and Industry are noted in Table 7 below:

Table 7 – Contracting Implications

Implications for DoD	Implications for Industry
DoD will provide additional consideration in proposal evaluations for contractors who adhere to OBM attributes	Industry should use OBM attributes to differentiate themselves from competitors
DoD will use a wide variety of contracting approaches for UAS acquisitions	Industry should take advantage of the multiple opportunities afforded to them via DoD's flexible contracting approach
DoD professionals will incentivize contractors to exceed minimum OBM attributes in contract awards	Industry should recognize added profit potential from using incentive-based contracting vehicles

Benefits

Pursuing an open approach to contracting will provide DoD many significant benefits and will enable the following open business and technical components to become integral parts of all future UAS GCS acquisitions:

- Enabling rapid technology insertion
- Adaptability to evolving requirements and threats
- Interoperability with joint warfighting applications and secure information exchange
- Reduction of development cycle time and total life-cycle cost
- Identification of potential candidates for reuse, from outside the contractor's own organization

Practices

Utilizing open practices in DoD's approach to acquiring GCS will drive greater efficiencies and will have wide reaching affects on both Industry and UAS Programs. To achieve the implications noted above, both DoD and Industry will adopt the following OBM practices:

[19] http://www.c4isrjournal.com/story.php?F=4042073

Practice 1 – DoD Will Structure Statements of Work (SOWs) to Include Open Business and Technical Attributes as Factors of Evaluation for Contract Award.

The establishment of an incentive and recognition program that incentivizes an Industry's commitment to pursuing open solutions is required. As a result, contracts will be structured to incentivize Industry to migrate to open business and technical practices, sample contracting language to support this structuring can be found in Appendix A. For example, SOWs will include requirements to ensure systems meet minimum open standards to ensure reconfigurability, portability, maintainability, technology insertion, vendor independence, reusability, scalability, interoperability, upgradeability, and long-term supportability as defined by OA. As part of the proposal evaluation process, Contracting Officers will give greater consideration (e.g. points), to those systems which exhibit these features.[20]

> ***Case Study: ID/IQ***
>
> ***SeaPort-e is the U.S. Navy's premier ID/IQ contract vehicle to acquire Navy NSSs and has been recognized for its flexibility. Under the SeaPort-E construct, the Navy has individual IDIQ umbrella contracts with a large and diverse community of developers, yet the Navy still retains a diverse array of contract types to use for task order competitions, depending on the type of development work it needs.***
>
> ***SeaPort-e allows the issuance of fixed-price and cost-plus task orders or any combination of the two. Under this type of contract, the Navy can also use award fees, incentive fees, or award terms—whichever it sees fit—to help motivate the contractor. Therefore, depending on the risks and uncertainty involved in the tasks, the Navy can still pick what it believes to be the best contracting approach.***

Practice 2 – DoD Will Utilize a wide variety of contracting approaches for UAS GCS Systems, Subsystems and Components (e.g. ID/IQ, Blanket Purchase Agreement (BPA), etc.).

DoD UAS acquisitions will use various contracting approaches including Multiple Award ID/IQ and BPA type contracts. These contracting vehicles a) permit flexible acquisitions and rapid responses; b) ensure the maximum potential for competition; c) allow for the inclusion of small and medium sized businesses; and d) provide transparency to both Government and Industry.

Flexible: ID/IQ and BPA contracts are flexible, permitting DoD to access a large and diverse community of developers while still preserving a diverse array of contractual incentives to use depending on the type of development work it needs.

Rapid: After completion of initial administrative tasks required to stand up an ID/IQ or BPA contracting vehicle, the time from which a program identifies a need to the time that requirement is addressed is greatly reduced.

Competition: ID/IQ contracts offer two levels of competition. First, there is the initial competition in which the Government awards the multiple award ID/IQ contracts to selected vendors/developers who must be pre-qualified to join the umbrella contracting agreement. A second level of competition occurs during task order awards for specific activities. Likewise,

[20] A full list of these features can be found in Appendix A.

BPAs offer the opportunity for Government to compete requirements across multiple suppliers to reap the benefits provided by the marketplace.

Transparent: Both ID/IQ and BPA vehicles can be managed via net centric and cloud enabled tools to further enhance transparency between DoD and Industry. These tools can serve as a central location for information for the R&D community and the Services. The portal can be used to share information with contract holders such as planned solicitations, RFIs, and draft RFPs.

Practice 3 – DoD Will Incentivize Industry to Conform to an OBM Through Contracts.

The GCS OBM demands that contracts will contain the requisite language necessary to support implementation of open systems architecture. DoD will use contractual incentives to permit design disclosure, reuse, collaborative development, and competition throughout the system lifecycle for the UAS GCS being acquired. Contract incentives fall into two major categories; award fees and award terms. For services acquisitions DoD will be predisposed toward Cost-Plus-Fixed-Fee (CPFF), or Cost-Plus-Incentive-Fee (CPIF) arrangements as noted in Dr. Carter's Better Buying Power memo. The following provides an overview of how UAS GCS acquisitions will utilize each.

Table 8 – Contracting Awards

Incentives Using Award Fees:	Incentives Using Award Terms:
Award fees can be structured around four different categories: (1) Cost, (2) Schedule, (3) Management, and (4) Technical attributes. This approach provides the program office flexibility to weight different portions of the contract and the proportion of the award fees associated with each. For example, 10%, 20%, 30%, and 40%, respectively, would hold technical attributes as the most important and cost as the least important.	Award terms are additional contract incentives where DoD monitors and evaluates the contractor's performance, and if it is decided that the contractor's performance was excellent, then the contractor earns an extension—thereby precluding the need for additional competition.

Practice 4 – Industry Should Use OBM Attributes to Differentiate Themselves From Competitors.

As the Government seeks to transform the way it does business with Industry, it will give additional consideration to those vendors who actively pursue adoption of OBM practices. Industry should recognize the added value their firms will gain during a source selection from the adoption of these practices. Those firms who have adopted open business approaches can use this to their advantage during the proposal phase of a program as a key differentiator from competitors. The firms who migrate first to adopt such an OBM will reap greater rewards.

Practice 5 – Industry Should Recognize Added Profit Potential From Using Incentive - Based Contracting Vehicles.

Industry can benefit significantly from performance based contracting vehicles as they offer the prospect of increased profit via award fees or extended contract terms via award terms. The highest performing firms in a particular sector can seek these performance incentives as a tremendous opportunity to bolster market share and increase profitability. Industry should tailor their business model to favor a performance-based contractual relationship with DoD as a means to maximize profitability.

Practice 6 – Industry Should Take Advantage of the Multiple Opportunities Afforded to Them Via an ID/IQ Contracting Approach.

Some contracts will be structured as BPAs others will be ID/IQs; all will be structured to incentivize Industry to migrate to open business and technical practices. Under an umbrella ID/IQ vehicle, Industry will have multiple opportunities to demonstrate their commitment to the new open business model by creating a community of multiple award ID/IQ contractors. Contractors will be a part of an inclusive, rather than exclusive, group of vendors with pre-qualified partners that have the skills and know-how to help develop UAS GCS giving contractors multiple opportunities to compete in areas where they might not have previously been in contention.

3. INTELLECTUAL PROPERTY RIGHTS

Rights to a company's IP for technical data and computer software (i.e. data rights) is a critical enabler for the GCS OBM in order for DoD to support design disclosure, strategic reuse of system components and SOA services, collaborative development and perhaps most importantly—the ability to compete and collaborate across the system lifecycle. IP is owned by the developer; however, under the Defense Federal Acquisition Regulations (DFARs) rights are granted to the Government to utilize this IP based on factors such as 1) the nature of the technical data (e.g. form, fit, and function data; and data necessary for operation, maintenance, installation, and training purposes) and; 2) the source of developmental funding of the item, process or computer software. There are companies that build their business model based on either an open IP model or closed IP model. The implications of IP for DoD and Industry under the GCS OBM are many. DoD will need to exercise and manage its data rights to facilitate reuse across different programs ultimately reducing costs and maximizing the prospects of competition across the system's lifecycle. Industry will need to be prepared to capitalize on the lower barriers to entry or articulate their firm's value proposition whether they choose to operate with an Open IP model or Closed IP model.

Background

IP rights are a range of intangible rights of ownership of an asset such as a technical design or a software program for a system, subsystem or component. DoD may have rights in a wide range of items across the UAS portfolio such as technical data, design artifacts, computer software, software documentation, test information, architecture materials, interface design description and other materials. There are two major categories defined by statute: "Technical Data" and "Computer Software," each of which is governed by specific and slightly different regulations. The law provides different methods for protecting the rights of ownership based on their type. There are essentially four types of IP rights (e.g. data rights) – patents, copyrights, trade secrets, and trademarks & service marks. Table 9 provides an overview of each of the rights categories.

Table 9 – Understanding and Leveraging Data Rights in DoD Acquisitions[21]

Rights Category	Applies to These Types of TD or CS	Rights Criteria	Permitted Uses Within the Government	Permitted Uses by Third Parties Outside the Government[22]
Unlimited Rights (UR)	All TD, and noncommercial CS	Developed exclusively at Government expense, and certain types of data (e.g.,FFF, OMIT, CSD)	All uses; no restrictions	All uses; no restrictions
Government Purpose Rights (GPR)	Noncommercial TD and CS	Developed with mixed funding	All uses; no restrictions	For "Government Purposes" only; no commercial use
Limited Rights (LR)	Noncommercial TD only	Developed exclusively at private expense	Unlimited; except may not be used for manufacture	Emergency repair or overhaul
Restricted Rights (RR)	Noncommercial CS only	Developed exclusively at private expense	Only one computer at a time; minimum backup copies; modification.[23]	Emergency repair/overhaul; certain service/maintenance contracts. All authorized third-party recipients of CS with other than UR must either sign an NDA directly with the CS owner in the instance of a CGSC (unless the NDA requirement is waived by the CS owner) or sign a standard NDA from DFARS 227.7103-7 or receive the CS under a contract containing DFARS 252.227-7025. A notice requirement exists for release of RR software.

[21] See Better Buying Power: Understanding and Leveraging Data Rights in DOD Acquisitions, DOD OA Working Group, March 28th, 2011. Located at https://acc.dau.mil/CommunityBrowser.aspx?id=436677&lang=en-US

[22] For rights categories other than UR, releases or disclosures to third parties must be accompanied by a Non-Disclosure Agreement (NDA), and may also require notice to the contractor owner of the data.

[23] See DFARS 252.227-7014(a)(14) for more information.

Rights Category	Applies to These Types of TD or CS	Rights Criteria	Permitted Uses Within the Government	Permitted Uses by Third Parties Outside the Government[22]
Negotiated License Rights	Any/all TD and CS including commercial TD and CS	Mutual agreement of the parties; use whenever the standard categories do not meet both parties' needs	As negotiated by the parties; however, must not be less than LR in TD and must not be less than RR in noncommercial CS (consult with legal counsel)	
SBIR Data Rights	Noncommercial TD and CS	All TD or CS generated under an SBIR contract	All uses; no restrictions	Cannot release or disclose except to Government support contractors
Commercial TD License Rights	Commercial TD only	TD related to commercial items (developed at private expense)	Same as LR	
Commercial CS Licenses	Commercial CS only	Any commercial CS or CS documentation	As specified in the commercial license customarily offered to the public[24]	

Benefits

In an open IP model, a firm recognizes the limits of its own innovative capacities (such as limited expertise, resource constraints, etc…) and seeks to bolster its market share by augmenting the innovation it brings to bear through business partnerships with outside firms. In this open paradigm, a company is incentivized to seek out the most advantageous solutions to couple with its own contributions and capabilities in hopes that a more innovative solution with lower costs of development and production will be embraced by the marketplace. As demand for this solution increases, the participating firms gain a larger proportion of market share and make additional profits. Because this model is open, the firms who invested their own resources and participated in the collaborative development process internalize the profits. As the solution becomes more innovative, the product may make additional gains in market share thus yielding greater profits than an equivalent product developed in a closed environment. Likewise, as the open solution costs less (as a result of outside resources providing lower cost contributions for development and production) prospects for profitability of the participating firms become greater. Finally, the open solution offers the prospects of IP licensing for the specific knowledge that was used to create the open product. As other firms in the market seek to emulate a successfully developed open solution, the original developer can sell IP licenses to others—including its competitors and/or DoD. These licenses permit the original developer to profit from reuse of its innovation without the burden of trying to maintain a tightly controlled, closed business model.

[24] Such licenses must be consistent with Federal procurement law and satisfy user needs.

Implications

The implications of IP rights on DoD and Industry are noted in Table 10 below:

Table 10 – IP Implications for OBM

Implications for DoD	Implications for Industry
DoD will exercise rights already granted to the Government to drive reuse and increase competition across the UAS portfolio	Industry should recognize there will be lower barriers to entry in the UAS Marketplace permitting firms to broaden the range of their own expertise and expand market presence
DoD will determine what additional rights to IP they may need to acquire to support UAS SOA Services or components across the lifecycle	Industry should articulate their increased value proposition if they choose to operate with a closed IP model
DoD will treat acquisitions as strategic investments in technology through the use of a "virtual marketplace"	Industry should understand the impact of IP on DoD programs and recognize DoD will use Data Rights as part of its best-value evaluation criteria during source selections

Practices

Practice 1 - DoD Will Exercise its Rights to a Third Parties IP to Facilitate a Greater Number of Competitions for the Goods/Services it Acquires. Competition yields significant benefits for acquisition of defense systems via reductions in cost, improvements in performance and shorter development cycle times. As DoD seeks to improve its acquisition outcomes by increasing prospects for competition throughout the system lifecycle, programs will need to have the appropriate resources in place, such as streamlined business processes, appropriately trained staff, innovative technological tools, etc., to support the increased workload resulting from engaging in additional competitions for goods and services.

Case Study: Proctor & Gamble

Proctor and Gamble (P&G) has built a strong foundation around utilizing an OBM to leverage its proprietary technologies. By 2000, P&G's in-house R&D was unable to keep pace with the nature of the rapidly changing marketplace. This failure to respond to market demand in a timely manner contributed to its difficulty in sustaining high levels of market growth. During this period, more than 90% of P&G's technologies went unused in its products. Ultimately, P&G recognized the waste this created as the investment in these idle technologies went unused in the marketplace. In response, P&G decided to change the model for the way it conducted its in-house research from one that was closed and built upon proprietary solutions, to one that was open and built on collaboration across the marketplace. P&G's new research unit was titled "Connect and Development" and was designed around the theory of open innovation. The results of this effort for P&G were astounding:

- ***By 2006, more than 35% of new products had elements originating from outside P&G (up from only 15% in 2000);***
- ***45% of product development initiatives contained key elements discovered externally;***
- ***R&D productivity increased by 60%;***
- ***R&D investment as a percentage of sales decreased from 4.8% in 2000, to 3.4% in 2006.***

Sources: "P&G's New Innovation Model," Harvard Business Review, 2006. and http://www.openinnovate.co.uk/papers/PG_Open_Innovation.pdf

Practice 2 – DoD Will Determine What Additional Rights to a Third Parties IP It Should Acquire to Support the UAS Portfolio.

> ***Case Study: Raytheon***
>
> ***In 2007, Raytheon began an "OpenAIR" business model that is aimed to encourage collaboration across the marketplace by lowering barriers to market entry. OpenAIR provides an opportunity for firms of all levels (small, medium, large) and types (private, academia, non-profit, etc.) to get involved in the overall design and production effort, permitting an increase in competition, collaboration and creativity. This approach drives costs down and accelerates time-to market. As a result, Raytheon's customers receive best-of-breed and affordable solutions in a shorter span of time. These solutions and savings can then be passed on to the warfighters and taxpayers. The OpenAIR business model is built on four pillars:***
>
> - ***Hardware — Placing emphasis on commercial off-the-shelf (COTS) products, standards, transparency in selection criteria, competition and re-competition.***
> - ***Software — Designing for standard interfaces and maximum reuse.***
> - ***Data rights — Encouraging suppliers to share data rights with Customers and Partners.***
> - ***Intellectual property — Having the agility to meet proprietary needs while still treating all partners fairly and equitably.***
>
> ***Source : http://www.raytheon.com/businesses/rtnwcm/groups/public/documents/content/rtn_bus_ids_prod_openair.pdf.***

Government purpose rights (GPR) for technical data and computer software enable the Government to use this intellectual property, for any Government purpose, without having to pay for using the information a second time. For legacy programs or current programs beyond Milestone B with less than a minimum of GPR rights, DoD acquisition and contracting personnel will undertake a business case analysis to determine if additional data rights are needed to support the UAS portfolio. The purpose of this business case analysis is to identify the costs and associated benefits for acquiring additional rights in cases where the program has not included GPR or less restrictive rights in initial contracts or where programs failed to appropriately exercise their current rights and DoD has "lost" these rights over time. During this analysis, programs should also assess the potential consequences of not acquiring additional data rights and the impact this would have on sustainability, competition and ultimately system lifecycle costs.

For future acquisitions, programs can seek to acquire additional data rights during the initial contractual negotiations as part of a priced option. Programs may also choose to evaluate the inclusion of such an option or additional license rights at no-added cost in its best-value determinations for contract award.

Practice 3 – DoD Will Treat Acquisitions as Strategic Investments in Technology Through the Use of a "Virtual Marketplace."

A key feature of the OBM is transparency – the ability of DoD and Industry to "see" what IP resources are available for use in system development based on DoD's technology investments. To that end, a "virtual marketplace" comprised of a federated, network of interoperable repositories could serve a critical role as the primary source for dissemination of information on IP across the UAS community. Through the use of a "virtual marketplace," artifacts could be visible to both Government and Industry and opportunities for reuse could flourish across the UAS community. As more reuse occurs, less duplicative investments would be made to develop similar solutions prompting more strategic investment planning for technology development. The implication of this reuse could limit programmatic funds dedicated to solving problems already addressed by preexisting solutions found in the marketplace.

Practice 4 – Industry Should Capitalize on Lower Barriers to Entry into the UAS Marketplace, Which Will Allow Firms to Broaden the Range of Their Own Expertise and Expand Market Presence.

Moving to an OBM will lower the barriers to entry for firms seeking to enter the defense marketplace. The OBM will decrease the up-front costs for small businesses as well as allow multiple firms to compete on programs previously absent from market competition due to the lack of design disclosure. A reduction in proprietary systems and barriers to entry will increase innovation and the quality/performance of the firms participating within the market. The net result will be better acquisition outcomes for both the Warfighter and taxpayer.

Practice 5 – Industry Needs to Articulate Its Value Proposition – Companies Do What They Do Best By Leveraging Specialization.

In a closed business model, IP that goes unused is developed at the expense of a firms' bottom-line and ultimately decreases shareholder value. An OBM allows firms to focus resources on their most profitable activities. By focusing resources in this way, Industry can increase value for their shareholders by focusing solely on lower risk/higher reward activities, which will lead to increased profit margins. In an OBM, the technology pool is broader, thus collaboration and/or licensing agreements with outside entities that hold expertise in specialized areas become more cost efficient rather than in-house development for that very same innovation.

Case Study: Eli Lilly

Pharmaceutical manufacturer Eli Lilly used an OBM to exploit the power of the internet to overcome its most challenging research problems. In the late 1990s, two Eli Lilly executives sought to create a collaboration environment where research problems could be solved not behind closed doors, but rather out in the marketplace of ideas, where the best solutions could be easily identified outside of traditional corporate boundaries. The result was the creation of the InnoCentive tool which was designed to connect Seekers (those with seemingly unsolvable research problems) with Solvers (those who have potential solutions to these problems). In this construct, if Solvers are able to provide a successful solution; a pre-specified monetary award is given to the Solver and Intellectual property associated with solution is transferred exclusively to Seeker. The results of this program have been significant and are a testament to the value created through the adoption of open business practices in management of intellectual property:

- ***Since 2001, more than 170,000 participants from 175 countries have registered as Solvers;***
- ***Success rate of 50% since 2001 on problems that had previously stumped internal R&D staff;***
- ***$4 million in awards have been paid to Solvers.***

Source: "The Next Wave of Open Innovation," http://www.businessweek.com/innovate/content/apr2009/id2009048_360417.htm, April 9, 2009.

The OBM will increase the total utilization of IP in the market. Increased IP utilization equals a greater number of opportunities to bring a unique product to DoD. The more products a firm can bring to market, the greater portion of market share it can seek to acquire. In a closed business model, most companies fail to utilize a high proportion of their IP. With an open business model, this unused intellectual property can be leveraged by licensing the IP to another firm who may have the expertise, efficiencies, or customer base to utilize these otherwise dormant innovations.

4. DESIGN DISCLOSURE CONCEPTS

A key attribute of the OBM is having insight into the design of a program or product. Companies that continue to invest in innovation and open up their R&D activities will be more competitive in the marketplace. Open models can also enable greater value capture, by utilizing a key asset, resource, or position not only in the company's own business, but also in other companies' businesses.[25] DoD must also open up its R&D activities to drive innovation and leverage designs across many programs to drive down costs. This requires early and often access to GCS software and system design artifacts that DoD has IP rights to (see Table 7).

Background

Design Disclosure is a means of making technical data related to the design of a component, sub-system, or system available to qualified recipients. The goal is to establish and maintain a process that will provide "early and often" design disclosure directly to DoD or to third-party contractors via DoD-established access. Design Disclosure is enabled through a variety of mechanisms including:

- Storing data, code and design artifacts in a repository either maintained or overseen by the Government;
- Providing the artifacts electronically upon requests made via DoD;
- Allowing requesting parties to obtain artifacts directly from the source firm through a process involving DoD review and approval.

In addition, DoD can require contractors to provide access to the design artifacts when DoD has Unlimited Rights or Government Purpose Rights as described in Table 7. Each Service or program has the flexibility to establish the most appropriate mechanism for their specific needs in order to solve the design disclosure issue in a manner that is both cost-effective and responsive to requests.[26]

> *"If companies open up their innovation process to utilize the work of others on the one hand, and share their own work with others on the other hand, innovation can thrive once more. If they are able to do so, many more ideas will become available to them for consideration, and many more pathways for unused internal ideas will emerge to unlock their latent economic potential as they go to market."*
>
> *Source: iBID*

Benefits

The benefits of design disclosure to both DoD and Industry are many. Implementing design disclosure processes across the UAS community will support an OBM and help DoD drive more efficiencies.

Effective design disclosure will enable the Services and UAS programs to share software modules thus decreasing development costs, reducing fielding time, and reducing the operational costs of a system during the sustainment phase of the lifecycle. The incentive for businesses will be for innovative development rather than lifecycle support contracts. The goal is to shift the paradigm where the most effective software modules/services/applications will prove to be more lucrative than maintaining a ubiquitous GCS. With this change, small businesses and non-traditional GCS suppliers will have a greater opportunity to enter the marketplace.

[25] Can't Afford to Innovate? Open up!, by Henry Chesbrough, Forbes, March 29, 2011

[26] Naval Open Architecture Contract Guidebook for Program Managers, Version 2.0 30JUN2010. Available https://acc.dau.mil/NOAGuidebook

Table 11 provides a summary of the design disclosure implications for both DoD and Industry.

Table 11 – Design Disclosure Implications

Implications for DoD	Implications for Industry
DoD will create a venue for third-party vendor involvement in the design and innovation process	Industry should document and make design artifacts available as they are created, including source code and Reference Architecture (RA)
DoD will adjudicate requests for access to design artifacts	Industry should document in a standard format (e.g. UML, XML, or XMI)
DoD will provide Industry a design artifact repository	Industry should collaborate with third-party vendors, leveraging their external IP
DoD will encourage component reuse across programs	Industry should encourage component reuse across programs
DoD will document and make available Government R&D efforts	Industry should transfer R&D risk to third-party companies for service (application) development

Practices

Practice 1 – DoD Will Require Full Design Disclosure in Future UAS GCS Acquisitions.

DoD will include more Design Disclosure requirements in Sections C and H of the RFP for future UAS GCS acquisitions. These RFP additions include direct access to the development environment, standard formatted design information, component and system interface definitions, and inspections. Program managers will also use DFARS 227.7103-8(b), regarding deferred ordering of technical data, to obtain these materials. The recommendation is based on instances where DoD would like to have had access to design artifacts and other materials that were produced during the development of software that were not specifically identified in the Contract Data Requirements Lists (CDRLs) and Design Information Documents (DIDs). See Contracting section for specific information on incentives and Appendix A for specific examples for contracting language in support of Full Design Disclosure.

Practice 2 – Industry Should Recognize Benefits of Design Disclosure.

The GCS community should embrace the notion of design disclosure to ensure innovation continuance and to reduce product costs. Short-term market gains resulting from isolating IP and design artifacts will have negative long-term results. As the commercial market embraces and benefits from OBM practices, the GCS community needs to participate in order to benefit from this technology-management wave.

Practice 3 –Industry Should Use Existing DoD Software Repositories and Collaborative Development Environments (CDE).

DoD will encourage the use of existing DoD software repositories and collaboration environments such as Navy Integrated Collaborative Environment (NICE)[27], Software Hardware Asset Reuse Enterprise (SHARE)[28] or Forge.mil. Specifically, the GCS Ecosystem, Figure 12 on page 41, will be used by both DoD and Industry for the creation, maintenance and upgrade of GCS applications. The GCS repository contains all of the necessary models and interfaces to create GCS compliant applications. Industry should populate the GCS repository with applicable Reference Architectures (RA)[29] and applications in either source code or executable format. The GCS Ecosystem provides a vehicle to extend existing models and interfaces to allow for innovation and system evolution.

5. STRATEGIC REUSE

The development of the common UAS control station architecture based on SOA principles, standard data models, and service interface definitions can be considered an evolution in DoD architectural development that builds upon commercial best practices. The UAS SOA defines the use of loosely coupled software services to support the requirements of the missions across the UAS portfolio. When deployed, these independent services can be accessed without the knowledge of the underlying platform implementation or programming language. Organizing and utilizing these distributed capabilities will provide a uniform means to offer, discover, interact with and use capabilities to meet the requirements of the GCS.

Background

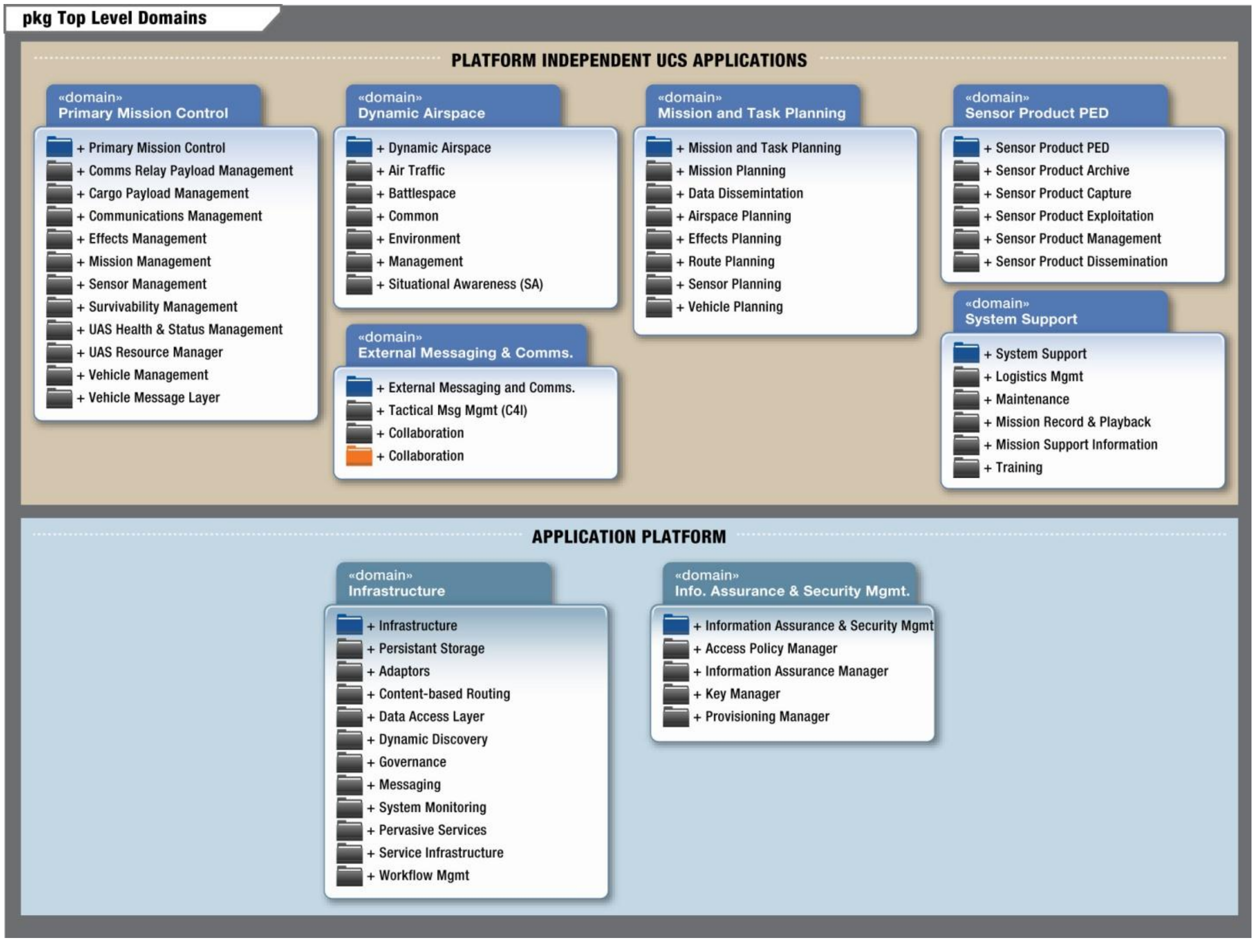
The UAS SOA will facilitate the reuse of services across the multiple, distributed UAS platforms and will be accessible across networks. Figure 9 illustrates the SOA based architecture for the Common GCS.

[27] NICE. Available https://acc.dau.mil/adl/en-US/44949/file/13048/Presentation%208_NICE%20%20Surface%20Domain%20ARpdf

[28] SHARE. Available https://acc.dau.mil/CommunityBrowser.aspx?id=117905

[29] Reference Architecture (RA) is a high-level system design free of implementation details consisting of: 1) a high-level description of the system components, 2) definitions of relationships between components, 3) definitions of relationships between system components and elements external to the system, and 4) identification of performance drivers and capacity requirements.

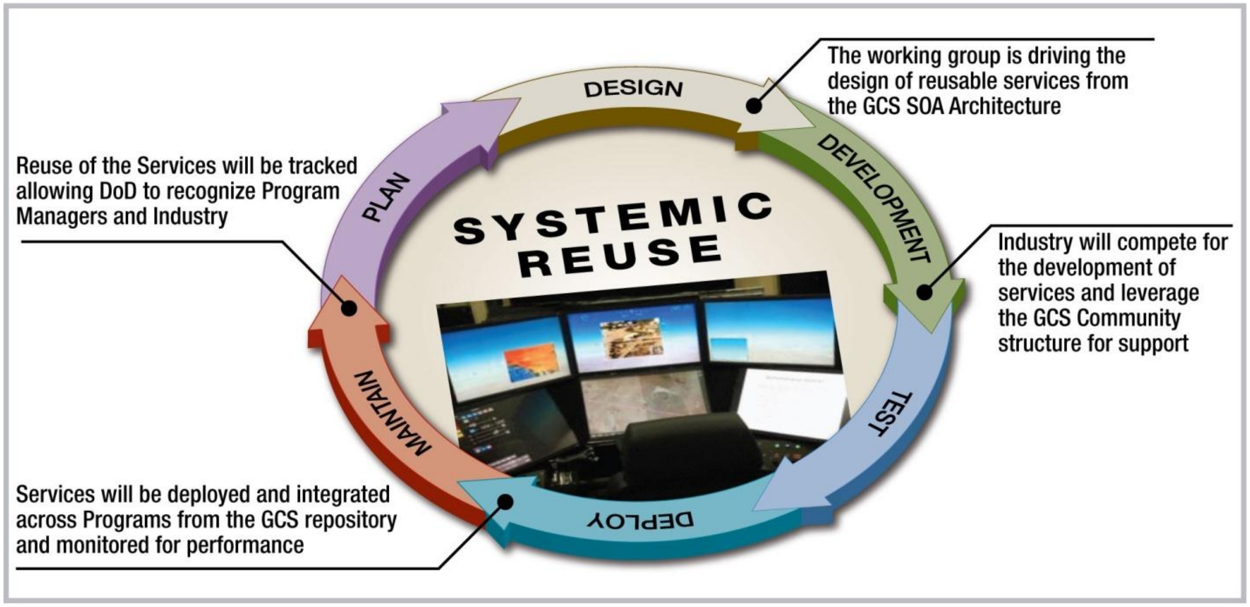
Figure 9 – Domain Based Architecture for the Common GCS from UAS Control Segment Architecture Version 2.2 [30]



The Task Force is planning to adopt a systemic approach to reuse with a structured plan and well-defined processes, lifecycles and commitments for funding, staffing, and incentives for use. The UAS Application Store provides the ecosystem to support the reuse of these SOA Services. SOA services will begin to be integrated in the legacy programs. Services will be competed to bring the best technology to the Warfighter and widen the industrial base. Figure 10 illustrates a systemic approach the Task Force may adopt to ensure reuse across the platforms becomes second nature.

[30] UAS Control Segment (UCS) Architecture Version 1.0, p34, Figure 11 – UCS domain Model.

Figure 10 – Systemic Approach to Reuse Across GCS Platforms



Benefits

If adopted properly, the UAS approach to reuse will provide many benefits to both DoD and Industry including:

- Increase in software productivity across UAS portfolio
- Reduced time to field capabilities due to loose coupling
- Reduced software development and maintenance costs
- Improved interoperability due to independence from specific systems and languages
- Innovation for specific services by specialized firms
- Ability to compete at the SOA service level

Case Study: CAAS

In the mid 1990s, the Army's Technical Applications Program Office (TAPO) adopted a product line approach for helicopter mission and avionics software systems based on the Common Avionics Architecture System (CAAS). The CAAS user group expanded beyond Army to reduce development, maintenance, and integration costs across USMC, USAF, and USCG fixed wing and rotorcraft helicopters. Results include:

- *Strategic software reuse of around 80% across CAAS*
- *Reduced system development costs from CAAS*
- *Reduced time to deploy CAAS across platforms*
- *Reduced integration and test costs across platforms*
- *Reduced flight-test costs across platforms*
- *Reduced documentation costs across platforms*
- *Consolidated simulator flight training to one facility and reuse of training materials*
- *Elimination of multiple software maintenance contracts across platforms*
- *One-time development cost savings for implementing new functionality across platforms*

Source:
http://www.sei.cmu.edu/library/abstracts/reports/05tr019.cfm

DoD must take advantage of the software development efforts it has already paid Industry to develop across the UAS portfolio. Embracing reuse as a 'first-order' priority when deriving solutions for GCS requirements will help DoD reduce the total ownership costs of its mission systems and increase speed to deliver capability to the Warfighter. Program Managers should evaluating the SOA Services from the UAS Application Store for reuse into existing PORs or new start programs.

Implications

Reusing SOA services across the UAS Portfolio to drive greater efficiencies will have wide reaching affects on both Industry and UAS Programs. The implications of reuse are provided below:

Table 12 – Implication of Reuse

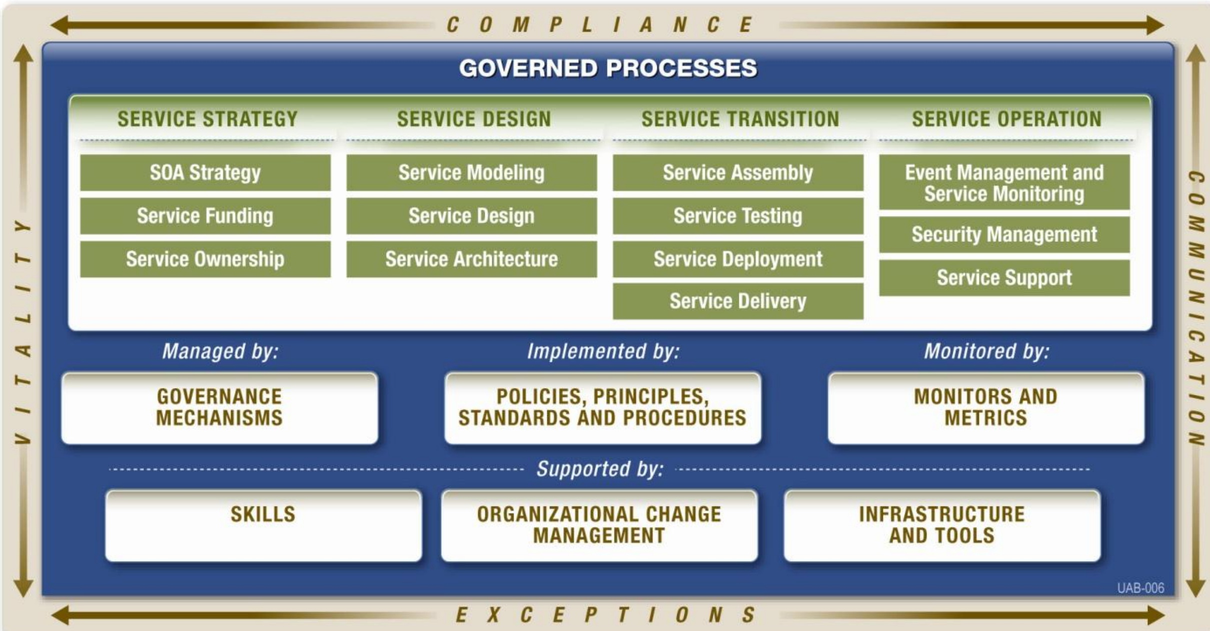
Implications for DoD	Implications for Industry
DoD will exercise rights to IP more diligently and ensure companies do not co-mingle software development efforts to support improper rights claims.	Industry should seek to better understand the IP rights granted to DoD when DoD pays for development or contributes with mixed funding. Industry should expect DoD to exercise its rights and provide reusable services to a third party when granted GPR.
DoD will need to understand what reusable technical data and computer software exist today across DoD that can be leveraged for future development efforts.	Industry should understand what reusable technical data and computer software exist today that can be leveraged for future development.
DoD will be expected to share technical data and computer software across the enterprise to drive more reuse opportunities. The UAS Application Store provides this platform.	Industry should collaborate more with partners from Government and Industry to reuse SOA services DoD has already acquired. The UAS Application Store provides this platform.
DoD will seek to understand the impact on planning; traceability; target compatibility; dead and deactivated code; verification and testing; overuse of inheritance; ambiguity; coding issues; and Library dependence when reusing services.	Industry should articulate potential cost savings from reuse to DoD in future requests for proposals to receive additional consideration during source selection.

Practices

Practice 1 – DoD will Establish a Governance Structure to Support Strategic Reuse.

DoD will establish a governing structure over the catalog of SOA services to define roles and responsibilities, establish decision making rights, define the high value SOA business services, manage the lifecycle of the SOA assets and measure effectiveness. Figure 11 provides an illustrative framework DoD will follow. Companies will need to adapt to this structure and work within defined procedures as their “service” may be integrated across several platforms.

Figure 11 – Illustrative SOA Framework



Practice 2 – DoD Will Exercise Intellectual Property Rights to Facilitate Reuse.

As DoD seeks to reduce duplicative investments across the UAS Portfolio, Program Offices will exercise rights granted to DoD for technical data and computer software for which they funded or co-funded with Industry (i.e. unlimited or GPR rights). DoD will provide reusable data or software to a third party vendor when applicable to prevent new development for similar capabilities that already exist. The UAS Application Store will facilitate this reuse.

Practice 3 – DoD Will Incentivize Strategic Reuse Across Programs.

The establishment of an incentive and recognition program that captures both Program Managers and Industry's commitment to reuse is essential to success. Within the Government, incentive programs will capture employees' contributions on asset development and reuse. Requests for Proposals and contracts will be structured to incentivize Industry to reuse GCS services across multiple platforms to drive down costs. See the Contracting section for specific information on incentives and Appendix A for specific examples for contracting language in support of Strategic Reuse.

Practice 4 - Industry Should Seek to Foster Collaboration and Reuse across Traditional DoD Boundaries.

The pressure on DoD budgetary resources demands greater levels of collaboration between UAS Programs, Resource Sponsors, and Industry throughout the acquisition lifecycle. Greater collaboration and shared investments will be a key differentiator in the marketplace for those firms who choose to support this approach. Industry should recognize opportunities to provide DoD with efficiency gains by leveraging certain technology investments across the UAS portfolio so that any savings can be used to acquire additional capabilities. This reuse model is very similar to the one adopted by the Common Avionics Architecture System (CAAS) User Working Group. Industry must adapt to this new model and partner with DoD to drive reuse across the platforms.

Practice 5 – DoD will Capture Reuse Metrics to Articulate DoD's Cost Savings.

Establishment of reuse metrics to drive change across the UAS portfolio is needed to manage and monitor performance. Data on services must be collected when the services are cataloged into a repository. Companies today have the capability to capture data on assets and establish reuse scorecards to help organizations track top assets by mission area, quality of asset, and cost of asset. The UAS Sponsors, Program Executive Offices (PEOs), and Program Managers must have insight into this data when developing new solutions so they can explore the potential to reuse assets the Government has already paid to develop. Firms who actively seek to provide DoD a clear picture of precisely how much value is being gained from reuse within their program will be given additional consideration during determination for source selection and/or granting of award fees/terms.

6. COLLABORATIVE DEVELOPMENT ENVIRONMENT (CDE)

In this framework, the OBM has been described as a facilitator to enhance innovation through the maximization of unrealized IP, increased collaboration among stakeholders, and reduced production costs. One of the keys to achieving an OBM with these attributes is a Collaborative Development Environment (CDE).

Background

The term, CDE, was coined by Grady Booch, noted IBM Fellow, and alludes to an environment that provides a seamless integration between development, communications, and collaboration tools for interested stakeholders.[31]

A CDE can scale from a global team of developers with offices in multiple countries spanning several time zones to a small, local team divided by differing work schedules or department affiliations. In either case, collaboration is enabled with business analysts, architects, developers, testers, lawyers, business stakeholders, and other subject matter experts separated by time, distance, or organization to synchronize and optimize the process of software development and delivery.

Case Study: Boeing 787 Dreamliner

The idea of a CDE evolved from Boeing's Global Collaborative Environment (GCE) where Boeing, along with 40 dispersed global partners, leveraged a common digital environment to effectively collaborate and develop a single 3D product definition throughout all phases of the 787's lifecycle. Every aspect of the plane and its manufacturing processes were designed, created, modeled and tested digitally within the GCE before migrating anything to the physical production environment. The use of the GCE saved thousands of man-hours, reduced cost, and eliminated waste by enabling designers and stakeholders to share ideas, knowledge and to work together toward a common task.

Source: http://www.alphaworks.ibm.com/topics/cde

[31] IBM Alpha Works: CDE http://www.alphaworks.ibm.com/topics/cde

CDEs are beginning to emerge across DoD. For example, Forge.mil is a collaborative software development environment designed to improve the ability of DoD to rapidly deliver dependable software, services, and systems. In addition to the SoftwareForge component of Forge.mil, a collaborative environment for the shared development of open source and DoD community source software, the DoD recently launched the ProjectForge component, a SaaS version of SoftwareForge designed to meet the application development needs of private-access projects.

Benefits

The CDE is an essential component of the OBM in that it creates the collaborative environment to maximize the exposure and exploitation of IP and fosters innovation while reducing cost and time to market. One of the major benefits of the CDE is an ecosystem where OSD, the Services, integrators, suppliers, and new market entrants can collaborate leveraging each others IP (via appropriate licensing agreements) and break "closed IP management," a practice were only a fraction of an organization's IP is used or licensed to another party for commercialization/production.

Table 13 – CDE Implications

Implications to DoD	Implications to Industry
DoD will encourage programs and military Services to use existing DoD CDE environments, specifically the GCS Ecosystem	Industry should document and make design artifacts available as they are created in a standard format (e.g. XMI, XML, UML)
DoD will include GCS Government R&D efforts (e.g. DoD Labs, National Labs, SBIR and STTR efforts)	Industry should submit Reference Architectures and applications (either source code or executables)
DoD will adjudicate access requests to the CDE (GCS Ecosystem)	Industry should collaborate with third-party vendors, leveraging their IP
DoD will work collaboratively across the programs to maximize data sharing and technology interchange	Industry should encourage component reuse across programs

Practices

Practice 1 – DoD Will Use the GCS Ecosystem for Future UAS Acquisitions.

The GCS Ecosystem, Figure 12, is the CDE for the GCS community bringing together all of the stakeholders in the UCS-WG to create the use cases to define requirements that generate models and interfaces for the GCS. Model and interface data is stored in the repository for any authorized user to download. The repository also stores Reference Architectures (RAs) and applications, in either source code or executable format, for stakeholders to use or build upon. The CDE (GCS Ecosystem) also provides a means for a party to extend the existing model and the interface to allow for innovation and system evolution.

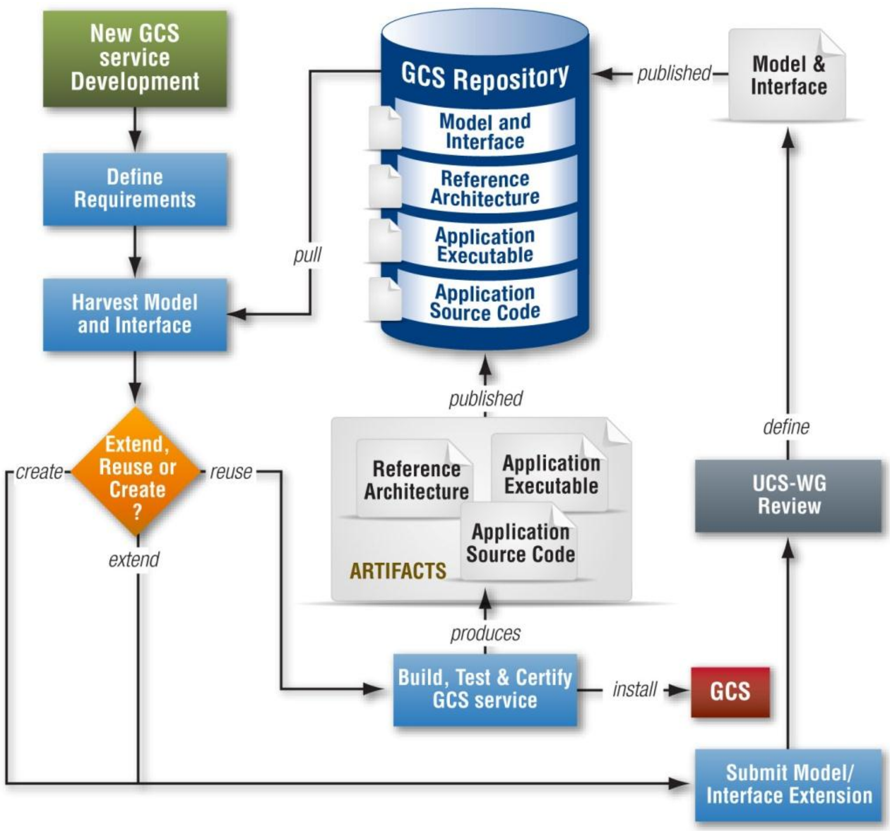
Practice 2 – DoD Will Require Use of CDEs in Future UAS GCS Acquisitions.

OSD recommends that the Services include CDE requirements in Sections C and H of the RFP. These RFP additions include direct access to the development environment, inspections, and should include a statement concerning the CDE as part of a design disclosure plan - a detailed description of the contractor's approach to facilitate the sharing of system or component design information. See the Contracting section for specific information on incentives and Appendix A for specific examples for contracting language for use of CDEs.

Practice 3 – Industry Should Embrace CDEs in Future UAS GCS Acquisitions.

The CDE for the GCS community is the GCS Ecosystem. Industry should use the ecosystem to download models and interfaces for any GCS development effort. Industry should upload RAs and applications, in either source code or executable format to the ecosystem as a result of a development effort. Industry should use the ecosystem, via the UCS-WG, to extend an existing model or interface if a particular feature is not already defined.

Figure 12 – GCS Ecosystem



The GCS Ecosystem is the CDE for the GCS community and consists of three base scenarios; reuse, extend and create. The process begins with an entity tasked to create a new GCS service. The initial steps are to define the GCS service requirements followed by a "pull" from the GCS Repository to obtain a model and interface that best matches the proposed new service. The model and interface are used to define a service. The model defines how the service operates with respect to the rest of the GCS (system resources, data definitions, the functions, etc) while the interface defines how the service communicates with the GCS and other services (messaging formats). At this point the scenarios come into play.

Reuse Scenario. If a model and interface exists for the proposed service, the service can then be built (programmed), tested, and certified for installation on a GCS. The resulting artifacts of this activity, RA, application source and executable code are published to the GCS Repository.

> **RA** is a high-level system design free of implementation details consisting of: 1) a high-level description of the system components, 2) definitions of relationships between components, 3) definitions of relationships between system components and elements external to the system, and 4) identification of performance drivers and capacity requirements.
>
> **Application Source Code** consists of one or more text files written in a computer programming language by computer programmers, who specify the actions to be performed by a computer. The source code needs to be converted into binary machine code (either complied or interpreted) before an application or service can be run. Source code is only useful to a computer programmer who wishes to understand or modify a program
>
> **Application Executable Code** is binary machine code that the computer can directly read and execute. Most computer applications are distributed as executable files, which does not include the source code.

Extend Scenario. If a model and interface are found to be a near fit for the proposed new service, the development team may elect to extend the model and interface to meet the proposed new service requirements. Model and interface extension is a form or reuse and a way to ensure compatibility with older GCS that may not be able to utilize the proposed new service. In this scenario, a model or interface will need to be further defined to describe and define the new proposed features and sent to the UCS-WG for review. Once the UCS-WG, a body of GCS stakeholders, has completed the review the extended model and interface will be considered as defined and published in the GCS Repository where the submitting team can pull the model and interface and continue with the reuse scenario.

Create Scenario. In the case were a model and interface does not exist for a proposed service, one will need to be defined. The create scenario is identical to the extend scenario, the only difference being that a unique model and interface will need to be defined and submitted for the UCS-WG to consider. As with the extend scenario, once the UCS-WG publishes the new model and interface, the development team can pull it from the repository and continue with the reuse scenario.

Lessons Learned form the Open Technology Development (OTD)[32] recommend that software acquisition and development processes should consist of **use**, **extend** and **create**. Use refers to simply utilizing the existing standards and interfaces, extend refers to submitting a change to a standard to fulfill the current requirements and create refers to initiating a new standard of model or interface.

[32] http://www.oss-institute.org/OTD2011/OTD-lessons-learned-military-FinalV1.pdf

The ecosystem is seen as a way for all levels of Industry to increase their revenue stream by licensing IP to multiple projects and suppliers. Collaboration is enhanced by facilitating technology and design interchange, reduced production time and costs by reusing proven and certified technology, and breaking the closed IP management by providing a venue for boutique and global firms to submit their IP to the GCS marketplace for general consumption.

The ecosystem is a collaboration tool allowing stakeholders to collaborate directly through the UCS-WG or by extending the repository, defining emerging service models and interfaces for others entities to create.

7. TECHNOLOGY INSERTION STRATEGIES

Technology Insertion (TI) is a means to evolve systems, either incrementally or as a large all-encompassing upgrade, to inject mature technology innovations into fielded systems as well as systems under development. TI is also a risk mitigation strategy to avoid technology obsolescence while simultaneously reducing operational costs and maximizing a system's initial return on investment (ROI).

> *"TI integrates the efforts of the Science and Technology community, the Joint Capabilities Integration and Development System, and the lifecycle logistics planning process. This integration ensures that mature technological solutions increase readiness, reduce lifecycle costs, and reduce the logistics footprint."*
> ***Source: https://acc.dau.mil/CommunityBrowser.aspx?id=32703***

Many of the GCS currently in operation were built in isolation and procured as part of a larger UAS acquisition. The result is a closed system that is difficult to upgrade, has limited interoperability, and is expensive to maintain. TI, as part of an OBM, is seen as a corrective measure to these issues and as a vehicle to inject mature innovative advancements into fielded systems.

The goal for the I-IPT is to increase the rate in which new, innovative technology can be inserted into GCS programs. TI for a GCS involves determining which technologies to replace during a design refresh; deciding the design refresh content, and deciding when that design refresh should take place.

Benefits

There are numerous TI benefits for both the Government and Industry. Implementing a Technology Insertion strategy within the I-IPT will drive efficiencies such as:

- Enabling third-party vendors to develop and bring to the GCS market their IP driving down R&D costs and ideally introducing more capable software at a lower production cost
- Creating a dynamic GCS Industry that actively uses TI to regularly refresh the technology capability of both existing and developmental systems creating an incentive for business to derive value from innovative software algorithms

> *"A Technology Insertion approach provides a path for near-term incremental capability improvements and addresses OSD's long range UAS goals to improve the efficiency, interoperability and scalability needs of the growing UAS force capability."*
> *Source: http://www.uasvision.com/2011/02/11/northrop-grumman-gets-3m-uas-commo-architecure-working-group-contract/*

- Increasing small and third-party vendor participation in the GCS community since TI can occur on a relatively small scale, reducing barriers to entry

DoD must establish a culture that regularly uses TI to refresh the GCS technology base in order to increase the rate in which innovative technology is adopted without having to acquire a new system.

An active TI strategy has implications to both DoD and Industry, Table 14 is a summary of the implications to the GCS community.

Table 14 – Technology Insertion Implications

Implications to DoD	Implications to Industry
DoD will provide an Incentive Structure for TI. Similar to the incentive structure for reuse, TI needs to be incentivized, recognizing programs that embrace and actively employ TI as a means to increase capabilities while curtailing development and maintenance costs.	Industry should increase collaboration through the establishment of a healthy TI program capable of ingesting technology from vendors outside the mainstream Defense Industry. Programs will be encouraged to reuse mature technology and IP from other industries (e.g. software gaming and medical imaging) to shorten development time and costs while making substantial leaps in capability.
DoD will provide a structure that provides guidance on how technology will be identified and evaluated for GCS inclusion.	Prime Integrators should work with other vendors and research institutions to champion TI and assist in the adoption of this TI into current programs.

Practices

Practice 1 – DoD Will Develop a TI Roadmap for Future UAS GCS Acquisitions.

Each UAS PoR will devise and fund a TI roadmap to guide the evolution of their system upgrades for the GCS. TI for a GCS involves determining which technologies to replace during a design refresh; deciding the design refresh content, and deciding when that design refresh should take place. The roadmap will be a vehicle to support the development of industry standards where current standards are insufficient, or don't' exist. Each technology used in the implementation of a GCS (i.e., hardware, software, manufacturing technologies and support the systems, information, and IP) can be characterized by a lifecycle curve that begins with introduction and maturing of the technology, and ends in some type of unavailability or obsolescence. To date, the UAS GCS community neither controls the supply chains for critical portions of the GCS technological content nor does it have the ability to influence the lifecycle characteristics of these technologies. Instead it is reliant and dependant on technology to evolve while maintaining unavailable/obsolete technology at great expense in order to ensure sustainment of the Warfighter's current capability.

Practice 2 –DoD Will Require TI Plans in Future UAS GCS Acquisitions.

DoD will include TI requirements in Sections C and H of the RFP. These sections will require the contractor to provide a detailed description of how the proposed system will allow for rapid and affordable TI and refresh. In addition, respondents will be required to provide a detailed description of how a modular design strategy will be demonstrated in all aspects of future system upgrades. See the Contracting section for specific information on incentives and Appendix A for specific examples for contracting language in support of TI.

Practice 3 –Industry Should Recognize Additional Business Opportunities in TI.

> ***Case Study: P-3C Orion AIP Program***
>
> ***The P-3C is a maritime patrol aircraft however, the armament and sensor upgrades included in the Anti-surface Warfare Improvement Program (AIP) have made it suitable for sustained combat air support over land. The AIP program enhanced P-3C avionics, non-acoustic sensors, communications, and survivability features significantly increased the aircraft's surveillance role. The technology used draws on the latest COTS and non-developmental items giving a vintage 1960 aircraft 21st Century capabilities at a reduced cost.***
>
> ***http://www.lockheedmartin.com/products/P3CAntiSurfaceWarfareImprovementPro/index.html***

Industry should recognize the value DoD is placing on TI as a means to keep current GCS solutions viable by evolving the system as technology, mission, and threat evolve. Industry can benefit significantly from assisting UAS programs expand their TI capabilities as additional opportunities emerge for inclusion of a firm's products in systems where they had been previously locked-out. Parts of DoD are already practicing TI, such as the Department of the Navy's Technology Insertion Program for Savings (TIPS).[33] For the GCS community, the Ecosystem, Figure 12, provides a framework for conducting TI. The Ecosystem allows an approved entity to "pull" GCS model and interface details from the repository, create new applications and even extend the model and feed the new applications back to the PoRs for consideration. Industry should realize that this construct permits a greater number of opportunities for firms to enter the UAS GCS marketplace as they are able to submit numerous GCS applications for insertion across a variety of UAS platforms.

8. TESTING STRATEGIES

> ***"Typical metrics indicate that as much as 20-40% of the development budget and as much as 30-50% of software maintenance budget is consumed by testing."***
>
> ***Source: Wellpoint Internal Document***

The GCS of the UAS portfolio consists primarily of software; unfortunately software testing is the most expensive portion of any GCS procurement and development effort. While an essential element of GCS acceptance, software testing needs to become more efficient to foster innovation, collaboration, technology insertion, and reuse among programs. These test efficiencies will translate to lower system costs and decrease the time to field improved capabilities.

[33] TIPS http://www.onr.navy.mil/Science-Technology/Directorates/Transition/Technology-Transition-Initiatives-03TTX/Technology-Insertion-Program-Savings-TIPS.aspx

The cost of requirements based test development is the driving cost factor when testing. Tests that are traced to requirements, design and code should be managed by an automated testing environment which performs the execution of the tests, capture and checking of the results at a lower cost. Ideally, the tests should be performed on each integrated image even if the tests focus on specific units down to the function level.

Requirement based testing is a certification objective, but for certification a measure of the adequacy of the requirements based test is also required. This is accomplished by measuring the degree of coverage of the code. Measurement can be made at the source code, object code or executable code level. The degree of coverage of the underlying constructs depends on the design assurance level of the software. Typically, coverage is measured through the use of automated tools, using the same tests as are used for requirements based testing. If only requirements based tests are used, than any code that is not covered will demonstrate unintended functionality, which will need to be addressed.

By accepting services into the UAS portfolio which adhere to the automated testing approach, the DoD will enable the military Services and Programs to perform regression testing easily and inexpensively.

The Automated reuse of Test will reduce the effort of test development without reducing the benefit of running the tests. This will make reuse of code easier and more efficient. Unit Test refers to tests that verify the functionality of a specific section of code, usually at the function level. In an object-oriented environment, this is usually at the class level.

The Task Force also plans to follow the commercial software Industry lead in gaining test efficiencies by using a “test utility” or Next Generation Test (NGT) model. The NGT model is an on-demand service, in which the client is billed on outcome or usage resulting in a cost savings in excess of 35%[34].

The success of the NGT model is attributed to the use of automation and predictive analytics. For instance, code analysis has been automated combining both static and dynamic analysis of the source code, which identifies errors, vulnerabilities, and compliance issues prior to system integration testing. Advanced defect methods is a predicative analysis capability that can analyze process and code structure to detect and localize software defects early in the Software Development Life Cycle (SDLC) while preventing future defects from being injected into the system, Figure 13 Next Generation Testing Strategy is a depiction of this type of structure.

Background

In the DoD testing community, each Service conducts its own software test protocol that encompasses the six levels of testing:

> <u>Unit Test</u> - refers to tests that verify the functionality of a specific section of code, usually at the function level. In an object-oriented environment, this is usually at the class level. This

[34] Wellpoint internal document

may be performed on individual units in a test environment, or on individual units in the operational software.

Integration Test - verifies the interfaces between components against a software design. Software components are integrated in an iterative way to allow interface issues to be localized more quickly and fixed. Integration testing works to expose defects in the interfaces and interaction between integrated components (modules). Progressively larger groups of tested software components corresponding to elements of the architectural design are integrated and tested until the software works as a system.

System Test - tests a completely integrated system to verify that it meets its system level requirements.

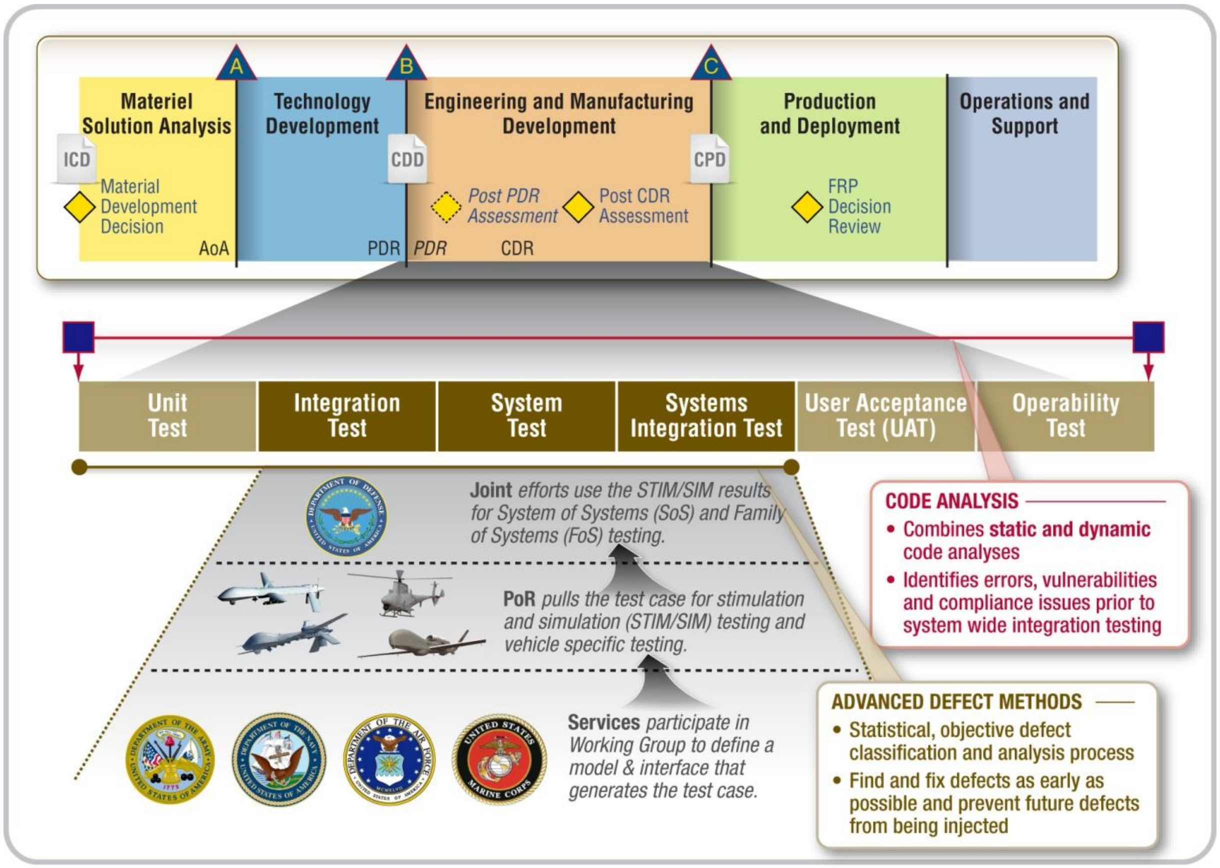
System Integration Test - tests verifies that a system is integrated to any external or third-party systems or systems-of-systems defined in the system requirements.

User Acceptance Test - is performed by the customer, often in their lab environment on their own hardware.

Operability Test – is performed in an operational environment, sometimes referred to as Alpha and Beta tests.

These protocols are usually enforced through contractual language with the integrator and are documented within the Software Requirements (SR) and Design Information Documentation (DID), artifacts such as the Software Development Plan (SDP), Software Test Plan (STP), Software Test Description (STD) and the Test and Evaluation Master Plan (TEMP). These DID artifacts historically have not addressed how the integrator plans to reduce testing cost (automation or outsourcing), accept and recognize unit level testing from other projects as part of code reuse plan, or even how TI will be addressed as part of the testing strategy.

Figure 13 – Next Generation Testing Strategy



Benefits

There are numerous testing efficiencies that can be realized for both DoD and Industry, Figure 14 is an example of the various savings that NGT can achieve.

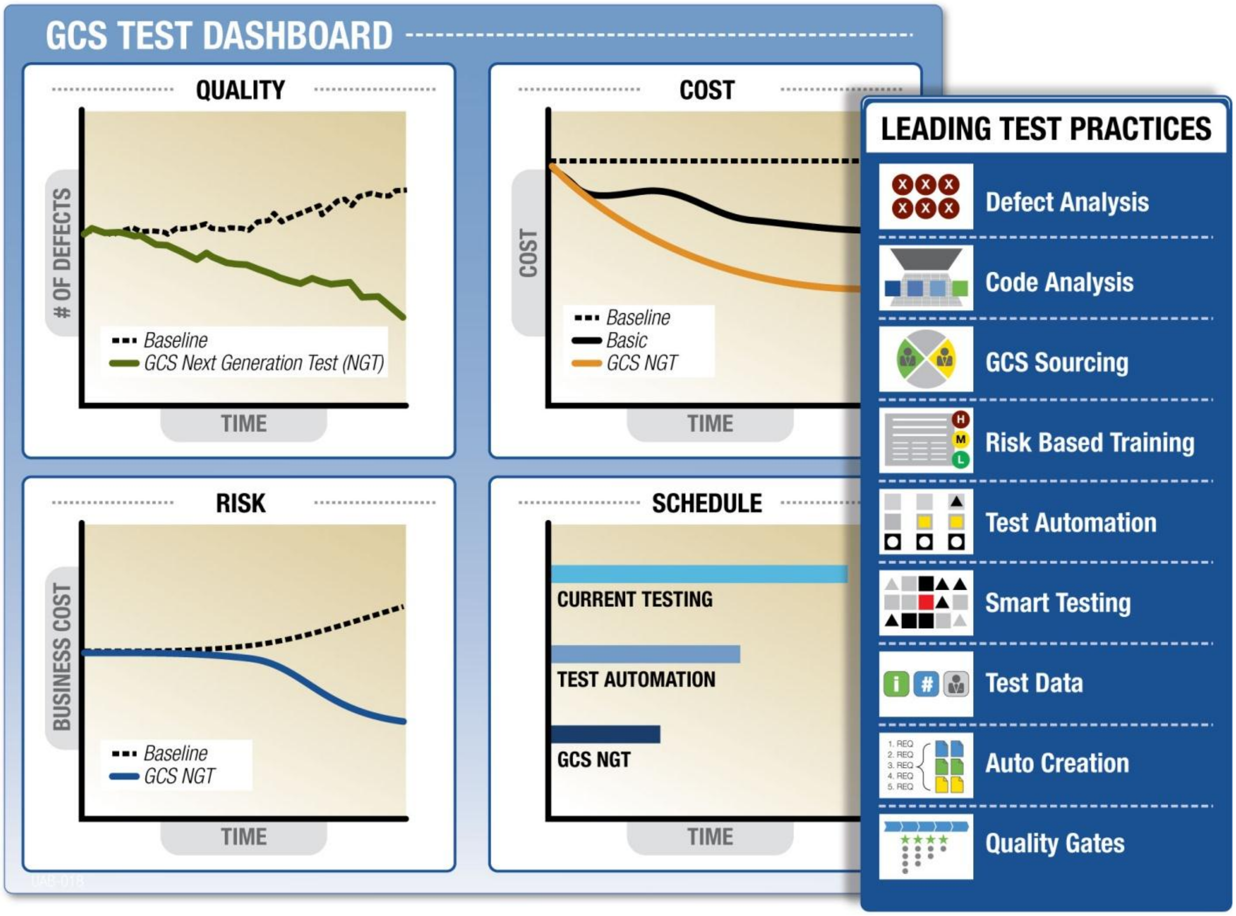
- Recognizing unit level testing performed on other projects will encourage software reuse and reduce the time to field new capabilities by eliminating redundant and duplicative testing.
- Streamlining the testing process and accepting tests performed outside a PoR will enable large and small businesses to make available more of their innovative applications. Current testing cost has restricted innovative services (applications) from being marketed to the GCS community.
- Automating or outsourcing testing will help lower the cost barrier to entry to the UAS GCS market.

Case Study: SEGA

The consumer electronics market has been challenging game software manufacturers to streamline game titles development and deliver innovative products to market faster without compromising software integrity. At SEGA, 47 of 220 work days are actually spent on developing planned features of new applications; more than 30% of developer time is spent on testing and bug repairs. Automating testing resulted in adding 44 days of innovation and feature development to every single developer's schedule.

Source: http://www.coverity.com/html/software-integrity-solutions.html

Figure 14 – GCS Test Dashboard



Efficient software testing will require both DoD and Industry to modernize the way they view and conduct software testing. Some of these implications are detailed in Table 15.

Table 15 – Testing Implications

Implications for DoD	Implications for Industry
DoD will provide governance for automated test tools and test outsourcing	Industry should recognize added value from investing in automated testing tools or outsource testing to test centers
DoD will establish test reciprocity among Services and Joint entities	Industry should accept DoD approved unit testing results from other vendors as a mean to reduce costs
DoD will provide governance detailing the type of testing required for critical and non-critical components	Industry should eliminate redundant/duplicative testing as a means to improve efficiency

Practices

Practice 1 – DoD Will Require Test Automation.

Software testing is one of the most time consuming and expensive portions of GCS development and needs to become more efficient to ensure the continued success of DoD's UAS programs. DoD will require test automation in Sections C and H of the Request for Proposal (RFP) for future UAS GCS acquisitions. This contract language will support unit testing reciprocation between Service and programs and provide requirements for testing automation to facilitate rapid and affordable technology insertion and third-party innovation for both fielded systems and those under development.

Practice 2 – DoD Will Leverage Existing DoD Testing Resources to Improve Efficiency.

DoD will encourage the use the Joint Interoperability Test Command (JITC)[35], an organization that tests technology pertaining to multiple branches of the armed services and Government. JITC's mission is to provide a full-range of rapid, standardized and customized test, evaluation, and certification services to support global net-centric warfighting capabilities.

DoD will also encourage the use of the Software Engineering Center (SEC). The SEC produces and releases new software and software upgrades to improve the operation of current systems and provides quick fixes to existing software. The SEC also helps other organizations acquire custom software products through the SEC's Field Support Engineers (FSEs), who are deployed with military units to provide direct support to the Warfighter during exercises, contingencies, and combat operations.[36]

Practice 3 – Industry Should Embrace Utilization of Automated Testing Tools.

Industry should reduce testing cost and schedules by using automated software test tools and outsource software testing to dedicated test center. The use of automation or outsourcing of testing services where efficiencies can be achieved should to be documented in Industry responses to RFPs to demonstrate that not only all of the required testing will be done, but also address how reuse and TI will be incorporated in the test strategy as a means to reduce costs and increase cycle times. Such considerations from Industry will be favorably received by DoD during source selection.

Practice 4 – Industry Should Create a Test Cost Reduction Plan.

Industry should document a plan for reducing testing costs through automation or outsourcing and communicate this plan to DoD. The plan should demonstrate that Industry recognizes the value of reusing test results from other projects and how this reduction in test costs might be passed on to DoD.

[35] Joint Interoperability Test Command. http://jitc.fhu.disa.mil/index.html

[36] US Army SEC. Available http://www.sec.army.mil/secweb/about_sec/SECroles.php

9. AUTOMATION TOOLS

Automation tools aid in the creation, management, and testing of system/software artifacts. The UAS GCS development community should start using a set of tools to automate the design processes and artifacts associated with UAS and GCS applications. Any reduction in development or test time realized through the use of automation tools is time gained in fielding new capability to the Theater Commander.

Background

Engineers and managers have used development tools for decades to aid in creating, testing, managing and maintaining systems. System automation tools used in the DoD space include tools such as:

- Project Management
- Requirements development and tracking
- Modeling & Simulation (M&S)
- Development
- Bug/Defect Tracking
- Testing
- Configuration Management
- Source Code Security
- Risk Management
- Information Assurance

The tools listed above are available from a number of sources including Commercial of the Shelf (COTS), Government off the Shelf (GOTS), Open Source and Freeware. Examples of Freeware or GOTS applications from DISA were discussed in greater detail in the Design Disclosure and Collaborative Development Environment sections. DoD will work with Industry to identify and adopt a GCS toolkit to foster collaboration and decrease the time required to field new capabilities.

Benefits

The GCS toolkit is envisioned to benefit both DoD and Industry by:

- Creating efficiencies in system development, test, and certification processes
- Reducing time to field new capabilities by leveraging previous efficiencies
- Reducing system maintenance costs
- Creating transparent design disclosure
- Enabling collaboration among community stakeholders

The use of automation tools by the GCS community has benefits and implications for both DoD and Industry. The implications for both groups are summarized in Table 16.

Implications

Table 16 – Automation Tools Implications

Implications for DoD	Implications for Industry
Warfighters will have access to new applications more quickly	Industry will have access to tools to assist in the development and maintenance of UAS applications
DoD will provide oversight and management across the lifecycle of the toolkit	Small business and new entrants should have greater access to the UAS marketplace as they will not be required to develop their own unique toolkits

Practices

DoD's approach to providing software tools will drive greater efficiencies and have affects on both Industry and Government. To achieve the implications noted above, both Government and Industry will adopt the following OBM practices:

Practice 1 - DoD Will Develop and Maintain Tools.

DoD will develop or contract with Industry to develop automation tools determined as necessary by DoD. DoD will maintain the tools to ensure the integrity and utility of the tools. Industry should provide feedback to DoD on tool utility, defects and deficiencies so tools may be modified and updated as necessary. DoD will also qualify the tools if required so that the tools may be used to obtain certification credit.

Practice 2 – DoD Will Require a Documented Tool Automation Approach from Industry.

In response to the Technical Approach section in the SOW, DoD will require a well defined description that includes utilization of automated tools and supporting documentation articulating the process to be followed in support of the Software Development Plan (SDP). Government will require the tool automation approach to ensure tools are used not only cost effectively but also within the known guidelines of Cybersecurity.

Practice 3 – Industry Should Describe Benefits from Using Automated Tools in the SDP.

Automation tools need to be identified to avoid duplication of tool capability, investment or development. Industry should document the techniques and tools that will be used to perform software engineering tasks in the SDP and include the associated cost, performance and schedule benefits which it has identified as a result of such automation.

10. CERTIFICATION

Information Assurance (IA) and Safety system certification requirements are significant drivers of system development costs. This is particularly true of one-off and unique system builds. As such certification costs can be reduced as a result of using a GCS OBM. In previous sections, automation (tools and testing) enabled by standardization was the benefit of an OBM. For certification these factors hold true, however, in this case, increasing the commonality of certification and the subsequent certification artifact reuse and disclosure becomes the key elements to reduce costs and schedules.

Information Assurance Background

Information Assurance certification for each of the Services is governed by DIACAP processes including Top Secret/Sensitive Compartmented Information (SCI) and Below Interoperability (TSABI) and Secret and Below Interoperability (SABI) requirements for operating in mixed classification environments. Common Criteria certification is required for IA and IA-enabling components that are applied to the design solution. Cross Domain Solutions that may be included in the design are governed by the Unified Cross Domain Management Office (UCDMO). Additional requirements may be imposed by each of the Services.

Each of the military Services is responsible for certifying and obtaining Authority to Operate (ATO) for their PoR prior to placing them into an operational status

Flight Safety Background

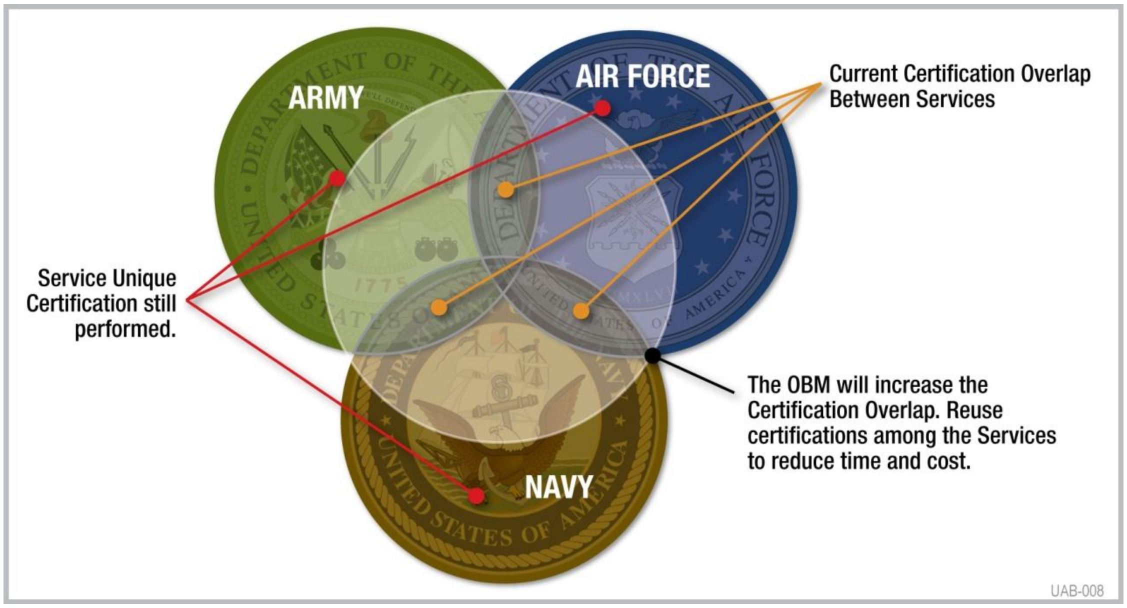
The safety of flight is a system property. Many integrated components must work in concert to ensure that fault conditions are not raised, or if they are, they are mitigated. As GCS are constructed of many services, running on many platforms, a POR will perform various safety analyses to classify the criticality of the components and their interactions.

Any component or any integration of components will be assigned a Design Assurance Level. Certification evidence will be required to demonstrate the acceptable level of assurance that the components and their integration meets the designated Design Assurance Level.

Certification Efficiencies

As the UAS GCS community matures and evolves to an OA where services are reused, there is potential to grow the certification overlap between the Services and thus reduce certification cost and time. Figure 15 is a Venn diagram showing the current state of certification overlap and how that certification overlap grows through the use of the OBM. The increased certification overlap will reduce system cost and accelerate fielding time by reusing certifications for the base services saving certification testing for only those topics that are Service unique.

Figure 15 – Certification Overlap and Service Unique Certification



Benefits

The OBM certification is envisioned to benefit both DoD and Industry by:

- Creating efficiencies in GCS system development, test, and certification processes both for initial development and deployment as well as during technology refresh and insertion
- Reducing time to field new capabilities by leveraging previous efficiencies
- Reducing development, acquisition, operational, and technology refresh and insertion costs
- Focusing certification activities on Service unique requirements

Implications

The reuse of certification artifacts by the GCS community has benefits and implications for both DoD and Industry. The implications to both are summarized the Table 17.

Table 17 – Certification Implications

Implications for DoD	Implications for Industry
DoD will identify redundancies in certification requirements and pursue standardization to improve efficiency	Industry will not have to undergo redundant Certification, only military Service specific certification thus reducing their certification burden
DoD will contract development and verification of applications based on identified criticality levels ranging from the highest (Level A – Catastrophic, to Level E - non-critical , thus reducing the certification burden,	Industry should design and build and verify applications ranging from the most critical to non-critical applications to limit the certification burden

Practices

The notion of increasing the Service certification overlap will have effects on both Industry and DoD. To achieve the implications noted above, DoD and Industry will adopt the following OBM practices:

Practice 1 – DoD Will Require Documentation of Certification Artifacts.

DoD will require Industry to submit an Open Systems Management Plan as part of the RFP Section H (Special Contract Requirements). This requirement is to ensure that certification artifacts are documented and delivered as part of an open system strategy.

Practice 2 – DoD Will Provide a Certification Repository.

DoD will provide a repository structure for Industry and the Services to store and access certification artifacts. Industry should use the repository in accordance with DoD guidelines. DoD will work with Industry to develop an appropriate certification repository structure that meets the needs of the Services and Industry.

Practice 3 – Industry Should Define Interface Certification.

Industry should document the certification requirements (DO-178B, Information Assurance, MILS, and others) and how their design addresses those certification requirements as part of the Interface Design and Management section of the Open Systems Management Plan. The certification documentation is required for reuse on other programs, avoiding the pitfall of recertifying a previously certified service.

Practice 4 – Industry Should Capitalize on Reuse of Certification Artifacts.

Industry should maximize the reuse of certification artifacts and results from other vendors and PoRs restricting certification efforts to Service unique requirements. Certification items that should be reused include, but are not limited to, Information Assurance (IA), MILS, and DO-178B. Any deviation from a reuse strategy needs to be documented and justified as necessary since proper certification reuse will reduce cost and time to field.

SECTION VI – CONCLUSION

DoD currently faces a wide variety of emerging threats and evolving national security requirements. DoD must meet these challenges head-on despite significant downward pressure on available resources for modernization. As a result, DoD must rethink how it acquires, designs, and builds its systems.

DoD's UAS programs and their suppliers currently operate in a silo environment whereby some legacy programs are closed and proprietary. In this environment, firms assign value to IP based on internal innovation. In an OBM, value is created by leveraging many more ideas, stemming from the inclusion of outsiders' IP and inclusion of a variety of external concepts. DoD is transforming to an OBM for its GCS to facilitate the acquisition of new capabilities rapidly and affordably. This approach will simultaneously provide Industry the opportunity to commercialize unused IP (internal or external) that otherwise might not have entered the GCS market.

Adoption of this model will leverage the collaborative innovation of numerous participants across DoD and Industry permitting shared risk, maximized asset reuse, and reduced total ownership costs. The business model described in this framework achieves these goals through the utilization of ten components; each supported and implemented through a series of practices that have implications for both DoD and Industry. Working together, DoD and Industry, must adopt these practices as a means to deliver innovative GCS solutions to our armed forces. Both the Warfighter and the taxpayer are counting on our commitment to achieve greater capabilities while reducing lifecycle costs - as partners, DoD and Industry have a mutual obligation to fulfill this promise.

APPENDIX A: RECOMMENDED RFP LANGUAGE FOR GCS SOA SERVICE

Adopting a standardized approach to contracting language across the GCS portfolio will improve communication of requirements to Industry partners and enhance enterprise-wide opportunities for competition and component reuse. The recommended Request for Proposal (RFP) language provided is designed to permit a UAS program to acquire a Service Oriented Architecture (SOA) based Service (SOA Service) for a GCS based on the UAS Control Segment Architecture Conformance Specification (UCS ACS).

Appendix A contains recommended guidance and is offered with the understanding that individual PEOs and Program Managers can be flexible in selecting and weighting those items needed to meet their needs, and, where necessary modify and/or expand the language provided to Program offices.

Recommended Section C RFP Language

Background on Section C language

Section C of a Request for Proposal (RFP) and the resulting contract contains the detailed description of the products to be delivered or the work to be performed for the government. Section C typically includes a Statement of Objectives (SOO) for the RFP or a Statement of Work (SOW). The SOO is a clear and concise statement that delineates the program objectives and the overall program approach, including the outcome desired. The SOO, along with the Open Business Model (OBM), Development Environment (M2/M3), certification requirements, and system/component conformance specifications, provides Offerors guidance for proposing a solution to meet the user's needs.[37] Program Managers are encouraged to use the Open Architecture Assessment Model (OAAM)[38], the Open Architecture Assessment Tool (OAAT)[39] or another assessment methodology to evaluate the current state of openness in their program and help determine the best way forward for SOO or SOW development.

An SOO is different than a Statement of Work (SOW) or Performance Work Statement (PWS). A SOW is not typically "performance-focused" as it defines "what" work should be performed and details specific instructions for "how" it should be completed. The SOW establishes and defines all non-specification requirements for Offeror's efforts either directly or with the use of specific cited documents.

Alternatively, a Performance Work Statement (PWS) and Statement of Objectives (SOO) are "performance-focused" and define only "what" work should be performed; leaving the specifics as to "how" the work should be performed up to the vendor to permit innovation in delivery performance and opportunities for cost savings. A PWS describes the required results in very

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[37] Available at www.ucsarchitecture.org

[38] Open Architecture Assessment Model can be accessed at https://acc.dau.mil/adl/en-US/31395/file/5658/OAAM.pdf.

[39] Open Architecture Assessment Tool can be accessed at https://acc.dau.mil/CommunityBrowser.aspx?id=121180.

specific and objective terms with measurable outcomes. A SOO defines higher-level performance objectives only. The SOO approach is used in solicitations when the Government intends to provide the maximum flexibility to each Offeror to propose an innovative approach. In short, the PWS provides a more detailed description of "what" work should be provided, while the SOO provides a more general description permitting increased flexibility in the Offeror's response. For more information on the differences between an SOW, PWS, and SOO see: https://acc.dau.mil/CommunityBrowser.aspx?id=353255.

The following sections contain recommended language for the SOO to be included in Section C of the RFP/contract for the acquisition of a SOA Service for a UAS GCS. Language is provided by OSD with the understanding that individual PEOs and Program Managers will incorporate the language into RFPs and tailor as necessary to meet Programs needs. Ultimately, there must be consistent language provided to industry to drive towards the reuse across the UAS portfolio. If the Program Office is not planning on using a SOO, then the Program Manager must translate the enclosed SOO objectives in Section C into concrete SOW or PWS tasks the offeror can respond to.

Section C Language Statement of Objectives

[*Note to Preparers:* *This recommended language provides the basis for the Statement of Objectives to procure an open architected GCS. This language is focused on supporting DoD's goal to reduce duplication across the UAS portfolio* ***.]***

Open Systems Objectives for the Acquisition of a SOA Service based on GCS Architecture

The Government intends to procure a SOA Service to be integrated in legacy GCS programs or developed for new starts based on an open systems approach to systems design and development. The following overall objectives for this Program include:

Objective 1: Procure an Open System Architected GCS

Objective 2: Adopt Open Business Practices

Objective 3: Design for Life Cycle Affordability Across all Future UAS Platforms

Open Systems Approach for Acquisition of a SOA Service in Support of an Open System Architected GCS

In satisfying the Government's goal of procuring an open system architected GCS, the following objectives have been developed for the acquisition of a SOA service to support the above noted GCS:

Objective 1: Procure an Open System Architected GCS

1. *The Offeror shall develop an SOA Service which can function within the [insert Program Name] GCS while ensuring modularity, interoperability, extensibility,*

reusability, composeability, reliability, and maintainability.[40] *Additional nonfunctional requirements include scalability, replaceability, portability, supportability and affordability. To accomplish this, the Offeror shall:*

a. Ensure that the SOA Service meets or exceeds external information exchange requirements. Actions to support these requirements shall include planning that identifies the Offeror's specific approach to ensuring SOA Service interface data is defined per the requirements defined in the UAS Control Segment Architecture Conformance Specification 2.2. The Offeror shall ensure the SOA Service is interoperable with many-to-many exchanges of data, and can verify the trust and integrity of users and applications. All data shall be transmitted through interfaces as defined in the UCS ACS.

2. *The Offeror shall facilitate integration with other SOA Services and systems from multiple sources both in the initial design and in any potential future enhancements. To accomplish this, the Offeror shall:*

a. Ensure that the design of the SOA Service results in software components that have minimal dependencies on other components (loose coupling), as evidenced by using standard interfaces defined in UCS ACS and by the absence of implicit data sharing. The purpose of this requirement is to ensure that any non-interface related changes to one component will not necessitate extensive changes to other components across the GCS, and hence facilitate easy component replacement, upgrade, and system enhancement thus maximizing acquisition flexibility. The approach used to determine the level of coupling within a given SOA Service shall be described in detail.
b. The Offeror's SOA Service design shall result in components that are characterized by the singular assignment of identifiable and discrete functionality (high cohesion). The purpose is to ensure that any changes to system behavioral requirements can be accomplished by changing a minimum number of software components within the system. The approach used to determine the level of cohesion and the design trade-off approach shall be described.
c. The Offeror's SOA Service design approach shall maximize software independence from platform-specific considerations, such as hardware and transport layer, thereby facilitating technology refresh. The design shall be optimized at the lowest component level to minimize inter-component dependencies. The layered design shall also isolate the application software layers from the infrastructure software (such as the operating system) to enhance portability and to facilitate frequent technology refresh. The design shall be able to survive a change to the computing infrastructure with minimal or no changes required to the application logic. The SOA Service design shall minimize inter-component dependencies to allow components to be decoupled

[40] For definitions of *modularity, interoperability, extensibility, reusability, composeability and maintainability, scalability, replaceability, portability, supportability and affordability* see: Open Architecture Technical Principles and Guidelines, 1.5.6 available at: https://acc.dau.mil/adl/en-US/187045/file/34492/OA%20Architectural%20Principles%20and%20Guidelines%20v.1.5.6.pdf.

and reused, where appropriate, across various DoD or Service programs and platforms.

d. The Offeror will be required to ensure that all SOA Service requirements are accounted for through a demonstrated ability to trace each requirement to one or more software components which make up the SOA Service being provide

3. *The Offeror shall enable technology reduced integration time for new SOA Service capabilities as they become available in the future. To accomplish this the Offeror shall:*
   a. Maximize use of automated testing and certification tools.
   b. Minimize the number of different automated testing and certification tools used (e.g. consolidate as many testing and certification tools as possible).

4. *The Offeror shall allow for the insertion of software, middleware, or hardware, with minimal impact to physical elements, components, and functions. To accomplish this the Offeror shall:*
   a. Clearly define and describe how all SOA Service interfaces meet the specifications defined in the UCS ACS.
   b. Identify the interface and data exchange standards between the software component and the interconnectivity or underlying information exchange medium.

5. *The Offeror shall mitigate the impacts of proprietary software in the SOA Service.*
   a. The Offeror may use proprietary, vendor-unique or closed components as long as they are wrapped in standard interfaces as defined in UCS ACS.

Objective 2: Adopt Open Business Practices

1. *Ensure acquisition flexibility for control segment subsystems & components;*
   a. The Offeror shall address how it will provide to the Government information needed to support third-party development and delivery of competitive alternatives for the SOA Service components being provided through use of the OSD UAS Application Store. The Offeror shall provide a list of those proprietary, vendor-unique elements that it requests be exempt from this requirement.

2. *Ensure access to technologies and products supported by many suppliers (a broad industrial base which does not restrict available sources to the detriment of competition) to drive innovation at all levels of industry.*
   a. In designing the SOA Service the Offeror shall use the following standards in descending order of importance:

      - Standards as specified within the contract
      - Standards as specified within the UCS ACS CAPIS document.

   Note: Standards that are not specified within this contract or that are modified must be submitted to and approved by the Government Program Manager prior to use.

3. *Maximize use of collaborative development.*
    a. The Offeror shall use the (insert applicable military branch name (Army, Air Force, Navy) Collaborative Development Environment (CDE) in conjunction with the I-IPT to generate models and interfaces for the GCS. Model and interface data that is stored in the repository must be made available for any authorized user to download. The repository will also store Reference Architectures (RAs) and applications, in either source code or executable format, for stakeholders to use or build upon. The CDE will provide protection for program data in accordance with the Program Protection Plan (PPP). The Offeror will optimize the use of the CDE with its subcontractors and suppliers, as well as participating Government organizations.

        The Offeror shall develop, update and maintain a Data Accession List (DAL) that identifies all data and documentation generated under the execution of the SOA Service effort. A list of the data to be provided on the CDE will be attached to the CDE implementation plan CDRL. This listing will be inclusive to the lowest known tier of suppliers, vendors, and subcontractors and their products necessary to support design, production and the life cycle support of the SOA Service. Included will be composite view of listed data and its condition, both technical (e.g. configuration item description and WBS allocation) and legal (data rights status and applicable DFAR basis for assertion).

        The CDE will be able to exchange classified data up to and including the Secret/NOFORN level. It is not required to have an integrated classified and unclassified CDE. Classified data will need to be partitioned between the Secret and the Secret/NOFORN level. CDE process controls, in addition to use of business tools (such as Associate Contractor nondisclosure agreements), will apply and will use system-level and data-level Metadata tags for identification and protection of digital form data (such as for classified, Export Control, Proprietary, or Distribution Statements). The Government will require continued use of the CDE for the duration of the program. The Offeror will provide the Government with strategies to ensure continued use of the CDE.

Objective 3: Design for life cycle affordability across all future UAS platforms.

1. *The Offeror shall design for cost-effective control of UAS platforms by maximizing reuse across the UAS Portfolio. .*
    a. In support of this requirement, the Offeror shall maximize reuse of software and technical data found in the (insert applicable military branch name (Army, Air Force, Navy) Collaborative Development Environment (CDE) and/or OSD UAS Application Store or unless a determination based on cost, schedule, or performance is made not to reuse. Such a determination shall be provided as part of the RFP response for this requirement.

2. *The Offeror shall allow for affordable support and upgrades by maximizing reuse across Service and Joint UAS programs.*

a. In support of this requirement, the Offeror shall reuse pre-existing or common items such as those found in the (insert applicable military branch name Army, Air Force, Navy) Collaborative Development Environment (CDE) and/or OSD UAS Application Store unless a determination based on cost, schedule, or performance is made to not reuse. Such a determination shall be provided as part of the RFP response for this requirement. Exceptions to reuse of pre-existing items must be accompanied by justification, such as cost (both of adoption and life cycle support), schedule, functional and non-functional performance, etc. The general objective of these efforts shall be the development of a common SOA Service components which meet the performance requirements of the various DoD or Service GCS requirements, where commonality offers the greatest technical and cost benefits.
b. Offerors shall consider use of third-party products that may be innovative or new to the program and provide compelling performance improvements or best value. In particular, the Government's goal is to encourage Offerors to reuse software and components, especially in cases where the Government has GPR or greater rights. As part of system acceptance, the Offeror shall demonstrate the steps necessary to give third parties, as directed by the Government, the ability to integrate their components into the Offeror's solution. This effort shall be comprehensive and require the Offeror to perform the following activities:
c. Inventory: A detailed inventory of all code files in the SOA Service baseline shall be conducted. This inventory shall extend to all third-party software not delivered within the terms of the contract but used in the SOA Service to form the working product. Third-party product descriptions and version information shall be required for all operating SOA Services.
d. Inspection: File headers and any other company markings found in the source code shall be inspected to ensure clear indication that the Government has GPR to use the software delivered in the contract.
e. Conduct Demonstration: The Offeror shall conduct a formal demonstration of the SOA Service and approved procedures to show the software can be successfully ported to other third-party compatible open architecture processing systems.

3. *The Offeror shall support nonfunctional requirements including scalability, replaceability, portability, supportability and affordability.* The Offeror shall establish a process to logistically support the SOA Service over the life cycle to be addressed in the relevant logistics CDRL if there is a need by the government. The Offeror shall describe the availability of commercial repair services, facilities, and manpower required for life cycle support and demonstrates they are adequate to ensure long term support for the SOA service being provided. The Offeror shall provide the proposed methodology for pass through of any warranties to the Government.

Recommended Section L RFP Language

Section L of the RFP provides proposal instructions, conditions and notices to Offerors. Offerors should be encouraged to clearly demonstrate, through their use of similar technologies previously developed, the ability to meet the design, development, testing, and production requirements of the solicitation, in particular its approach to a modular open system design, in the quantities and schedules specified in the RFP. Section L should be carefully structured to address only those elements determined to be keys to success. This section contains recommended guidance, and is offered with the understanding that individual PEOs and Program Managers will incorporate the language into RFPs and tailor as necessary to meet Programs needs.

*[**Notes to Preparers**: Four factors have been developed to support Section L of the RFP for an open architected SOA services in conformance with the GCS Architecture – Technical, Management, Cost, and Past Performance. The end goal of OSD is to ensure SOA Services developed for the GCS will be used across the UAS portfolio. As such, it is recommended that each Program Manager pay close attention to the language on data rights developed by Navy, Army, and Air Force intellectual property lawyers.]*

Factor 1: Technical Approach for Developing SOA Services

The Offeror shall describe its proposed technical approach and processes to developing the SOA Service to be employed in performing this contract. At a minimum, the Offeror shall describe its technical approach and processes in the following areas:

Subfactor 1: SOA Technical Approach. The Offeror shall describe its technical approach for developing an open SOA service using a modular software design; standards-based interfaces; and widely-supported, consensus-based standards. At a minimum, the Offeror shall describe the following as part of its technical approach:

a. **SOA Service Capability Requirements** – A detailed description of the Offeror's approach for addressing how the SOA Service offered incorporates appropriate considerations for Program Sponsor SOA Service requirements.
b. **Traceability of SOA Service Requirements –** A detailed description of the Offeror's approach for ensuring that all SOA Service requirements are accounted for through a demonstrated ability to trace each requirement to one or more software components as defined in the UCS ACS.
c. **Modular Open Systems Design Approach (MOSA)** – A detailed description of the Offeror's modular open systems approach for development of the SOA Service.
d. **Minimization of Inter-Component Dependencies** – A detailed description of the Offeror's approach for designing a SOA Service that, to the maximum extent practicable, minimizes inter-component dependencies and allows components to be decoupled and reused, where appropriate, across various DoD or Service programs or replaced by competitive alternatives.
e. **Asset Reuse –** A detailed description of the steps the Offeror has taken to reduce acquisition of duplicative software components where possible.

f. **Technology Insertion and Refresh –** A detailed description of how the Offeror's proposed SOA Service will allow for rapid and affordable technology insertion and refresh.

g. **Design Disclosure –** Within the constraints of contractual data rights, a detailed description of the Offeror's approach to facilitate the sharing of the design information in support of peer reviews and the incremental development processes

Subfactor 2: Conformance with UCS ACS and OBM

[Notes to Preparers: The language used in this section shall be specified by the Program Office to ensure the technical design complies with the GCS Architecture and Open Business Model components.]. The Offeror shall describe how its design conforms to the UAS Control Segment Architecture Conformance Specification (UAS ACS) and I-IPT's UAS Open Business Model (OBM) .

Subfactor 3: Treatment of Proprietary or Vendor-Unique Elements. The Offeror shall justify any use of proprietary, vendor-unique, or closed software components. Justification shall include a description of the decision leading to the selection of specific COTS products. The Offeror shall define its process for identifying and justifying proprietary, vendor-unique or closed code modules or software to be used.

<u>Factor 2: Management Approach</u>

The Offeror shall describe its management approach for developing the SOA service including the management structure, processes and procedures proposed for planning, monitoring, controlling, and delivering the required contract deliverables, artifacts, and data items required for delivery under the Contract Data Requirements List (CDRL.) according to contractually defined budget, schedule and performance requirements.

<u>Factor 3: Cost Proposal</u>

[***Notes to Preparers*** *– Each Program Manager should insert specific cost evaluation language which supports the acquisition strategy for the GCS and SOA Service being acquired. The cost evaluation will vary based on the size and complexity of the Program or SOA Service being developed. t is important the Program Manager work with its appropriate Legal Counsel to address Subfactor 3 and determine the level and amount of data needed to support the cost evaluation. The U.S. Government is entitled to certain automatic or default rights because of statute or regulation, e.g., 10. U.S.C. 2320. In these cases the Government "exercises" these rights. In cases where the Government requires data rights beyond these entitlements, then the Government can attempt to "acquire" the additional rights through negotiations and possible additional cost. The reference language provided below is intended to be used for the acquisition of these additional data rights*.]

Subfactor 1. Cost of SOA Service

Subfactor 2: Software Reuse

The Offeror shall indicate what if any software they reused to develop the SOA Service and to the extent possible quantify the cost savings associated with reusing existing software in the SOA Service being proposed.

Subfactor 3. <u>Cost of Priced options of Noncommercial Technical Data (TD), Noncommercial Computer Software (CS), and Noncommercial Computer Software Documentation (CSD)</u>

(a) Cost/Price Information. In addition to the submission requirement of DFARS 252.227-7017, the Offeror shall provide a list entitled "Supplemental Information Concerning Cost/Price of Noncommercial Technical Data (TD), Noncommercial Computer Software (CS), and Noncommercial Computer Software Documentation (CSD)" (hereinafter the Supplemental 7017 Cost/Price List). This list shall be provided as an attachment to proposal. **Note to Preparers:** *It is recommended that this list be made part of the proposal and be resubmitted to the Government when changes are made.*] This list shall provide supplemental information concerning the noncommercial TD, CS, or CSD identified in the DFARS 252.227-7017 "Identification and Assertion of Use, Release, or Disclosure Restriction" list (hereinafter 7017 List), as follows:

(1) <u>License Option Price Information</u>. For each item of noncommercial TD, CS, and/or CSD that the Offeror asserts should be delivered with less than Government Purpose Rights (GPR) (as defined in (DFARS 252.227-7013 "Rights in Technical Data – Noncommercial Items" (March 2011) and/or DFARS 252.227-7014 "Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation", and for which the Offeror is willing to sell to the Government greater rights than those identified in the 7017 List, the Offeror shall identify those greater rights, provide an option price at which the Government may purchase such greater rights, and identify the period of time during which the option is available for the Government to exercise. **[Note to Preparers:** *Evaluation of options should be addressed in Sections B and M of the RFP.***]**

(2) <u>Government Preferences</u>. The Offeror may state any license option price as a firm fixed price, a percentage royalty rate (or use fee), or any other comparable compensation scheme, provided that the Government can reasonably calculate a sum-certain price for the license option using the price information and terms and conditions information the Offeror provided. The Government prefers that any license option prices the Offeror provides in the Supplemental 7017 Cost/Price List cover all noncommercial CS, noncommercial CSD, and noncommercial TD included in any affected software and that the Offeror states license option prices on a price-per-system basis.

[Note to Preparers: *Ensure that FAR 52.227-6 is included in Section I.***]**

(b) Duty to Submit Negative List. If there is no supplemental information to be submitted in the Supplemental 7017 Cost/Price List, the Offeror shall submit the list and enter "None" as the body of the list. Failure to provide a list may render the Offeror ineligible for award.

(c) Use During Source Selection. Information provided in the Supplemental 7017 Cost/Price List, as well as the information provided in the 7017 List, may be used in the source selection process as part of the Government's best value analysis to evaluate the impact on the Government's ability to use, reuse, or disclose the TD, CS, and/or CSD for government purposes.

Supplemental Information Concerning Cost/Price of Commercial Computer Software (CS), and Commercial Computer Software Documentation (CSD) and Commercial Technical Data (TD)

(a) Cost/Price Information. The Offeror shall provide a list to the Government, entitled "Commercial Restrictions List – Cost/Price Information" (hereinafter the CRLCPI List). This list shall be provided as an attachment to proposal. The CRLCPI List shall state a license option price for all commercial CS, commercial CSD, and commercial TD on the CRL List for which the Offeror is willing to provide the Government with greater license rights than the level of rights to which the Government would otherwise be entitled. If the Offeror is willing to provide a license option, the Offeror shall identify the specific rights it is willing to grant, and the period of time during which the option is available for the Government to exercise.

[*Note to Preparers:* *It is incumbent upon the Program Manager and Contracting Officer to fully understand the terms of the license including the specific rights and limitations (if any) proposed by the Offeror. Open Source Software licenses may or may not have associated costs, but will have specific terms with which the Government must comply. Another option is to negotiate a modified Open Source Software License that best reflects the OSA concepts necessary to implement the contract requirements. Recommend License agreements should be included in Section J of the Contract. Recommend consulting with the appropriate Legal Counsel. See Appendix 5 for additional details.***]**

(b) License Option Pricing: Government Preferences. The Offeror may state any license option price as a firm fixed price, a percentage royalty rate (or use rate), or any other comparable compensation scheme, provided that the Government can reasonably calculate a sum-certain price for the license option using the price information the Offeror provided. The Government prefers that any license option prices the Offeror provides in the CRLCPI List cover all commercial CS, commercial CSD, and commercial TD included in any affected software and that the Offeror states any license option prices on a price-per-system basis. ***[Note to Preparers:*** *Evaluation of options should be addressed in Sections B and M of the RFP.***]**

(c) Duty to Submit Negative List. If the Offeror has no Option License Pricing to provide in the CRLCPI List, the Offeror shall still submit the CRLCPI List and enter "None" in the body of the List. Failure to provide a list may render the Offeror ineligible for award.

Factor 4: Past Performance Building SOA Services

The Offeror shall demonstrate, through its use of previously developed technologies, the Offeror's ability to meet the design, development, testing, and production requirements of this solicitation. The Offeror shall provide a list of [insert number (e.g. 3] past performances of similar size and scope to the efforts described herein within the last five (5) years. In addition to past performance, any relevant contracts and subcontracts of an acquired company, division, or subsidiary shall be identified. The Offeror shall place particular emphasis on DoD or Government contracts and subcontracts, especially those that involved a modular open systems approach and/or the provision of SOA Services similar to those being offered in response to this solicitation.

If the Offeror did not perform ***[Note to Preparers: describe the type of project here*]** during the last five years, the Offeror may discuss other related projects that demonstrate the Offeror's capabilities to perform work of similar nature and magnitude. Note, if the Offeror omits projects or contracts of which the Government evaluation team is aware or becomes aware, then customer assessments may be sought from the relevant program and technical support offices. Offerors are advised that (1) the Government may contact any or all references listed in the proposal and other third parties, unreferenced customers, agencies, Offerors, consumer protection organizations, etc., for performance information, or use any other data available (such as Offeror Performance Assessment Reporting System (CPARS)); (2) the Government reserves the right to use any such information received as part of its evaluation of the Offeror's past performance; and (3) if the Offeror omits projects of which the Government evaluation team is aware or becomes aware, customer assessments may be sought from the relevant organizations.

For each listed contract, the Offeror shall prepare a synopsis that includes a narrative self-assessment of the contract and specific details describing why the contract was, or was not, successful. Each synopsis shall be in the following format:

Corporate Experience and Past Performance Information Form					
Name of Offeror:					
Contract Number, Order Number, or Identifier and Type					
Customer Name and Location:					
Customer Point of Contact (Name and Title):					
Telephone Number (PLEASE VERIFY) and e-mail address:					
Total dollar amount for this effort during the past 5 years (show calendar year and dollars): **(For ordering vehicles, show both the annual estimated contract amount and the amount of orders actually performed):**					
Number of personnel (FTE) performing per year (avg.):		**Period of Performance:**			

Corporate Experience and Past Performance Information Form	
Detailed description of the work performed sufficient to demonstrate the relevance of the reference to the solicitation:	
Quality, delivery, or cost problem(s); corrective action(s) taken; and effectiveness of the corrective action(s):	
Subcontractor(s) utilized in performance of this contract, description of the extent of work performed by subcontractor(s), along with annual dollar value of all subcontracts:	

Customer References. The Offeror shall request Customer questionnaires to be submitted directly to the Procurement Contracting Officer's (PCO's) representative and/or copies submitted with the Offeror's proposal and provide the following information for each described contract:

- The Procuring Contracting Officer's name, address, and telephone number.
- The Administrative Contracting Officer's name, address, and telephone number.
- The Government and Offeror's Program Managers' names, addresses, and telephone numbers.
- The names, addresses, and telephone numbers of other individuals having knowledge of the Offeror's performance under each contract.

At a minimum, the Government's questionnaire for assessing an Offeror's SOA Service past performance must address the following:

- The degree to which the Offeror demonstrated its design approach, plans for technology insertion, and sustainment strategy were consistent with the modular open systems requirements.
- The degree to which the Offeror managed the impact of changing requirements and evolving technology on the system's ability to continue to satisfy improved capabilities over time.
- The degree to which the Offeror's test and evaluation planning contained the means for testing the conformance to open standards to ensure the openness of key interfaces throughout the system life cycle.
- The degree to which the Offeror's approach contains capabilities to easily and quickly update, revise, and change the SOA Service as threats (warfighting and information assurance threats) or technologies (COTS or reusable) evolve.

Recommended Section M Language

The following is an extensive list of factors and subfactors that can be tailored and incorporated into Section M. Programs can delete the items they feel are redundant or not important for their specific acquisition requirements. Preparers need to include the factors and subfactors that will be determinant in the selection process and delete the factors and subfactors that are of minor or no importance. In particular, Programs should be aware of asking for the same information in multiple places – the decision to do so should be deliberate and the evaluation of Offeror's response done carefully evaluated in a consistent manner. This section contains recommended guidance, and is offered with the understanding that individual PEOs and Program Managers will incorporate the language into RFPs and tailor as necessary to meet Programs needs and OSD's goals.

EVALUATION FACTORS

[Note to preparers, each Program Office may select, modify or delete rating factors to meet the requirements of their acquisition. Factor weighting, is used, should reflect order of importance (e.g. technical is more important than price).]

The Government will evaluate the Offeror's proposal in accordance with the factors and sub factors set forth below:

Factor 1: SOA Service Technical Approach and Processes [insert weighting if used]

The Government will evaluate the Offeror's ability to demonstrate a thorough understanding of the complete range of tasks in the RFP and implementation of OSA Technical Approaches. The Government will evaluate the Offeror's:

1. Approach for supporting the objectives set forth in the Section C Statement of Objectives
2. Ability to overcome the technical challenges which must be addressed to fulfill the [*Program Name*] requirements
3. Solutions for clarity, completeness, and feasibility
4. Approach to seamlessly provide the services and capabilities described in accordance with [insert Agency/organizational standards, policies and processes as applicable]

The Government will use information provided in the proposal to assess the Offeror's:

Subfactor 1. SOA Technical Approach

Subfactor 2: Conformance with the UAS Control Segment Architecture Specification and adoption of the Open Business Model (OBM)

Subfactor 3. Treatment of Proprietary or Vendor-Unique Elements

<u>Factor 2: Management Approach [insert weighting, if used]</u>

In evaluating the Management Approach, the Government will use information in the proposal to assess the degree to which the Offeror's approach addresses planning, monitoring, controlling, and delivering the required contract deliverables, artifacts, and data items required for delivery under the contract Data Requirements List (CDRL.) according to contractually defined budget, schedule and performance requirements.

<u>Factor 3: Cost Proposal [insert weighting, if used]</u>

Subfactor 1. Cost of SOA Service.

Subfactor 2: Software Reuse

Subfactor 3. <u>Cost of Priced Options for Noncommercial Technical Data (TD), Noncommercial Computer Software (CS), and Noncommercial Computer Software Documentation (CSD).</u>

<u>Factor 4: Past Performance Building SOA Services [insert weighting, if used]</u>

Offeror's Development of a SOA Service in Support of an Open Systems Architecture Past Performance

In assessing the Offeror's past performance submissions on similar contracts, the Government will consider how well the Offeror previously implemented a SOA Service in an Open Systems Architecture.

APPENDIX B: RECOMMENDED RFP LANGUAGE FOR GCS SYSTEM

Adopting a standardized approach to contracting language across the GCS portfolio will improve communication of requirements to Industry partners and enhance enterprise-wide opportunities for competition and component reuse. The recommended Request for Proposal (RFP) language provided in this document is designed to permit a UAS program to acquire a GCS based on the UAS Control Segment Architecture Conformance Specification 2.2 (UCS ACS).

This document contains only recommended guidance and is offered with the understanding that individual PEOs and Program Managers can be flexible in selecting and weighting those items needed to meet their needs, and, where necessary modify and/or expand the language provided to Program offices.

Recommended Section C RFP Language

Background on Section C language

Section C of a Request for Proposal (RFP) and the resulting contract contains the detailed description of the products to be delivered or the work to be performed for the government. Section C typically includes a Statement of Objectives (SOO) for the RFP or a Statement of Work (SOW). The SOO is a clear and concise statement that delineates the program objectives and the overall program approach, including the outcome desired. The SOO, along with the Open Business Model (OBM), Development Environment (M2/M3), certification requirements, and system/component conformance specifications, provides Offerors guidance for proposing a solution to meet the user's needs.[41] Program Managers are encouraged to use the Open Architecture Assessment Model (OAAM)[42], the Open Architecture Assessment Tool (OAAT)[43] or another assessment methodology to evaluate the current state of openness in their program and help determine the best way forward for SOO or SOW development.

An SOO is different than a Statement of Work (SOW) or Performance Work Statement (PWS). A SOW is not typically "performance-focused" as it defines "what" work should be performed and details specific instructions for "how" it should be completed. The SOW establishes and defines all non-specification requirements for Offeror's efforts either directly or with the use of specific cited documents.

[41] Available at www.ucsarchitecture.org

[42] Open Architecture Assessment Model can be accessed at https://acc.dau.mil/adl/en-US/31395/file/5658/OAAM.pdf.

[43] Open Architecture Assessment Tool can be accessed at https://acc.dau.mil/CommunityBrowser.aspx?id=121180.

Alternatively, a Performance Work Statement (PWS) and Statement of Objectives (SOO) are "performance-focused" and define only "what" work should be performed; leaving the specifics as to "how" the work should be performed up to the vendor to permit innovation in delivery performance and opportunities for cost savings. A PWS describes the required results in very specific and objective terms with measurable outcomes. A SOO defines higher-level performance objectives only. The SOO approach is used in solicitations when the Government intends to provide the maximum flexibility to each offeror to propose an innovative approach. In short, the PWS provides a more detailed description of "what" work should be provided, while the SOO provides a more general description permitting increased flexibility in the Offeror's response. For more information on the differences between an SOW, PWS, and SOO see: https://acc.dau.mil/CommunityBrowser.aspx?id=353255.

The following sections contain recommended language for the SOO to be included in Section C of the RFP/contract for the acquisition of a UAS GCS. This section contains only recommended guidance, and is offered with the understanding that individual PEOs and Program Managers can be flexible in selecting and weighting those items needed to meet their needs. If the Program Office is not planning on using a SOO, then the Program Manager must translate the enclosed SOO objectives in Section C into concrete SOW or PWS tasks the offeror can respond to.

Recommended Section C Language Statement of Objectives

Open Systems Objectives for the Acquisition of an Open Architected GCS

The Government intends to procure a GCS based on an open systems approach to systems design and development. The following overall objectives for this Program include:

Objective 1: Procure an Open System Architected GCS

Objective 2: Adopt Open Business Practices

Objective 3: Design for Life Cycle Affordability Across all Future UAS Platforms

Approach for Acquisition of an Open System Architected GCS

In satisfying the Government's objective of procuring an open system architected GCS, the following approaches shall be utilized the GCS acquisition:

Objective 1: Procure an Open System Architected GCS

1. *The Offeror shall develop a GCS for the [insert Program Name] while ensuring modularity, interoperability, extensibility, reusability, composeability and*

maintainability.[44] *Additional nonfunctional requirements include scalability, replaceability, portability, supportability and affordability. To accomplish this, the Offeror shall:*

a. Ensure that the GCS meets or exceeds external information exchange requirements. Actions to support these requirements shall include planning that identifies the Offeror's specific approach to ensuring GCS interface data is defined per the requirements defined in the UAS Control Segment Architecture Conformance Specification 2.2 (UCS ACS). The Offeror shall develop system upgrades, IT system capabilities, and business rules that ensure that: 1) Metadata will be posted to the OSD UAS Application Store for users to access and download except when limited by security, policy, or regulations; 2) Data within the GCS shall provide for interoperability with many-to-many exchanges of data, and verified trust and integrity of users and applications; and 3) All data shall be transmitted through interfaces as defined in the UCS ACS 2.2.
b. The offeror shall ensure that its projects, at the architectural and operational level, continue to promote the use of an open architecture as well as adoption of other standards and requirements, tailored to meet its specific Service and Joint requirements.

2. *The Offeror shall facilitate integration with other systems and use of products from multiple sources both in the initial design and in future enhancements. To accomplish this, the Offeror shall:*

a. Ensure that the design of the GCS results in components that have minimal dependencies on other components (loose coupling), as evidenced by using standard interfaces defined in UCS ACS 2.2 and by the absence of implicit data sharing. The purpose of this requirement is to ensure that any non-interface related changes to one component will not necessitate extensive changes to other components across the GCS, and hence facilitate easy component replacement, upgrade, and system enhancement thus maximizing acquisition flexibility. The approach used to determine the level of coupling within a given GCS component shall be described in detail.
b. The Offeror's GCS design shall result in components that are characterized by the singular assignment of identifiable and discrete functionality (high cohesion). The purpose is to ensure that any changes to system behavioral requirements can be accomplished by changing a minimum number of components within the system. The approach used to determine the level of cohesion and the design trade-off approach shall be described.
c. The Offeror's GCS design approach shall result in a layered system design, maximizing software independence from platform-specific considerations, such as hardware and transport layers, thereby facilitating technology refresh. The GCS design shall be optimized at the lowest component level to minimize inter-component dependencies. The layered design shall also isolate the application

[44] For definitions of *modularity, interoperability, extensibility, reusability, composeability and maintainability, scalability, replaceability, portability, supportability and affordability* see: Open Architecture Technical Principles and Guidelines, 1.5.6 available at: https://acc.dau.mil/adl/en-US/187045/file/34492/OA%20Architectural%20Principles%20and%20Guidelines%20v.1.5.6.pdf

software layers from the infrastructure software (such as the operating system) to enhance portability and to facilitate technology refresh. The design shall be able to survive a change to the computing infrastructure with minimal or no changes required to the application logic. The interfaces between the layers shall be built to open standards as defined in UCS ACS 2.2. The system architecture shall minimize inter-component dependencies to allow components to be decoupled and reused, where appropriate, across various DoD or Service UAS programs and platforms.

d. The Offeror will be required to ensure that all GCS requirements are accounted for through a demonstrated ability to trace each system requirement to one or more hardware/software components which make up the GCS being provided.

3. *The Offeror shall enable technology reduced integration time for new GCS and SOA Services capabilities as they become available in the future. To accomplish this the Offeror shall:*
   a. Maximize use of automated testing and certification tools.
   b. Minimize the number of different automated testing and certification tools used (e.g. consolidate as many testing and certification tools as possible).

4. *The Offeror shall allow for the insertion of software, middleware, or hardware, with minimal impact to physical elements, components, and functions. To accomplish this the Offeror shall:*
   a. Clearly define and describe how all GCS interfaces meet the specifications defined in the UCS ACS 2.2.
   b. Identify the interface and data exchange standards between all components and the interconnectivity or underlying information exchange medium;

5. *The Offeror shall mitigate the impacts of software, firmware, or hardware, in the proposed system that are proprietary and/or closed implementations.*
   a. The Offeror may use proprietary, vendor-unique or closed components as long as they are wrapped in standard interfaces as defined in UCS ACS 2.2.

Objective 2: Adopts Open Business Practices

1. *Ensure acquisition flexibility for control segment subsystems & components;*
   a. The Offeror shall address how it will provide to the Government information needed to support third-party development and delivery of competitive alternatives for GCS subsystems & components. The Offeror shall provide a list of those proprietary, vendor-unique elements that it requests be exempt from this requirement.

2. *Ensure access to technologies and products supported by many suppliers (a broad industrial base which does not restrict available sources to the detriment of competition) to drive innovation at all levels of industry.*
   a. In designing the GCS the Offeror shall use the following standards in descending order of importance:

      - Standards as specified within the contract

- Standards as specified within the UCS ACS 2.2 CAPIS document.

Note: Standards that are not specified within this contract or that are modified must be submitted to and approved by the Government Program Manager prior to use.

3. *Maximize use of collaborative development.*
    a. The Offeror shall use the (insert applicable military branch name (Army, Air Force, Navy) Collaborative Development Environment (CDE) in conjunction with the I-IPT to generate models and interfaces for the GCS. Model and interface data that is stored in the repository must be made available for any authorized user to download. The repository will also store Reference Architectures (RAs) and applications, in either source code or executable format, for stakeholders to use or build upon. The CDE will provide protection for program data in accordance with the Program Protection Plan (PPP). The Offeror will optimize the use of the CDE with its subcontractors and suppliers, as well as participating Government organizations.

    The Offeror shall develop, update and maintain a Data Accession List (DAL) that identifies all data and documentation generated under the execution of the GCS effort. A list of the data to be provided on the CDE will be attached to the CDE implementation plan CDRL. This listing will be inclusive to the lowest known tier of suppliers, vendors, and subcontractors and their products necessary to support design, production and the life cycle support of the GCS. Included will be composite view of listed data and its condition, both technical (e.g. configuration item description and WBS allocation) and legal (data rights status and applicable DFAR basis for assertion).

    The CDE will be able to exchange classified data up to and including the Secret/NOFORN level. It is not required to have an integrated classified and unclassified CDE. Classified data will need to be partitioned between the Secret and the Secret/NOFORN level. CDE process controls, in addition to use of business tools (such as Associate Contractor nondisclosure agreements), will apply and will use system-level and data-level Metadata tags for identification and protection of digital form data (such as for classified, Export Control, Proprietary, or Distribution Statements). The Government will require continued use of the CDE for the duration of the program. The Offeror will provide the Government with strategies to ensure continued use of the CDE.

Objective 3: Design for life cycle affordability across all future UAS platforms.

1. *The Offeror shall design for cost-effective control of future UAS platforms by maximizing reuse across Service and Joint UAS programs.*
    a. In support of this requirement, the Offeror shall maximize reuse of pre-existing or common items such as those found in the (insert applicable military branch name (Army, Air Force, Navy)) Collaborative Development Environment (CDE) and/or OSD UAS Application Store or unless a determination based on cost, schedule, or performance.. Such a

determination shall be provided as part of the RFP response for this requirement.

2. *The Offeror shall allow for affordable support and upgrades by maximizing reuse across Service and Joint UAS programs.*
    a. In support of this requirement, the Offeror shall reuse pre-existing or common items such as those found in the (insert applicable military branch name (Army, Air Force, Navy)) Collaborative Development Environment (CDE) and/or OSD UAS Application Store unless a determination based on cost, schedule, or performance is made to not reuse. Such a determination shall be provided as part of the RFP response for this requirement. Exceptions to reuse of pre-existing items must be accompanied by justification, such as cost (both of adoption and life cycle support), schedule, functional and non-functional performance, etc. The general objective of these efforts shall be the development of a common GCS component which meets the performance requirements of the various DoD or Service GCS requirements and conforms to UCS 2.2 specifications.
    b. Offerors shall consider use of third-party products that may be innovative or new to the program and provide compelling system performance improvements or best value. In particular, the Government's goal is to encourage Offerors to reuse software and components, especially in cases where the Government has GPR or greater rights. As part of system acceptance, the Offeror shall demonstrate the steps necessary to give third parties, as directed by the Government, the ability to integrate their components into the Offeror's solution. This effort shall be comprehensive and require the Offeror to perform the following activities:
        i. <u>Inventory</u>: A detailed inventory of all code files in the GCS baseline shall be conducted. This inventory shall extend to all third-party software not delivered within the terms of the contract but used in the GCS to form the working product. Third-party product descriptions and version information shall be required for all operating GCS components.
        ii. <u>Inspection</u>: File headers and any other company markings found in the source code shall be inspected to ensure clear indication that the Government has GPR to use the software delivered in the contract.
        iii. <u>Build Procedure Development</u>: A build procedure for the GCS shall be developed in sufficient detail to allow a third party to recreate the operational system on a compatible processing platform. This build procedure shall address the results of the code inventory and inspection to account for software that is not deliverable due to proprietary rights limitations such that the user can still complete the installation process.
        iv. <u>Conduct Demonstration</u>: The Offeror shall conduct a formal demonstration of the GCS and approved procedures to show the software can be successfully ported to other third-party compatible open architecture processing systems.

3. *The Offeror shall enable nonfunctional requirements including scalability, replaceability, portability, supportability and affordability.* The Offeror shall establish a process to logistically support the GCS over the life cycle. The Offeror shall describe the availability of commercial repair services, facilities, and manpower required for life cycle support and demonstrate they are adequate to ensure long term support for the GCS being provided. The Offeror shall provide the proposed methodology for pass through of any warranties to the Government.

Recommended Section L Language

Section L of the RFP provides proposal instructions, conditions and notices to Offerors. Offerors should be encouraged to clearly demonstrate, through their use of similar technologies previously developed, the ability to meet the design, development, testing, and production requirements of the solicitation, in particular its approach to a modular open system design, in the quantities and schedules specified in the RFP. Section L should be carefully structured to address only those elements determined to be keys to success. This section contains recommended guidance, and is offered with the understanding that individual PEOs and Program Managers will incorporate the language into RFPs and tailor as necessary to meet Programs needs.

*[**Notes to Preparers:** Four factors have been developed to support Section L of the RFP for an open architected GCS in conformance with the GCS Architecture – Technical, Management, Cost, and Past Performance. As such, it is recommended that each Program Manager pay close attention to the language on data rights developed by Navy, Army, and Air Force intellectual property lawyers.]*

Factor 1: GCS Technical Approach and Processes

The Offeror shall describe its proposed technical approach and processes to developing the GCS to be employed in performing this contract. At a minimum, the Offeror shall describe its technical approach and processes in the following areas:

Subfactor 1. Open Systems Approach and Goals. The Offeror shall describe its open systems approach for using modular software design, standards-based interfaces, and widely-supported, consensus-based standards to achieve the following goals. At a minimum, the Offeror shall provide the following as part of its proposal:

a. **GCS Capability Requirements** – A detailed description of the Offeror's approach for addressing how the GCS offered incorporates appropriate considerations for Program Sponsor specific GCS requirements.

b. **Traceability of GCS Requirements** – A detailed description of the Offeror's approach for ensuring that all GCS requirements are accounted for through a demonstrated ability to trace each requirement to one or more items defined in the UCS ACS 2.2.

c. **Modular Open Systems Design Approach (MOSA)** – A detailed description of the Offeror's modular open systems approach for development of the GCS.

d. **Minimization of Inter-Component Dependencies** – A detailed description of the Offeror's approach for designing a GCS that, to the maximum extent practicable, minimizes inter-component dependencies and allows components to be decoupled and reused, where appropriate, across various DoD or Service programs or replaced by competitive alternatives.

e. **Asset Reuse** – A detailed description of the steps the Offeror has taken to reduce acquisition of duplicative hardware/software components where possible.

f. **Technology Insertion and Refresh** – A detailed description of how the Offeror's proposed GCS will allow for rapid and affordable technology insertion and refresh.

g. **Design Disclosure –** Within the constraints of contractual data rights, a detailed description of the Offeror's approach to facilitate the sharing of the design information in support of peer reviews and the incremental development processes

Subfactor 2. Conformance with UCS ACS and OBM.

*[**Notes to Preparers:** The language used in this section shall be specified by the Program Office to ensure the technical design complies with the GCS Architecture and Open Business Model components.].* The Offeror shall describe how its design conforms to the UAS Control Segment Architecture Conformance Specification 2.2 (UAS ACS) and I-IPT's UAS Open Business Model (OBM).

Subfactor 3. Treatment of Proprietary or Vendor-Unique Elements. The Offeror shall justify any use of proprietary, vendor-unique, or closed software components. Justification shall include a description of the decision leading to the selection of specific COTS products. The Offeror shall define its process for identifying and justifying proprietary, vendor-unique or closed code modules or software to be used.

Subfactor 4. GCS Life Cycle Management. The Offeror shall describe and demonstrate the strategy for reducing GCS supportability costs through insertion of COTS or reusable NDI products.

Factor 2: Management Approach

The Offeror shall describe its management approach for developing the GCS including the management structure, processes and procedures proposed for planning, monitoring, controlling, and delivering the required contract deliverables, artifacts, and data items required for delivery under the Contract Data Requirements List (CDRL.) according to contractually defined budget, schedule and performance requirements.

Factor 3: Cost Proposal

*[**Notes to Preparers** – Each Program Manager should insert specific cost evaluation language which supports the acquisition strategy for the GCS and SOA Service being acquired. It is important the Program Manager work with its appropriate Legal Counsel to address Subfactor 3. The U.S. Government is entitled to certain automatic or default rights because of statute or regulation, e.g., 10. U.S.C. 2320(a)(2)(A & C). In these cases the Government "exercises" these rights. In cases where the Government requires data rights beyond these entitlements, then the Government can attempt to "acquire" the additional rights through negotiations and possible additional cost. The reference language provided below is intended to be used for the acquisition of these additional data rights.]*

Subfactor 1. Cost of GCS.

Subfactor 2. Hardware/Software Reuse. The Offeror shall indicate what if any hardware/software they reused to develop the GCS and to the extent possible quantify the cost savings associated with reusing existing hardware/software in the GCS being proposed.

Subfactor 3. Cost of Priced options of Noncommercial Technical Data (TD), Noncommercial Computer Software (CS), and Noncommercial Computer Software Documentation (CSD).

(a) **Cost/Price Information.** In addition to the submission requirement of DFARS 252.227-7017, the Offeror shall provide a list entitled "Supplemental Information Concerning Cost/Price of Noncommercial Technical Data (TD), Noncommercial Computer Software (CS), and Noncommercial Computer Software Documentation (CSD)" (hereinafter the Supplemental 7017 Cost/Price List). This list shall be provided as an attachment to proposal. **Note to Preparers:** *It is recommended that this list be made part of the proposal and be resubmitted to the Government when changes are made.*] This list shall provide supplemental information concerning the noncommercial TD, CS, or CSD identified in the DFARS 252.227-7017 "Identification and Assertion of Use, Release, or Disclosure Restriction" list (hereinafter 7017 List), as follows:

(1) License Option Price Information. For each item of noncommercial TD, CS, and/or CSD that the Offeror asserts should be delivered with less than Government Purpose Rights

(GPR) (as defined in (DFARS 252.227-7013 “Rights in Technical Data – Noncommercial Items” (March 2011) and/or DFARS 252.227-7014 “Rights in Noncommercial Computer Software and Noncommercial Computer Software Documentation”, and for which the Offeror is willing to sell to the Government greater rights than those identified in the 7017 List, the Offeror shall identify those greater rights, provide an option price at which the Government may purchase such greater rights, and identify the period of time during which the option is available for the Government to exercise. **[Note to Preparers:** *Evaluation of options should be addressed in Sections B and M of the RFP.***]**

(2) Government Preferences. The Offeror may state any license option price as a firm fixed price, a percentage royalty rate (or use fee), or any other comparable compensation scheme, provided that the Government can reasonably calculate a sum-certain price for the license option using the price information and terms and conditions information the Offeror provided. The Government prefers that any license option prices the Offeror provides in the Supplemental 7017 Cost/Price List cover all noncommercial CS, noncommercial CSD, and noncommercial TD included in any affected software and that the Offeror states license option prices on a price-per-system basis.

[Note to Preparers: *Ensure that FAR 52.227-6 is included in Section I.***]**

(b) Duty to Submit Negative List. If there is no supplemental information to be submitted in the Supplemental 7017 Cost/Price List, the Offeror shall submit the list and enter “None” as the body of the list. Failure to provide a list may render the Offeror ineligible for award.

(c) Use During Source Selection. Information provided in the Supplemental 7017 Cost/Price List, as well as the information provided in the 7017 List, may be used in the source selection process as part of the Government’s best value analysis to evaluate the impact on the Government’s ability to use, reuse, or disclose the TD, CS, and/or CSD for government purposes.

Supplemental Information Concerning Cost/Price of Commercial Computer Software (CS), and Commercial Computer Software Documentation (CSD) and Commercial Technical Data (TD)

(a) Cost/Price Information. The Offeror shall provide a list to the Government, entitled “Commercial Restrictions List – Cost/Price Information” (hereinafter the CRLCPI List). This list shall be provided as an attachment to proposal. The CRLCPI List shall state a license option price for all commercial CS, commercial CSD, and commercial TD on the CRL List for which the Offeror is willing to provide the Government with greater license rights than the level of rights to which the Government would otherwise be entitled. If the Offeror is willing to provide a license option, the Offeror shall identify the specific rights it is willing to grant, and the period of time during which the option is available for the Government to exercise.

***[Note to Preparers:** It is incumbent upon the Program Manager and Contracting Officer to fully understand the terms of the license including the specific rights and limitations (if any) proposed by the Offeror. Open Source Software licenses may or may not have associated costs, but will have specific terms with which the Government must comply. Another option is to negotiate a modified Open Source Software License that best reflects the OSA concepts necessary to implement the contract requirements. Recommend License agreements should be included in Section J of the Contract. Recommend consulting with the appropriate Legal Counsel. See Appendix 5 for additional details.*]

(b) License Option Pricing: Government Preferences. The Offeror may state any license option price as a firm fixed price, a percentage royalty rate (or use rate), or any other comparable compensation scheme, provided that the Government can reasonably calculate a sum-certain price for the license option using the price information the Offeror provided. The Government prefers that any license option prices the Offeror provides in the CRLCPI List cover all commercial CS, commercial CSD, and commercial TD included in any affected software and that the Offeror states any license option prices on a price-per-system basis. **[Note to Preparers:** *Evaluation of options should be addressed in Sections B and M of the RFP.***]**

(c) Duty to Submit Negative List. If the Offeror has no Option License Pricing to provide in the CRLCPI List, the Offeror shall still submit the CRLCPI List and enter "None" in the body of the List. Failure to provide a list may render the Offeror ineligible for award.

<u>Factor 4: Past Performance Building Open Systems</u>

The Offeror shall demonstrate, through its use of previously developed similar technologies, the Offeror's ability to meet the design, development, testing, and production requirements of this solicitation. The Offeror shall provide a list of [insert number (e.g. 3)] all past performances of similar size and scope to the efforts described herein within the last five (5) years. In addition to past performance, any relevant contracts and subcontracts of an acquired company, division, or subsidiary shall be identified. The Offeror shall place particular emphasis on DoD or Government contracts and subcontracts, especially those that involved a modular open systems approach.

If the Offeror did not perform [***Note to Preparers:*** *describe the type of project here*] during the last five years, the Offeror may discuss other related projects that demonstrate the Offeror's capabilities to perform work of similar nature and magnitude. Note, if the Offeror omits projects or contracts of which the Government evaluation team is aware or becomes aware, then customer assessments may be sought from the relevant program and technical support offices. Offerors are advised that (1) the Government may contact any or all references listed in the proposal and other third parties, unreferenced customers, agencies, Offerors, consumer protection organizations, etc., for performance information, or use any other data available (such as Contractor Performance Assessment Reporting System (CPARS)); (2) the

Government reserves the right to use any such information received as part of its evaluation of the Offeror's past performance; and (3) if the Offeror omits projects of which the Government evaluation team is aware or becomes aware, customer assessments may be sought from the relevant organizations.

For each listed contract, the Offeror shall prepare a synopsis that includes a narrative self-assessment of the contract and specific details describing why the contract was, or was not, successful. Each synopsis shall be in the following format:

<table>
<tr><th colspan="5">Corporate Experience and Past Performance Information Form</th><th></th></tr>
<tr><td>Name of Offeror:</td><td colspan="5"></td></tr>
<tr><td>Contract Number, Order Number, or Identifier and Type</td><td colspan="5"></td></tr>
<tr><td>Customer Name and Location:</td><td colspan="5"></td></tr>
<tr><td colspan="3">Customer Point of Contact (Name and Title):</td><td colspan="3"></td></tr>
<tr><td colspan="3">Telephone Number (PLEASE VERIFY) and e-mail address:</td><td colspan="3"></td></tr>
<tr><td colspan="3">Total dollar amount for this effort during the past 5 years (show calendar year and dollars):
(For ordering vehicles, show both the annual estimated contract amount and the amount of orders actually performed):</td><td colspan="3"></td></tr>
<tr><td colspan="2">Number of personnel (FTE) performing per year (avg.):</td><td></td><td>Period of Performance:</td><td></td><td></td></tr>
<tr><td colspan="6">Detailed description of the work performed sufficient to demonstrate the relevance of the reference to the solicitation:</td></tr>
<tr><td colspan="6">Quality, delivery, or cost problem(s); corrective action(s) taken; and effectiveness of the corrective action(s):</td></tr>
<tr><td colspan="6">Subcontractor(s) utilized in performance of this contract, description of the extent of work performed by subcontractor(s), along with annual dollar value of all subcontracts:</td></tr>
</table>

At a minimum, the Government's questionnaire for assessing an Offeror's past performance must address the following:

- The degree to which the Offeror demonstrated its design approach, plans for technology insertion, and sustainment strategy were consistent with the modular open systems requirements.
- The degree to which the Offeror managed the impact of changing requirements and evolving technology on the system's ability to continue to satisfy improved capabilities over time.
- The degree to which the Offeror's test and evaluation planning contained the means for testing the conformance to open standards to ensure the openness of key interfaces throughout the system life cycle.
- The degree to which the Offeror's approach contains capabilities to easily and quickly update, revise, and change the GCS as threats (warfighting and information assurance threats) or technologies (COTS or reusable) evolve.

Recommended Section M Language

The following is an extensive list of factors and subfactors that can be tailored and incorporated into Section M. Programs can delete the items they feel are redundant or not important for their specific acquisition requirements. Preparers need to include the factors and subfactors that will be determinant in the selection process and delete the factors and subfactors that are of minor or no importance. In particular, Programs should be aware of asking for the same information in multiple places – the decision to do so should be deliberate and the evaluation of Offeror's response done carefully evaluated in a consistent manner. This section contains recommended guidance, and is offered with the understanding that individual PEOs and Program Managers will incorporate the language into RFPs and tailor as necessary to meet Programs needs and OSD's goals.

EVALUATION FACTORS

The Government will evaluate the Offeror's proposal in accordance with the factors and subfactors set forth below:

[Note to preparers, each Program Office may select, modify or delete rating factors to meet the requirements of their acquisition]

Development of an Open System Architected GCS.

Factor 1: GCS Technical Approach and Processes [insert weighting]

The Government will evaluate the Offeror's ability to demonstrate a thorough understanding of the complete range of tasks in the RFP and implementation of OSA Technical Approaches and Processes the Government will evaluate the Offeror's:

1. Approach for accomplishing the tasks set forth in the Statement of Objectives (SOO) (Section C);

2. Ability to overcome the technical challenges with must be addressed to fulfill the [*Program Name*] requirements
3. Solutions for clarity, completeness, and feasibility
4. Approach to seamlessly provide the services and capabilities described in accordance with [insert Agency/organizational standards, policies and processes as applicable]
5. The Government will use information provided in the proposal to assess the Offeror's ability to execute:

   Subfactor 1. GCS Approach and Goals

   Subfactor 2. Conformance with the UAS Control Segment Architecture Specification and adoption of the Open Business Model (OBM)

   Subfactor 3. Treatment of Proprietary or Vendor-Unique Elements

   Subfactor 4. GCS Life Cycle Management

<u>Factor 2: Management Approach [insert weighting]</u>

In evaluating the Management Approach, the Government will use information in the proposal to assess the degree to which the Offeror's approach addresses planning, monitoring, controlling, and delivering the required contract deliverables, artifacts, and data items required for delivery under the contract Data Requirements List (CDRL.) according to contractually defined budget, schedule and performance requirements.

<u>Factor 3: Cost Proposal [insert weighting]</u>

Subfactor 1. Cost of the GCS.

Subfactor 2: Hardware/Software Reuse

Subfactor 3. Cost of Priced Options for Noncommercial Technical Data (TD), Noncommercial Computer Software (CS), and Noncommercial Computer Software Documentation (CSD)

<u>Factor 4: Past Performance Building Open Systems [insert weighting]</u>

Subfactor 1. Offeror's Development of an Open Systems Architecture Past Performance

In assessing the Offeror's past performance submissions on similar contracts, the Government will consider how well the Offeror previously developed an Open Systems Architecture.

APPENDIX C: RECOMMENDED CDRLS

The OSD UAS Task Force has developed recommended contracting language to include in a Request for Proposal when acquiring a Ground Control Station Service Oriented Architecture Service or a Ground Control Station System based on the UAS Control Segment Architecture Conformance Specification (UCS ACS). The purpose of this language is to adopt a standardized approach across the GCS portfolio to enhance opportunities for reuse in the existing Programs of Record and New Start Programs.

Section C of a Request for Proposal (RFP) and the resulting contract contains the detailed description of the products to be delivered or the work to be performed for the government. Section C typically includes a Statement of Objectives (SOO) for the RFP or a Statement of Work (SOW). The government must specify the Contract Data Requirements List (CDRL) in the SOW. A CDRL is a list of authorized data requirements for a specific procurement that forms a part of the contract. The CDRL is the standard format for identifying potential data requirements in a solicitation, and deliverable data requirements in a contract.

CDRLs should be linked directly to Statement of Work (SOW) tasks and managed by the Program Manager. Data requirements can also be identified in the contract via Special Contract Clauses (e.g., DFARS), which define special data provisions such as Rights in Data, Warranty, etc. The purpose of the CDRL is to provide a standardized method of clearly and unambiguously delineating the Government's minimum essential data needs. The CDRL groups all of the data requirements in a single place.

In support of the GCS Open Business Model, the UAS Task Force has identified the recommended CDRLs that should be incorporated into the contract. This is not intended to be an exhaustive list of all potential deliverable items, but is an attempt to list only those deliverables we believe significantly support the goals of the Open Business Model and the GCS Open Systems Architecture. The frequency and delivery dates of the deliverables must be specified, along with a list of deliverable recipients.

[Note to Preparer: *The program plan and directive documentation should specify that anything the government paid to develop is available for delivery to the Government with all of the developmental artifacts and unlimited usage rights. In addition, the Program should require that the deliverables be provided (or deposited) in the GCS repository or GCS Application Store at https://ucsrepository.org***]**

[Note to Preparers: *To help clearly understand the data rights to be provided to the Government, the Government recommends that a table listing all the CDRLs be inserted as an attachment to the proposal which includes a column wherein the Offeror states the data rights to be provided with that CDRL when delivered.*

[Note to Preparers: *Software should be delivered in a standalone fashion, i.e., not encumbered by any particular configuration management tool. Existing and future programs that ultimately will use the software or artifacts should have the ability to use whatever configuration management tool they desire without any overt or hidden dependencies on a given tool.***]**

[Note to Preparers: *When citing regulations such as the DFARS and FAR, dates are included where possible to reflect the most recent clause dates. Program Managers and Contracting Officers must verify the latest clause dates before signing the final SOW.***]**

Prior to determining the CDRLs and DIDs required, it is recommended that the Program Office perform an assessment of its Intellectual Property Rights needs and craft its CDRL and Deliverable requirements accordingly. If the Program Office, PEO, Domain or Sponsor believes that the program deliverables would be of such interest that they warrant inclusion in the GCS repository or GCS Application Store, then the CDRL and deliverables should include those design, developmental, or diagnostic items needed to reproduce or recreate the asset.

The ideal asset would have artifacts in most or all of the following categories. The key to obtaining these artifacts is to require that they be delivered as part of the terms of the contract. In order to facilitate reuse of these artifacts, these items must be delivered with the appropriate data or license rights, e.g., Government Purpose Rights (GPR) or suitable special license rights. In order to facilitate reuse, the asset should bundle the following or their equivalent:

i. Requirements (e.g., Word documents, DOORS file or Excel or XML export or other file endings that apply.)
ii. Architecture models (e.g., System Architect files, including Department of Defense Architecture Framework (DoDAF) views where required or other file endings that apply.)
iii. Functional models (e.g., CORE file in native format or XML export) Software models (e.g., Rose/Rhapsody/iUML (Unified Modeling Language)/Artisan models in native or XMI format; minimum diagrams Class and State or Interaction/Sequence or other file endings that apply.)
iv. Hardware models (e.g., CAD DXF, IEGS files or other file endings that apply.)
v. Human systems engineering models (e.g., IPME or Envision Ergo files or other file endings that apply.)
vi. Cost models (e.g., PRICE, SEER, COMET, VAMOSC, Excel files or other file endings that apply.)
vii. Modeling and Simulation data (e.g., NETWARS/OPNET, NSS, GCAM -scenarios, environmental, platforms, tactics, MOEs, MOPs in XMI format following JC3IEDM or XMSF standards or other file endings that apply.)
viii. Test plans and results (e.g., QA Run, Quality Center files or Word or Excel export or other file endings that apply.)
ix. Logistics data (e.g., COMPASS, CASA, PowerLOG in native or XML/CSV format or other file endings that apply.)

The following sections identify recommended CDRLs and DIDs the Program Manager shall consider in its GCS contract:

1. Recommended Clause on Deferred Ordering of Technical Data or Computer Software (Including Design and Development Artifacts)

[Note to Preparer: *There may be instances where the Government would like to have access and the ability to download design artifacts and other materials that are produced during the development of software but which have not been specifically identified in the CDRLs and Data Item Descriptions (DIDs). These materials may be located in an Integrated Digital Design Environment (IDE). If the Government anticipates that it may need to require delivery of any such items in the future, it should use priced contract option CLINs for such potential delivery needs. In addition, it is recommended that the Program Manager use DFARS 252.227-7027, regarding deferred ordering of technical data, to obtain these materials. Reference to DFARS 252.227-7027, like reference to other FAR and DFARS clauses, should be included in Section I of the contract.***]**

a. DFARS 227.7103-8(b) Deferred Delivery and Deferred Ordering of Technical Data

Deferred Ordering. Use the clause at 252.227-7027, Deferred Ordering of Technical Data or Computer Software, when a firm requirement for a particular data item(s) has not been established prior to contract award but there is a potential need for the data at a later date. Under this clause, the contracting officer may order any data that has been generated in the performance of the contract or any subcontract there under at any time until three years after acceptance of all items (other than technical data or computer software) under the contract or contract termination, whichever is later. The obligation of subcontractors to deliver such data expires three years after the date the contractor accepts the last item under the subcontract. When the data are ordered, the delivery dates shall be negotiated and the contractor compensated only for converting the data into the prescribed form, reproduction costs, and delivery costs.

The software development process to be used by the winning contractor team is to be defined and documented in the developer's Software Development Plan (SDP) which shall be designated as a CDRL. Contractor teams are to submit an initial delivery of the SDP with the proposal. After contract award, an updated version is to be delivered based on discussion and negotiations with the Government regarding approval of SDP content.

Specifically, the SDP should:

i. Document all processes applicable to the GCS SOA Service or GCS system to be acquired, including the Primary, Supporting, and Organizational life cycle processes as defined by IEEE/EIA Std. 12207 as appropriate.
ii. Contain the content defined by all information items listed in Table 1 of IEEE/EIA Std. 12207.1, as appropriate for the system and be consistent with the processes proposed by the developers. If any information item is not relevant to either the system or to the proposed process, that item need not be required.
iii. Adhere to the characteristics defined in section 4.2.3 of IEEE/EIA Std. 12207, as appropriate.
iv. Contain information at a detail sufficient to allow the use of the SDP as the full guidance for the developers. In accordance with section 6.5.3a of IEEE/EIA Std. 12207.1, it should contain, "specific standards, methods, tools, actions, reuse strategy, and responsibility associated with the development and qualification of all requirements, including safety and security."

2. Recommended CDRL and Deliverable Items for UAS GCS

The following recommended deliverables for a GCS SOA Service or GCS open architected system have official Deliverable Item Descriptions (DIDs) accepted by the Department of Defense's Defense Standardization Program. The official DIDs are available from the Document Automation and Production Service (DAPS) Acquisition Streamlining and Standardization Information System (ASSIST) database at http://assist.daps.dla.mil. To obtain these DIDs simply search the database using either the DID's title or its ID number listed below in the brief descriptions.

[Note to Preparers: *Program Managers should use their business judgment and a business case analysis in defining the deliverables that will be specified in support of the larger GCS Task Force. Generally, programs should identify those items they believe would be necessary for either another Program Office or a third-party vendor to be able to replace a system component and successfully integrate it within the overall system. Larger programs (e.g., ACAT I and II programs) should consider their overall sustainability strategy and be more expansive when identifying deliverables. At a minimum, the items annotated with an asterisk (*) should be strongly considered for inclusion.***]**

NAME OF CDRL	DESCRIPTION OF CDRL	DID ID
Software Development Plan (SDP)	The developer's plans for conducting a software development effort. The term "software development" is meant to include new development, modification, reuse, reengineering, maintenance, and all other activities resulting in software products.	DO-178B11.2 DI-IPSC-81427A
Technical Report PSAC/ AQS (PSAC)	A technical report provides fully documented results of studies or analysis performed	DO-178B 11.1 DI-MISC-80508B
Systems Engineering Management Plan (SEMP)	The SEMP describes the contractor's technical approach and proposed plan for the conduct, management, and control of the integrated systems engineering effort. It shall be consistent with the government Systems Engineering Plan (SEP), if available.	DI-SESS-81785
Contractor's Configuration Management (CM) Plan	The Contractor's Configuration Management (CM) Plan describes the contractor's configuration management program, how it is organized, how it will be conducted, and the methods procedures and controls effective configuration identification, change control, status accounting, and audits of the total configuration, including hardware, software and firmware. The principle use is to provide the government a basis for review, evaluation and monitoring of the CM program and its proposed components.	DI-CMAN-80858B

NAME OF CDRL	DESCRIPTION OF CDRL	DID ID
Software Quality Assurance Plan (SQAP)	A technical report provides fully documented results of studies or analysis performed (replace with SQAR)	DI-MISC-80508B
Software Quality Assurance Report	The Software Quality Assurance Report will be used to ensure process and product conformance to technical requirements for quality, reliability, and functional performance, identify problems, and initiate corrective actions and quality improvements.	DI-QCIC-81795
Systems Safety Program Plan (SSPP)	The Contractor shall detail in the System Safety Program Plan (SSPP) the Contractor's program scope, safety organization, program milestones, requirements and criteria, hazard analyses, safety data, safety verification, audit program, training, accident/incident reporting, and interfaces. This Data Item Description (DID) contains the format and content preparation instructions for the SSPP. The SSPP includes details of those methods the contractor uses to implement each system safety task called for in the Government provided Integrated Safety Plan (ISP), the Statement of Work, and those safety-related documents listed in the contract for compliance. Examples of safety-related documents include Occupational Safety and Health Administration (OSHA) regulations and other national standards, such as the National Fire Protection Association (NFPA). The SSPP lists all requirements and activities required to satisfy the system safety program objectives, including all appropriate, related tasks. A complete breakdown of system safety tasks, subtasks, and resource allocations of each program element through the term of the contract is also included. A baseline plan is required at the beginning of the first contractual phase (e.g., Demonstration and Validation or Full-Scale Development) and is updated at the beginning of each subsequent phase (e.g., Production) to describe the tasks and responsibilities for the follow-on phase.	DI-SAFT-81626B
Software Safety Program Plan (SwSPP)	Subordinate to the System Safety Program Plan (SSPP)	DI-SAFT-81626B
System/Subsystem Specification (SSS)	The System/Subsystem Specification (SSS) specifies the requirements for a system or subsystem and the methods to be used to ensure that each requirement has been met. Requirements pertaining to the system or subsystem's external interfaces may be presented in the SSS or in one or more Interface Requirements Specifications (IRSs) referenced from the SSS.	DI-IPSC-81431A

NAME OF CDRL	DESCRIPTION OF CDRL	DID ID
System/subsystem Design Description (SSDD)	The System/Subsystem Design Description (SSDD) describes the system- or subsystem-wide design and the architectural design of a system or subsystem. The SSDD may be supplemented by Interface Design Descriptions (IDDs) (DI-IPSC-81436A) and Database Design Descriptions (DBDDs)(DI-IPSC-81437A)	DI-IPSC-81432
Interface Control Document (ICD)	The Interface Control Document (ICD) provides a record of all interface information (such as drawings, diagrams, tables, and textual information) generated for the project. It also provides access to, or delivery of, copies of the actual interface information	DI-CMAN-81248
System Safety Program Plan (SSPP)	This system safety standard practice identifies the Department of Defense (DoD) Systems Engineering (SE) approach to eliminating hazards, where possible, and minimizing risks where those hazards cannot be eliminated. DoD Instruction (DoDI) 5000.02 defines the risk acceptance authorities. This Standard covers hazards as they apply to systems / products / equipment / infrastructure (including both hardware and software) throughout design, development, test, production, use, and disposal. When this Standard is required in a solicitation or contract but no specific task is identified, only Sections 3 and 4 are mandatory. The definitions in 3.2 and all of Section 4 delineate the minimum mandatory definitions and requirements for an acceptable system safety effort for any DoD system.	DI-SAFT-81626
System Safety Hazard Analysis Report (SSHA) - Functional Hazard Assessment	Hazard Analyses are used to systematically identify and evaluate hazards, both real and potential, for their elimination or control. The System Safety Hazard Analysis Report documents these hazard analyses	DI-SAFT-80101B
System Safety Hazard Analysis Report (SSHA) - System (Software) Safety Assessment	Hazard Analyses are used to systematically identify and evaluate hazards, both real and potential, for their elimination or control. The System Safety Hazard Analysis Report documents these hazard analyses	DI-SAFT-80101B
System Safety Hazard Analysis Report (SSHA) - Safety Assessment Report (Software)	Hazard Analyses are used to systematically identify and evaluate hazards, both real and potential, for their elimination or control. The System Safety Hazard Analysis Report documents these hazard analyses	DI-SAFT-80101B
Software Test Report (STR)	The Software Test Report (STR) is a record of the qualification testing performed on a Computer Software Configuration Item (CSCI), a software system of subsystem, or other software-related item.	DI-IPSC-81440A

NAME OF CDRL	DESCRIPTION OF CDRL	DID ID
Configuration Control Board (CCB) Report, Record of Meeting/Minutes (RRM)	The report is a record of the proceedings of any specified meeting. The meeting minutes will be used by appropriate government and contractor personnel as a record on the deliberations and actions resulting from meetings related to performance of work under a contract.	DI-ADMN-81505
Software Accomplishment Summary (SAS)	A technical report provides fully documented results of studies or analysis performed	DI-MISC-80508B
Software Test Plan (STP)	Describes the software test environment to be used for the testing, identifies the tests to be performed, and provides schedules for test activities	DO-177B 11.3 DI-IPSC-81438A
Software Transition Plan (STrP)	The developer shall identify all software development resources that will be needed by the support agency to fulfill the support concept specified in the contract	DI-IPSC-81429A
Integrated Master Schedule (IMS)	An integrated schedule containing the networked, detailed tasks necessary to ensure successful program execution	DI-MGMT-81650
Software Requirements Specification (SRS)	Specifies the requirements for a Computer Software Configuration Item (CSCI) and the methods to be used to ensure that each requirement has been met.	DI-IPSC-81433A
Software Design Description (SDD)	Describes the CSCI-wide design decisions, the CSCI architectural design, and the detailed design needed to implement the software	DI-IPSC-81435A
Interface Requirements Specification (IRS)	Specifies the requirements imposed on one or more systems, subsystems, Hardware Configuration Items (HWCIs), Software Configuration Items (SWCIs), manual operations, or other system components to achieve one or more interfaces among these entities	DI-IPSC-81434A
Interface Design Description (IDD)	Describes the interface characteristics of one or more systems, subsystems, hardware configuration items (HWCIs), computer software configuration items (CSCIs), manual operations, or other system components	DI-IPSC-81436A
Reuse Management Report (ReMR)	Provides information about existing software products intended to be reused as-is or modified as part of the delivered operational software.	DI-SESS-81771
Data Accession List (DAL)	Provides a medium for identifying contractor internal data which has been generated by the contractor in compliance with the work effort described in the Statement of Work	DI-MGMT-81453A

NAME OF CDRL	DESCRIPTION OF CDRL	DID ID
Software Version Description (SVD)	Identifies and describes a software version consisting of one or more Computer Software Configuration Items (CSCIs). It is used to release, track, and control software versions.	DI-IPSC-81442[a] DO-178B 11.16
Software Product Specification (SPS)	Contains or references the executable software, source files, and software support information, including "as built" design information and compilation, build, and modification procedures, for a Computer Software Configuration Item (CSCI).	DI-IPSC-81441A
Product Drawings/Models and Associated Lists	Provide engineering data to support competitive procurement and maintenance for items interchangeable with the original items.	DI-SESS-81000E
Commercial Drawings/Models and Associated Lists	Define commercial items acquired by the Department of Defense	DI-SESS-81003E
Detail Specification Documents	Used to specify design requirements for items used in multiple programs or applications, in terms of materials to be used, how a requirement is to be achieved or how an item is to be fabricated or constructed	DI-SDMP-81464A
Program-Unique Specification Documents	Used to specify functional and performance requirements and, where applicable, design solutions for systems, items, software, processes, and materials developed and manufactured for use with a single system, product, or application	DI-SDMP-81493A
Software Test Description (STD)	Describes the test preparations, test cases, and test procedures to be used to perform qualification testing of a Computer Software Configuration Item (CSCI) or a software system or subsystem	DI-IPSC-81439A
Computer Software Product End Items	Provides data formatted for review or maintenance to ensure significant milestones are met	DI-MCCR-80700
Special Inspection Equipment (SIE) Drawings/Models and Associated Lists	Provide the data required for the limited production of SIE which duplicates the physical and performance characteristics of the original SIE	DI-SESS-81004E
Special Tooling (ST) Drawings/Models and Associated Lists	These data items provided the data required for the limited production of ST which duplicates the physical and performance characteristics of the original ST	DI-SESS-81008E

3. Additional documents for UAS GCS

The following additional documents for a GCS SOA Service or GCS open architected system do not have official Deliverable Item Descriptions (DIDs) accepted by the

Department of Defense’s Defense Standardization Program. However, these documents are related to air worthiness certification and could be included as contract deliverable items.

[Note to Preparers: *Program Managers should use their business judgment and a business case analysis in defining the deliverables that will be specified in support of the larger GCS Task Force. Generally, programs should identify those items they believe would be necessary for either another Program Office or a third-party vendor to be able to replace a system component and successfully integrate it within the overall system. Larger programs (e.g., ACAT I and II programs) should consider their overall sustainability strategy and be more expansive when identifying deliverables.]*

NAME OF DOCUMENT	DESCRIPTION	REFERENCE
Parameter Data Item File (PDIF)	Parameter Data Item File (PDIF) The PDIF provides a definition of all data that influences the behavior of the software without modifying the Executable Object Code. A parameter data item comprises a structure of individual elements where each element can be assigned a single value. Each element has documented attributes such as type, range, or set of allowed characters. The PDIF is subject to the same rigorous system engineering processes (e.g. configuration management (CM) and quality assurance (QA)) as the UoC software due to its ability to influence software behavior. The PDIF may include multiple sets of data which are specific to a particular integration or platform, in which case a UoC Integrator will update and maintain the PDIF for their specific integration. The Integrator’s PDIF will define the data items, aside from source code, that influences the UoC’s behavior within their platform (e.g. configuration parameters, I/O mappings, etc).	DO-178C Section 11.22
SCM Records	The results of the CM process activities are recorded in the SwCMR. These may include CM review or audit reports, meeting minutes, software baseline documentation, and software build reports, or software CM review records	DO-178C Section 11.18
SQA Records	The results of the QA process activities are recorded in the SwQAR. These may include QA review or audit reports, meeting minutes, records of authorized process deviations, or software conformity review records	DO-178C Section 11.19

NAME OF DOCUMENT	DESCRIPTION	REFERENCE
Software Verification Cases and Procedures SVCP (STD/SVCP)	The FAA applies DO-178B as the document it uses for guidance to determine if the software will perform reliably in an airborne environment,[1] when specified by the Technical Standard Order (TSO) for which certification is sought. The introduction of TSOs into the airworthiness certification process, and by extension DO-178B, is explicitly established in 14 Code of Federal Regulations (CFR) Part 21, Subpart O	DO-178C 11.13 DI-IPSC-81439A

APPENDIX D: ACRONYM LIST

The following abbreviations or acronyms used in the text and are defined below:

Abbreviation or Acronym	Definition
AS	Acquisition Strategy
ADM	Acquisition Decision Memorandum
BAMS	Broad Area Maritime Surveillance
CAAS	Common Avionics Architecture System
CC	Common Criteria
CDE	Collaborative Development Environment
CDRL	Contract Data Requirements List
CI	Configuration Item
COI	Community of Interest
COTS	Commercial Off The Shelf
DFARS	Defense Federal Acquisition Regulation Supplement
DIACAP	Defense Information Assurance Certification and Accreditation Process
DID	Design Information Document
DISA	Defense Information Systems Agency
DO	Document
DoD	Department of Defense
FAR	Federal Acquisition Regulations
FFRDC	Federally Funded Research and Development Center
FSE	Field Support Engineer
GCS	Ground Control Station
GFE	Government Furnished Equipment
GFI	Government Furnished Information
GIG	Global Information Grid
GPR	Government Purpose Rights
GOTS	Government Off The Shelf
I-IPT	Interoperability Integrated Product Team
ID/IQ	Indefinite Delivery Indefinite Quantity
IPT	Integrated Product Team
IP	Intellectual Property
JAUS	Joint Architecture for Unmanned Systems
JITC	Joint Interoperability Test Center
JUAS	Joint Unmanned Aircraft System

Abbreviation or Acronym	Definition
JUAS COE	Joint Unmanned Aircraft System Center of Excellence
KOSS	Key Open Sub Systems
LSI	Lead System Integrator
MAC	Multiple Award Contract
MILS	Multiple Independent Levels of Security
MRMUAS	Medium Range Maritime Unmanned Air System
NESI	Net-Centric Enterprise Solutions for Interoperability
NGT	Next Generation Test
NICE	Navy Integrated Collaboration Environment
NOA	Naval Open Architecture
OA	Open Architecture
OAAT	Open Architecture Assessment Tool
OBM	Open Business Model
OSD	Office of the Secretary of Defense
OUSD (AT&L)	Office of the Under Secretary of Defense for Acquisition, Technology and Logistics
PEO	Program Executive Office
PoR	Program of Record
R&D	Research and Development
RA	Reference Architecture
RFI	Request For Information
RFP	Request For Proposal
ROI	Return On Investment
SBIR	Small Business Innovative Research
SDP	Software Development Plan
SDLC	Software Development Lifecycle
SEC	Software Engineering Center
SHARE	Software Hardware Asset Reuse Enterprise
STD	Software Test Description
STP	Software Test Plan
STTR	Small Business Technology Transfer
STUAS	Small Tactical Unmanned Air System
SOA	Service Oriented Architecture
SOW	Statement Of Work
TEMP	Test and Evaluation Master Plan
TI	Technology Insertion
TIPS	Technology Insertion Program for Savings

Abbreviation or Acronym	Definition
UAS	Unmanned Aircraft system
UAV	Unmanned Aerial Vehicle
UCLASS	Unmanned Carrier Launched Airborne Surveillance and Strike
UCS	UAS Control Segment
UCS-WG	UAS Control Segment Working Group
UML	Unified Modeling Language
XMI	XML Metadata Interchange
XML	Extensible Mark-up Language

APPENDIX E: REFERENCES

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