Air Force Open Systems Implementation Guide

(DRAFT)

Prepared by:

HQ AFMC/ENPI

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1.0 Objectives

In today's global economy, everyone, including our potential adversaries, will gain increasing access to the same commercial technology base. The military advantage will go to the nation which has the best cycle time to capture technologies that are commercially available, incorporate them in weapon systems and field new operational capabilities. Open Systems (OS) concepts encourage the use of commercial products, processes, specifications and standards to enhance the pace of inclusion of new technology into weapon systems in a cost effective manner. OS help streamline the acquisition process and reduce life cycle cost by emphasizing performance based standards, reducing DoD unique requirements, and reducing hardware dependencies from software development. By promoting the use of commercial products, we can reduce the cost and risk inherent in the design of new acquisitions and concentrate on the seamless integration of our systems while increasing our interoperability and capability for continuous improvement via incorporation of evolutionary technology. OS concepts must be incorporated into every phase of the acquisition process and supported at all levels of DoD management.

2.0 Policy

On 29 June 1994, the Secretary of Defense issued a policy memo titled "Specifications and Standards -- A New Way of Doing Business." This initiative is to use performance and commercial specifications and standards instead of military specifications and standards where feasible. The Secretary of Defense's letter was followed by a 29 Nov 94 letter from The Under Secretary of Defense for (A&T), Dr. Kaminski, that stated: *"I am directing that "Open Systems" specifications and standards (electrical, mechanical, thermal, etc.) be used for acquisition of weapon systems electronics to the greatest extent practical. Effective immediately, these systems and subsystems shall be designed, developed, and constructed as Open Systems during the acquisition and modification process to reduce life-cycle cost and to facilitate effective weapon system intra- and interoperability."* Dr Kaminski's letter also established the Open Systems Joint Task Force (OS- JTF) which is responsible to accelerate the adoption Open Systems processes for DoD. Paragraph 6.1 describes the OS-JTF and their responsibilities.

Although the intial focus of Open Systems efforts was electronic systems, DoD 5000.2-R (dated March 15, 1996) expands the role of Open Systems in the acquisition process. Paragraph 4.3.4 states: *"An Open Systems approach shall be followed for all system elements (mechanical, electrical, software, etc.) in developing systems. This approach is a business and engineering strategy to choose specifications and standards adopted by industry standards bodies or de facto standards (set by the market place) for selected system interfaces (functional and physical), products practices and tools. Selected specifications shall be based on performance, cost, industry acceptance, long term availability and supportability, and upgrade potential."* For all C4I systems, information systems and weapons systems that must interface with C4I systems or information systems, mandatory guidance is contained in the Joint Technical Architecture (JTA) and the Technical Architecture Framework for Information Management (TAFIM).

3.0 Introduction

The purpose of this guide is to define an open system and the approach to its implementation. Guidance is provided for implementing an open systems approach on new and legacy systems. A generic open architecture framework is presented. In addition, the guide addresses specific requirements for implementation on C4I systems and systems that interface with C4I systems.

3.1 Open System

A system that implements sufficient open specifications for interfaces, services, and supporting formats to enable properly engineered components to be utilized across a wide range of systems with minimal changes, to interoperate with other components on local and remote systems, and to interact with users in a style that facilitates portability. An open system is characterized by the following:

- Well defined, widely used, non-proprietary (preferably) interfaces/protocols, and
- Use of standards which are developed/adopted by industrially recognized standards bodies, and
- Definition of all aspects of system interfaces to facilitate new or additional systems capabilities for a wide range of applications, and
- Explicit provision for expansion or upgrading through the incorporation of additional or higher performance elements with minimal impact on the system.

3.2 Open Systems Approach

Acquisition programs shall follow an open systems approach for military systems design. This approach is a business and engineering strategy, implemented by the IPT process, to choose widely used commercially supported specifications and standards for selected system interfaces (logical and physical), products, practices, and tools. Selection of commercial specification and standards shall be based on:

- those adopted by industry consensus based standards bodies or de facto standards (those successful in the market place);
- market research that evaluates the short and long term availability of products built to industry accepted specifications and standards;

- a disciplined systems engineering process that examines tradeoffs of performance, supportability and upgrade potential within defined cost constraints; and
- allowance for continued access to technological innovation supported by many customers and a broad industrial base.

3.3 Definitions. See Appendix A

4.0 Implementation Guidance

The Air Force uses the Open Systems concept as a business and technical approach. Open Systems is implemented through the Systems Engineering process and addresses the approach used to define the system architecture and the selection of interfaces. At first, the Open Systems approach assures that all interfaces have the potential to be open. The contract would include incentives for the contractor to include open systems in their system architecture, and would require an explanation for the use of unique interfaces. In an ideal world we would use only open specifications and standards, since this would allow for maximum use of existing technology and the possibility to upgrade inexpensively as new technologies become available. In reality, most military systems have unique functions which result in unique interfaces. The degree of Open Systems implementation depends on the availability of technology, system complexity, and operational requirements. Doing the “right thing” would most likely result in a mix of both open system specifications and unique customized interfaces.

Legacy systems present a greater challenge from both a business and technical aspect. There are more sustainment contract actions for legacy systems than for new systems. Also with reduced development budgets, we are concentrating on modifications, upgrades, and sustainment of our current inventory. Contributing to the need for Open Systems are Diminishing Manufacturing Sources (DMS), and the need for technology insertion. The integration and testing of new sub-systems and components are very expensive. Therefore, management of the “as integrated/as installed attributes and acceptance criteria are crucial in controlling interfaces and scoping test requirements.

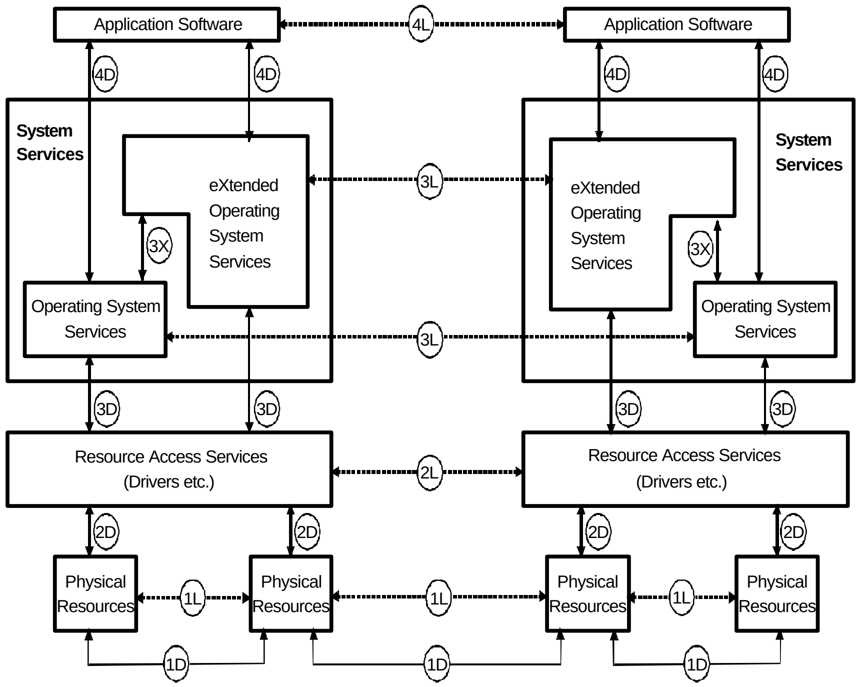
4.1 Generic Open Architecture (GOA) (SAE AS 4893)

The Generic Open architecture (GOA) was initiated to develop a framework which can be used to classify interfaces needed in airborne avionics systems. At the time of the development of the GOA, development of such a classification was considered a crucial part of transitioning open systems standards to military avionics. However, it was determined during the development of the GOA that the GOA framework is applicable to domains other than avionics. For that reason the framework is entitled Generic Open Architecture instead of the original name, Generic Open Avionics Architecture (GOAA).

The purpose of the GOA is to provide a framework to identify interface classes for applying open system interface standards to the design of a specific hardware/software system. This framework is used to define an abstract architecture based on a generic set of interface points. The generic set of system interface points facilitate identification of critical interfaces.

Figure 1 shows the GOA Framework within the context of two separate application platforms. These classes are the levels of interfaces from Physical Resources up to systems of Application Software which are to be completely defined in an architecture developed in accordance with this standard. It is intended that the GOA Framework be specialized for varying domains. A domain specific implementation of the GOA Framework will increase the chance that components/capabilities produced independently will “plug and play” and evolve affordably within the domain. The GOA Framework provides a basis for commonality for both vendors and users of components/capabilities. Application of the GOA Framework will impose constraints on individual domains and implementations. This will increase the likelihood that independently produced products will interoperate. The JACG is already using the GOA to develop an Aviation Domain Technical Framework (ADTF). Figure 2 shows how the GOA Framework can be extended to cover multiple applications within the aviation domain.

Generic Open Architecture Framework



4L Applications Logical Peer Interfaces
4D Applications-to-System Services Direct Interfaces (API)
3L System Services Logical Peer Interfaces
3D System Services Software-to-Resource Access Services Direct Interface
3X Extended Systems Services to Resource Access Services and Operating System Services
2L Resource Access Services Logical Peer Interfaces
2D Resource Access Services-to-Physical Resources Direct Interface
1L Physical Resources Logical Peer Interfaces
1D Physical Resources-to-Physical Resources Direct Interfaces

Figure 1

GOA Framework Application

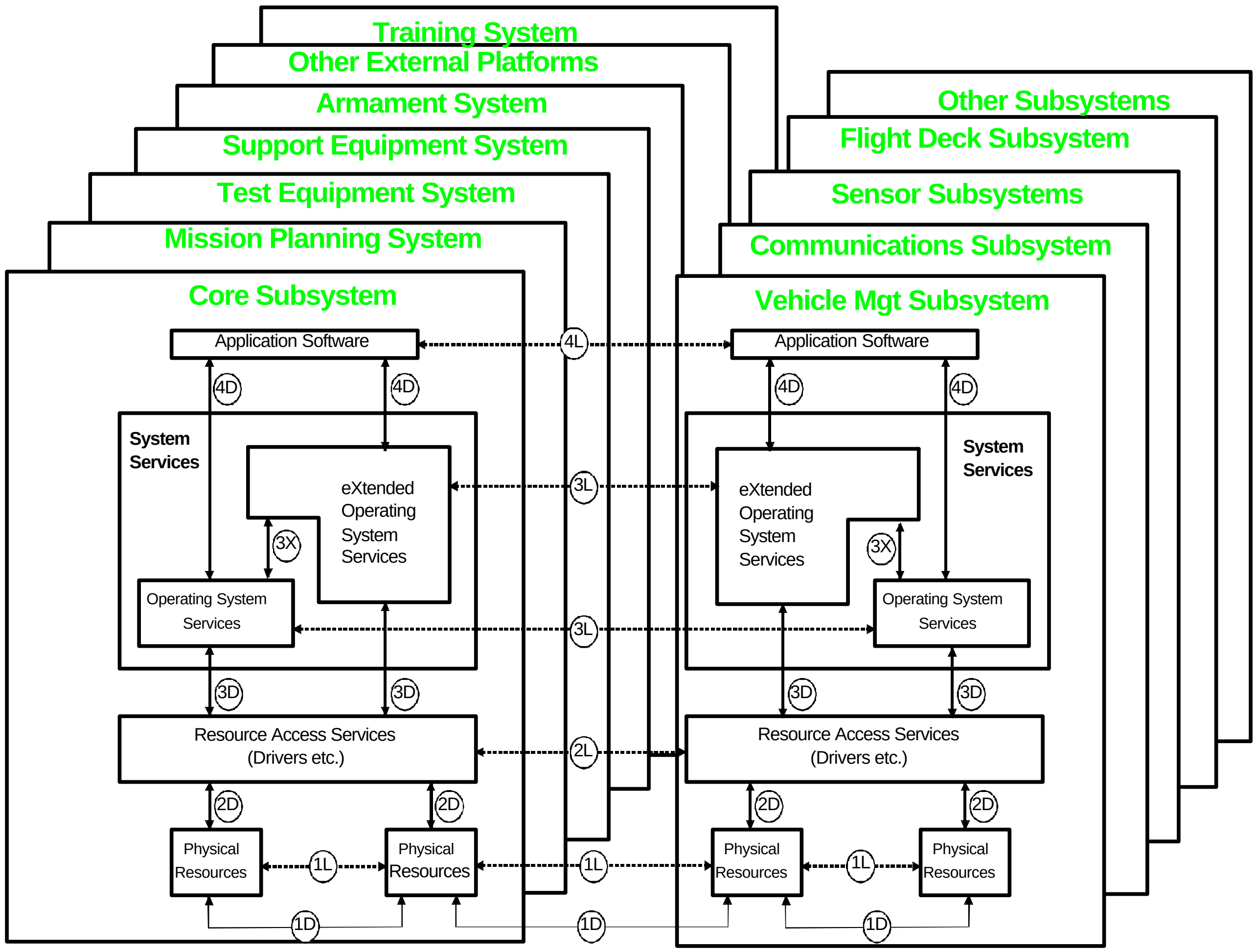


Figure 2

4.2 Joint Technical Architecture (JTA)

(http://www-jta.itsi.disa.mil/)

DoD Directive 4630.5 directs that all Command, Control, Communications, Computers, and Intelligence (C4I) systems shall be considered joint, unless specifically exempted. In accordance with this directive, the Joint Technical Architecture (JTA) shall be binding on all future DoD C4I system acquisitions. Systems developers shall use the JTA to ensure that new and upgraded C4I systems (and the interfaces to such systems) meet interoperability requirements. System integrators shall use it to facilitate the integration of existing and new systems. Operational requirements developers shall be cognizant of the JTA in developing requirements and functional descriptions. The DoD science and technology community shall use the JTA to ensure that the fielding of “good ideas” are not unduly delayed by the cost and time required by wholesale reengineering to specification.

The purpose of the JTA is: to provide the foundation for a seamless flow of information and interoperability among all tactical, strategic, and sustaining base systems that produce, use, or exchange information electronically; to mandate standards and provide guidelines for systems development and acquisition which will significantly reduce cost, development time, and fielding time for improved systems; and to influence the direction of the information industry’s technology development by stating the DoD’s direction and research and development investment so that it can be more readily leveraged in systems within DoD. For applicable systems, the JTA replaces the Standards Guidance (Vol 7) in the Technical Architecture for Information Management (TAFIM) currently cited in DoD Regulation 5000 .2-R.

4.3 Defense Information Infrastructure Common Operating Environment (http://spider.osfl.disa.mil/dii/)

Information processing standards support the objectives of reducing cost and time of development, easing software integration and maintenance, and improving interoperability. The primary mechanism is the concept of a Common Operating Environment (COE) that provides a reusable set of common software services via standard application program interfaces (APIs). By building modular applications that use a common software infrastructure accessed through a stable set of APIs, as well as a standard integration approach, developers will be able to "plug and play" their applications into a centrally maintained infrastructure.

The COE Concept is described in the Integration and Runtime Specification (I&RTS), Version 2.0, October 1995. The Defense Information Infrastructure (DII) COE is implemented with a set of modular software that provides generic functions or services, such as operating system services. These services or functions are accessed by other software through standard APIs. The DII COE may be adapted and tailored to meet the specific requirements of a domain. The key is that domain implementations adhere to the COE concept in that they provide standard modularized software services that are consistent with the Technical Architecture Framework for Information Management (TAFIM) Technical Reference Model (TRM) and that application programmers have access to these services through standard APIs. The DII COE is mandated by the JTA.

4.4 Technical Architecture Framework for Information Management (TAFIM)

(http://www.itsi.disa.mil)

In a memorandum dated June 23, 1994, the Assistant Secretary of Defense for C3I established the Technical Architecture Framework for Information Management (TAFIM) as the single framework to promote the integration of Department of Defense (DoD) information systems (C4I), expanding the opportunities for interoperability and enhancing our capability to manage information resources across the Department. The latest version of the TAFIM, Version 2.0, is complete and fully coordinated. The TAFIM will continue to guide and enhance the evolution of the Department's information systems technical architectures.

The TAFIM characterizes an information system as composed of data, mission-specific applications, and a technical infrastructure consisting of support applications, application concepts and communications networks. The TAFIM presents technical architecture concepts and design guidance for information systems in the Department of Defense (DoD).

The TAFIM provides guidance for the evolution of the DoD technical infrastructure. The TAFIM does not provide a specific system architecture. Rather, it provides the services, standards, design concepts, components, and configurations that can be used to guide the development of technical architectures that meet specific mission requirements.

The TAFIM is independent of mission-specific applications and their associated data. It introduces and promotes interoperability, portability, and scalability of DoD information systems. The TAFIM is an enterprise-level (Departmental- or DoD-Level) guide for developing technical architectures that satisfy specific functional requirements. It also provides an organizational level guide and link to the enterprise level. To achieve an integrated enterprise, it is assumed that all information systems must interoperate at some time. Therefore, their architects and designers should use the TAFIM as the basis for developing a common target architecture to which systems can migrate, evolve, and interoperate. Over time, interoperability between and among the number of systems will increase, providing users with improved services needed to achieve common functional objectives. To achieve portability, standard interfaces will be developed and implemented. Scalability will be developed in mission applications to accommodate flexibility in the functionality. The TAFIM is a framework for designing C4I Technical Architectures, and the DoD has utilized it along with the Army's Technical Architecture (ATA) to design the Joint Technical Architecture (JTA) for C4I systems.

4.5 Technical Reference Codes (TRCs)

(http://infosphere.safb.af.mil/~tnb/toplvl.html).

TRCs are an easily accessible compendium of interoperability-related standards, policy, and guidance. TRCs provide a collection of interoperability references (policy, directives, transition guidance, and standards) for acquiring and implementing Air Force information technology systems, system components, and services. TRCs bring together diverse government and non-government standards, as well as Air Force and DoD policies and guidance, to help USAF personnel plan for, acquire, and implement interoperable C4I systems and system components. The DoD TAFIM is the foundation for the TRCs. However, if there is a conflict between the TAFIM and TRCs, the guidance contained in the TRCs takes precedence. The TRCs implement interoperability-related standards in Volume 7 of the TAFIM by providing an improved organizational structure, more standards coverage, and Air Force and DoD policy information and guidance. There are two types of TRCs: Service and Component.

Component TRCs. These TRCs organize the body of interoperability information by category of system components. These components are defined as parts of C4I systems. Some examples of Component TRCs are routers, telephone switches, and computing platforms. Component TRCs are geared toward smaller acquisitions and piece-part buys. Their focus is on providing users with information on system component interoperability considerations. The target audiences for Component TRCs are the base, wing, or major command (MAJCOM) C4I professionals who work with end-users to acquire C4I system components, as well as AFMC product centers.

Service TRCs. These TRCs organize the body of interoperability information into C4I system capabilities available to a user. Service TRCs are intended for use in large acquisitions where the focus is on turning a user requirement into a C4I system capability. Consequently, the primary customers for Service TRCs are AFMC product centers charged with C4I system development or weapon system developments that must interface with C4I systems. The Service TRCs address services such as voice, computing, visual and imaging, etc.

The TRCs are organized for maximum utility by C4I architects and system planners. The two types of TRCs, Service and Component, are designed to mirror the two classes of problems that C4I planners face. The more function-oriented Service TRCs address the broad-based ideas that are primary concerns when planning entire systems, while the more physical systems-oriented Component TRCs address specific solutions to specific problems using C4I components. The nature of this organization causes some amount of overlap across Service and Component TRCs, but with experience, users will quickly find that the two types of TRCs work together, as Component TRCs tend to implement the concerns and ideas that are addressed by Service TRCs. Although there is no hard-and-fast rule for when to use a Service versus a Component TRC (or both).

4.6 Performance Based Business Environment (PBBE) for Existing Systems

(http://www.wpafb.af.mil/az/jacg/pbbe/pbbe.htm)

The key to incorporating Open Systems is the Performance Based Business Environment (PBBE). This allows us to control cost, risk, and insert technology through the utilization of Form, Fit, Function and Interface (F^3I) specifications combined with a flexible sustainment strategy. F^3I allows for the insertion of technology on one side of the interface without being forced to modify the other side of the interface. Flexible sustainment gives you several options of how to work with industry to support the weapons system. These options include long term maintenance agreements and performance incentives. This will help motivate the contractors. The PBBE gives the government control through high level performance specs, along with the options of Build-to-Print, Modified Build to Print, and Form, Fit, Function and Interface specifications to support the maintenance and support concepts and spares reprocurement. There are eight different PBBE guide and they are all available at JACG Website.

4.7 High Level Archtecture (HLA)

(http://www.dmso.mil/projects/hla/)

In accordance with the DoD Modeling and Simulation Master Plan (DoD 5000.59-P, dated October 1995), the Defense Modeling and Simulation Office (DMSO) is leading a DoD-wide effort to establish a common technical framework to facilitate the interoperability of all types of models and simulations among themselves and with C4I systems, as well as to facilitate the reuse of M&S components. This Common Technical Framework includes the High Level Architecture, which represents the highest priority effort within the DoD modeling and simulation community. Initial definition of the M&S High Level Architecture (HLA) was accomplished under the sponsorship of the Advanced Research Projects Agency (ARPA) Advanced Distributed Simulation (ADS) program. It was transitioned to the DMSO in March 1995 for further development by the DoD-wide Architecture Management Group (AMG). Central to this task was the development of a set of prototypes which addressed critical issues in the HLA. The HLA Baseline Definition was completed on 21 August 1996. It was approved by the Under Secretary of Defense for Acquisition and Technology [USD(A&T)] as the standard technical architecture for all DoD simulations on 10 September 1996.

5.0 Program Self-Assessments

Assessments are a snapshot of the degree of openness of a new program or major modification. They are a way to get an in-depth look into a program's degree of OS implementation. OSD has tasked the services to report twice a year on the implementation status of Open Systems. To date we are have only reviewed major programs but we will need to expand to all ACAT programs as we refine our approach. Selected programs have completed a self-assessment questionnaire (see appendix B). They used the questions in the Self-Assessment questionnaire to establish to what degree their programs are using an OS approach. The Self-Assessment questionnaire is a list of 28 questions to be used by the Integrated Product Team to determine the extent to which a program is implementing an OS approach. Each question has an Explanation/Expectation associated with it. These questions assume a description of the program has preceded this analysis that would cover basic program objectives, acquisition strategy, status and description of the contemplated system. The questionnaire is divided into six sections; Architecture, Interfaces, Choosing A Level, Reuse, Risks, and Supportability**.** An important point to remember is that a program should approach designing the system architecture using the OS concept but the actual implementation will vary from program to program.

6.0 Supporting Information and Related Projects

6.1 Open Systems Joint Task Force (OS-JTF)

(http://www.acq.osd.mil/osjtf)

The Open Systems Joint Task Force (OS-JTF) was chartered on 29 November 1994 when Under Secretary of Defense Kaminski signed an OS policy letter. Dr. Kaminski appointed H. Leonard Burke (formerly with NAVAIR) as the Task Force Director. The Task Force is staffed by representatives from each of the Services. The OS-JTF has a lead role in the OSD's OS initiative. Their web page contains extensive information on OS policy, briefings, papers, and training material.

6.2 Committee on Open Electronic Standards (COES)

(http://www.acq.osd.mil/osjtf)

The Committee on Open Electronic Standards (COES) was jointly chartered on 14 Nov 1995 by the director of the OS-JTF and the Chairman of the Standards Coordinating Committee (SCC). The COES was tasked to designate appropriate open systems standards for DoD weapons systems use. The key functions and responsibilities of the COES are as follows:

a. Coordinate and integrate identification and selection of open systems specifications and standards for weapons systems and platforms.

b. Coordinate identification and selection of Information Technology (IT) specifications and standards applicable to weapon systems through the SCC.

c. Coordinate identification and selection of non-IT specifications and standards (mechanical form factors, power distribution, RF/IF partitioning, etc.).

d. Coordinate DoD requirements for open systems specifications and standards for weapon systems. Satisfy these requirements by providing DoD positions and contributions to non-Government standards bodies.

e. Charter working groups to address specific open systems specifications and standards issues and activities as necessary.

f. Act as the focal point for the services, agencies, and CINCs to resolve issues related to open systems specifications and standards for weapon systems.

6.3 Related Projects

There are open systems initiatives currently under way in the Air Force or being worked by multi-service groups involving the Air Force. Appendix C contains a list of related projects that support implementing the Open Systems concept. This list will expand as new program/projects are started.

6.4 Lessons Learned

Important lessons learned will be incorporated into future updates of this guide.

7.0 Training and Education

As the charter and vision statements of the OS-JTF indicate, this activity will take a leadership role in the definition and establishment of training and education programs for OS. Development of a specific training and education program will need to follow the efforts of the OS-JTF, but early deployment is considered a key element in effective implementation of OS concepts in Air Force programs. The OS-JTF Homepage (http://www.acq.osd.mil/osjtf) includes training materials which can be reviewed by the individual.

8.0 References

1. SECDEF Policy Memorandum, Specifications and Standards -- A New Way of Doing Business, 29 Jun 1994

2. OUSD (A&T) Memorandum, Acquisition of Weapons Systems Electronics Using Open Systems Specifications and Standards, 29 November 1994.

3. SAF/AQ Policy 95A-003 Memorandum, Specifications and Standards -- A New Way of Doing Business, 22 June 1995

4. PDUSD (A&T) Memorandum, Assessment of Open Systems Approach in Major Programs, 11 Jan 1996

5. OUSD (A&T) Memorandum, Open Systems Acquisition of Weapons Systems, 10 July 1996

6. DoD 5000.2R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs (Part 4)

Appendix A
Definitions

Architecture

An architecture is a composition of (1) components (including humans) with their functionality defined (Technical), (2) requirements that have been configured to achieve a prescribed purpose or mission (Operational), and (3) their connectivity with the information flow defined (System). **(OS-JTF 1995)**

Commercial Item

1) Any item customarily used by the general public for other than governmental purposes, that has been sold, leased, or licensed to the general public, or that has been offered for sale, lease or license to the general public.

2) Any item that evolved from an item described in 1) above through advances in technology or performance that is not yet available in the commercial market, but will be available in time to meet the delivery requirements of the solicitation.

3) Any item that, but for modifications of a type customarily available in the commercial market or minor modifications made to meet DoD requirements, would satisfy the criteria in 1) or 2) above.

4) Any combination of items meeting the requirements of 1, 2, or 3 above or 5 below that are of a type customarily combined and sold in combination to the general public.

5) Installation services, maintenance services, repair services, training services, and other services if such services are procured for support of any item referred to paragraphs 1, 2, 3, or 4, above, if the sources of such services:

- offers such services to the general public and the DoD simultaneously and under similar terms and conditions and

- offers to use the same work force for providing the DoD with such services as the source used for providing such services to the general public.

6) Services offered and sold competitively, in substantial quantities, in the commercial marketplace based on established catalog prices of specific tasks performed and under standard commercial terms and conditions.

7) Any item, combination of items or service referred to in 1 through 6 above notwithstanding the fact that the item or service is transferred between or among separate divisions, subsidiaries, or affiliates of a contractor.

8) A nondevelopmental item developed exclusively at private expense and sold in substantial quantities, on a competitive basis, to State and local governments.

(The NDI Handbook DoD 5000.37H, 30 June 1995 draft)

Commercial product See Commercial Item. **(OS-JTF 1995)**

de jure standard

A standard that has been officially approved by a recognized standards body. **(OS-JTF 1995)**

de facto standard

A standard that is widely accepted and used but that lacks formal approval by a recognized standards organization. **(FED-STD-1037C**)

Domain

A Domain is a grouping of related items within a certain area of interest. DoD domains include Operational Domains (e.g., Joint Strike, Strategic Deterrence) and Functional Domains (e.g., communications, navigation, fire control). **(TRI-SERVICE Open Systems Architecture Working Group)**

Interface standard

A standard that specifies the physical or functional interface characteristics of systems, subsystems, equipment, assemblies, components, items or parts to permit interchangeability, interconnection, interoperability, compatibility, or communications. **(MIL-STD-962C draft dated 14 June 1995)**

Interoperability

The ability of two or more systems or components to exchange data and use information. **(IEEE STD 610.12)**

Modular

Pertaining to the design concept in which interchangeable units are employed to create a functional end product. **(FED-STD-1037C)**

Non Developmental Item (NDI)

1) Any commercial item.

2) Any previously developed item in use by a US Federal, State or Local government agency or a foreign government with which the US has a mutual defense cooperation agreement.

3) Any item described in subparagraph 1 or 2, above, that requires only minor modification in order to meet the requirements of the procuring agency.

4) Any item currently being produced that does not meet the requirement of paragraphs 1, 2, or 3 above, solely because the item is not yet in use. **(The NDI Handbook DoD 5000.37H, 30 June 1995 draft**)

Open Standards

Guideline documentation that reflects consensus based agreements on products, practices, or operations by nationally or internationally recognized industrial, professional, trade associations or governmental bodies. These standards support interoperbility, portability, and scalability and are equally available to the general public at no cost or with a moderate license fee. (**OSJTF 1995)**

Open System

A system that implements sufficient open specifications for interfaces, services, and supporting formats to enable properly engineered components to be utilized across a wide range of systems with minimal changes, to interoperate with other components on local and remote systems, and to interact with users in a style that facilitates portability. An open system is characterized by the following:

- Well defined, widely used, non-proprietary (preferably) interfaces/protocols, and
- Use of standards which are developed/adopted by industrially recognized standards bodies, and
- Definition of all aspects of system interfaces to facilitate new or additional systems capabilities for a wide range of applications, and
- Explicit provision for expansion or upgrading through the incorporation of additional or higher performance elements with minimal impact on the system. **(IEEE POSIX 1003.0/D15 as modified by the Tri-Service Open Systems Architecture Working Group)**

Open Systems Approach

Acquisition programs shall follow an open systems approach for military systems design. This approach is a business and engineering strategy, implemented by the IPT process, to choose commercially supported specifications and standards for selected system interfaces (logical and physical), products, practices, and tools. Selection of commercial specifications and standards shall be based on:

- those adopted by industry consensus based standards bodies or de facto standards (those successful in the market place);
- market research that evaluates the short and long term availability of products built to industry accepted specifications and standards;
- a disciplined systems engineering process that examines tradeoffs of performance, supportability and upgrade potential within defined cost constraint; and
- allowance for continued access to technological innovation supported by many customers and a broad industrial base. **(OS-JTF 1995)**

Open Systems Standards

Standards which control and fully define attributes for software, hardware, interface design, network protocol, circuit board design, etc.. These standards have been developed and maintained in a commercial consortium or higher organization such as ISO or IEEE group consensus process. Standards have requirements for compatibility and interoperability at the interface, but they do not define the performance of a given product. A commercial manufacturer may change the performance of a product without government knowledge (consent is not required since we are now only another customer) and still comply with the standard. **(NGCR Acquisition Guide 6 Mar 1995 Draft *modified by OSJTF 1995*)**

Operational Architecture

The description of the tasks, operational elements, and information flows required to accomplish or support a warfighting function. **(Joint Technical Architecture)**

Portability

The ease with which a system, component, data, or user can be transferred from one hardware or software environment to another. **(TAFIM Vol. 1 & 3)**

Scalability

The capability to adapt hardware or software to accommodate changing work loads. **(OS-JTF 1995)**

Specification

A document that prescribes, in a complete, precise, verifiable manner, the requirements, design, behavior, or characteristics of a system or system component. **(IEEE P1003.0)**

Standard

A document that establishes uniform engineering and technical requirements for processes, procedures, practices, and methods. Standards may also establish requirements for selection, application, and design criteria of material. **(DoD 4120.3-M)**

Standards Based Architecture

An architecture based on an acceptable set of standards governing the arrangement, interaction, and interdependence of the parts or elements that together may be used to form a Weapons Systems, and whose purpose is to insure that a conformant system satisfies a specified set of requirements. **(OS-JTF 1995)**

System

Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions. **(FED-STD-1037C)**

System Architecture

A description, including graphics, of systems and interconnections providing for or supporting warfighting functions. **(Joint Technical Architecture)**

Technical Architecture

A minimal set of rules governing the arrangement, interaction, and interdependence of the parts or elements that together may be used to form a system, and whose purpose is to insure that a conformant system satisfies a specified set of requirements. **(Joint Technical Architecture)**

Weapon System

A combination of one or more weapons with all related equipment, materials, services, personnel and means of delivery and deployment (if applicable) required for self sufficiency.

(JCS Pub 1-02)

Appendix B

Self-Assessment Questionnaire

BACKGROUND

OSD has mandated the use of the Open Systems concept for acquisition. Open Systems provide a foundation for lower life cycle costs and improved weapons systems performance through use of standards based architectures and greater access to commercial electronics technology, products and processes. In order to implement the policy a practical definition of an open systems approach is needed. Although the subject is complex and we are plagued with imprecise and conflicting terms, it is possible to bring order out of the chaos. The purpose of this paper is to provide a framework for understanding if a program is implementing an open system approach and how programs might be more successful in achieving the vision.

The following questions and discussion can be used by an Integrated Product Team or other reviewer to determine the extent to which a program is implementing an open systems approach. The question on the left side is intended to be answered by a program representative. The comments on the right establish the expectation for the answer. These comments provide the background or important considerations about the issue.

PROGRAM INFORMATION

This section asks for basic program information.

QUESTIONS	EXPLANATIONS/EXPECTATIONS
1. Program Description	1. General description of the program(i.e. what i who manages it, concepts for use, etc.)?
2. Program Objectives	2. What requirements are being addressed and w the schedule and intended operational implement
3. Acquisition Strategy	3. What is the current acquisition strategy?
4. Status	4. What is the status of the program and when is

	next Milestone Review scheduled?

ARCHITECTURE

An architecture identifies components, the relationship between components and the rules for the architecture's composition. An Open System Approach is based on an architecture that uses open standards to describe these relationships and rules.

QUESTIONS	EXPLANATIONS/EXPECTATIONS
5. Do you have a system architecture descriptior is traceable to the program's Operational Require Document (ORD)?	5. Architecture examples may range from a purel vertical, stove pipe architecture based on a propr implementation to a modular, hierarchical, layere architecture based on open standards for its inter
6. How has the system architecture been chosen How will be it be chosen?)	6. Does the government choose the architecture; industry choose the architecture or is the architec chosen in concert? The government may specify performance attributes of system building blocks including internal interface standards. Doing so without adequate input from industry runs the ris violating Secretary Perry's vision of "...A New W Doing Business." We may stifle innovation, limit performance and increase cost by attempting to substitute our wisdom for that of the designer. If the other hand, we provide no guidance, we may encourage development of proprietary architectu interfaces and components. That would leave us maintain and modify a unique product with a sing supplier at a high, non-competitive price. Each program must chose a way between these two extremes. A desirable situation is for a consensus among potential prime contractors and their key suppliers on application of widely accepted stand
7. What aspects of your program might limit the an open systems approach.?	7. This is a critical decision for the open systems approach and the response should address both hardware and software aspects. For example, so acquisitions where we are not modifying or organ supporting the product, we should specify no architecture. For large or complex programs may widely different answers for different portions of system.

CHOOSING A LEVEL

A standards based architecture will define interfaces between and performance of components at a high level of abstraction. Below the lowest level of government configuration control no specified architecture exists and the supplier has freedom to insert new technology and processes to lower cost and improve performance. We accept that below this level the supplier may provide proprietary designs.

QUESTIONS	EXPLANATIONS/EXPECTATIONS
8. At what level will the architecture be defined f this system? How were the levels of the architec chosen?	8. The architectural approach resulting from a sy engineering process should be linked to a busines analysis. The decisions about architecture should traceable to performance, life cycle cost, schedule risk. Alternatives for support, maintenance and upgrade should be evaluated.

INTERFACES

Interface choices must be made as part of the systems engineering process, considering programmatic, performance, and affordability requirements.

QUESTIONS	EXPLANATIONS/EXPECTATIONS
9. What hardware and software interfaces will be in the system? Which of these interfaces are proprietary? Which of these interfaces are unique this system? Which of these interfaces are based on standards which are not?	9. A major goal of open systems is to enable the widely used products within a domain of interest. use of accredited industry standards are preferred may be too restrictive. There are many wide spre commercial products based on de facto standards well as de-jure standards.

10. How are the interfaces selected?	10. While interfaces should be identified as early possible in the acquisition cycle, implementation decisions should be delayed as long as possible. Interfaces should be chosen that are technology independent. This approach sets the foundation long lived architectures that allow implementatio evolve. The TAFIM Volume three provides a pr which leads to the selection of interfaces for information technology systems.

11. What is your selection criteria?	11. Interface standards should be selected based their openness, maturity, and how well they satisf performance requirements and allow future techn insertion/transparency. Openness can be measure with respect to an interface standard's interoperal scalability and portability. Openness may also co whether a standard is recognized internationally, nationally, by consortium, as de facto or as milita Maturity can be gauged based on how wide sprea standard is in use and whether there are certificat conformance tests available for them. Finally, the standard can be measured against the system's cu and projected needs.
12. Has the program specified any options or extensions to the interface standards?	12. Open system interface standards normally hav profiles of mandatory, optional, configurable and extendible features. The commercial market norm only supports certain defined profiles of mandato optional features. While optional feature can be tailored to meet specific needs of the system, cau should be exercised in selecting these optional fea since products may not always be available, or ma conflict with other products built to the same stan The selected configurable features should not be vendor specific. Vendor extension features shoul avoided. Extensions to open interface standards to work against the benefits: portability, interoperability, etc.
13. How much does your system depend on extensions to standards?	13. Extensions and improperly implemented mandatory and optional features of interface stan can dramatically reduce technology choices and g increase integration costs. Some products simply not work as advertised, especially in conjunction products of other vendors (even when built to the standard). Increased, thorough conformance, interoperability and performance testing may be required.
14. Have you documented your use of standards	14. This documentation should be made availabl review.

15. What is your plan for system upgrade and technology insertion?	15. Select interfaces considering the impact of th system's evolutionary goals and growth needs
16. What parts of your system will be developed versus bought or reused? Is reuse important to y system achieving reduced development and produ cost?	16. Architectures are often defined to cover a relatively broad area or family of systems. Stand based architectures allows for reusability across a domain. Identify interfaces that support portabili interoperability.
17. What part of your system is Commercial Iter (CI), non-developmental items (NDI) based? Ar CI, NDI proprietary or open?	17. Does the use of CI or NDI products lead to vendor dependencies?
18. How many other customers use your selecte interfaces? How many suppliers provide product compliant with your selected interfaces? What m research supports your selection of interfaces? W other than traditional DoD suppliers included in t research?	18. The market tends to naturally select the stan that are best for the largest number of users. A h performance, but unsupported, standard may cos than a less capable standard for which many prod are available.
19. Do your information technology (IT) interfa have any relationship to the Technical Architectu Framework for Information Management (TAFII	19. C3I systems in DoD are required to be comp with the TAFIM. Weapons systems are required compliant with the TAFIM where they interface C3I systems.

SUPPORTABILITY

QUESTIONS	EXPLANATIONS/EXPECTATIONS
20. How will your approach to supportability ch to accommodate an open system environment in system?	20. Detailed product support planning must occu concurrently with the start of the development pr Baselines will be continually migrating because in is releasing new products every 18-24 months. Support must be defined, planned and purchased each baseline change. The NGCR "Open System Computer Resources Supportability Guide," 15 S 1995, describes 13 supportability disciplines and system issues with each of them.
21. What drivers influence your maintenance	21. Issues such as uniqueness of your product, s

philosophy?	availability from shared systems, redundancy or graceful degradation, automated fault detection a isolation and design stability of the product are so the major considerations to explore.
22. How will you combine maintenance via upgr with conventional repair and reuse of assets?	22. Your support infrastructure should facilitate technology insertion as well as reuse of retired as coordination with other platforms and user syster

REUSE

QUESTIONS	EXPLANATIONS/EXPECTATIONS
23. What elements of CI or NDI will be incorpor What hardware and software is reused?	23. Use of CI or NDI may lower the overall cost risk. This may however raise other issues for the program (e.g. supportability, configuration contro etc.). See the NDI Handbook DoD 5000.37H, 3 1995 (draft).

RISKS

QUESTIONS	EXPLANATIONS/EXPECTATIONS
24. What risks are there in your program as a res implementing an open systems approach? How d deal with the risk of re-using a component beyon capability?	24. Open systems approach should help manage risks associated with the use of commercial techn and CI.
25. What type of contract and incentive/award (c what are they incentivized for?) arrangement do y have with your contractor, his sub-contractor/ven team, and other competing teams (if any)?	25. Often the type of contractual relationship a program office has with its development contract will impede or facilitate accomplishment of broad ambiguous] program requirements. The arranger the prime contractor(s) has with the rest of his tea just as important.

26. What teaming arrangement does your prime contractor(s) have? What are the work assignment/responsibilities and how does this imp system interface selections?	26. Contractor teaming arrangements are often b on business decisions motivated toward winning contract. These same arrangements can later pre answers to interface decisions regardless of whet it's best for the program in the long term or not.
27. What is the process used to choose between developing a system component/sub-system in-ho (prime or contractor team) or purchasing from a supplier?	27. Expect a copy of the "Make or Buy" plan. If sparse in content, or non-existent, then it will be relatively easy for the contractor to mold the anal to his desired outcome. Contractor could be mot to develop a new capability in-house and get the government to pay for it, even though there's a perfectly good commercial item that could be use
28. How are open system interface requirements imposed on the developer? Tracked by the devel	28. How requirements are documented, imposed the contractor, and flowed down in a program ar critical. The contractor can show you how his cu approach will do everything you want on a progr but unless it's tied to the contract requirements it amounts to little more than a promise.

Chien Huo
703-578-6595
huoc@acq.osd.mil

Appendix C

Related Projects

There are many open systems initiatives currently under way in the Air Force or being worked by multi-service groups involving the Air Force. This section will expand as new program are started or old programs develop an open systems approach.

C.1 JACG Guide Specifications

(http://www.wpafb.af.mil/ngs)

The DoD aviation community is beginning to recognize the significance of product lines. The Joint Aeronautical Commanders Group (JACG) is developing guide specifications for use in acquiring new systems. The guides are organized into 11 templates that roughly correspond to product lines. The templates are: air superiority fighter; air-to-air missile; air-to-surface attack; cruise missiles; smart weapons; special operations (search and rescue, mine sweeping); transports (refueling, medical evacuation); electronic warfare; reconnaissance, surveillance, and command & control; antisubmarine warfare; and helicopter attack. The templates are a place to embed technical architecture requirements for a specific system acquisition.

C.2 Integrated Command and Control Experimentation Facility (ICEF)

The ICEF at the Electronic Systems Command (ESC) is a consolidated laboratory where the latest Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems and related technology are explored, applied, integrated, and evaluated. The facility includes the Command and Control Unified Battlefield Environment (CUBE), associated laboratory facilities, a common support infrastructure, and remote communication facilities. The CUBE uses a variety of realistic joint, combined, and coalition operational scenarios to support contingency operations, acquisition programs, and technology infusions. The associated laboratories are specialized on specific systems, mission areas, or domains. They are used individually in support of specific acquisition programs, and they are joined on integrated configurations for system of systems experiments.

C.3 Command and Control Product Line (CCPL) Program

The Command and Control Product Line (CCPL) Program is an ESC acquisition streamlining initiative to reduce the overall development time and cost associated with Command and Control

Chien Huo
703-578-6595
huoc@acq.osd.mil
(C2) acquisitions. The CCPL Program will expedite the fielding of C2 systems by reducing the time necessary to define requirements, develop specifications, and provide system design by eliminating the need for repetitive source selection to initiate the design, development, and fielding of C2 systems with common features. Early prototyping and development of C2 systems using standard, tested components will be initiated by issuing Task Orders against multiple indefinite delivery/indefinite quantity contracts. By utilizing reusable software engineering technology, software repositories, C2 product line architecture, and rapid prototyping techniques, a CCPL developer can quickly integrate tested components into functional systems. The CCPL goal is to rapidly design, develop, and deliver quality operational C2 systems that satisfy the majority of user's functional and performance requirements at reduced costs over the standard acquisition process.

C.4 Evolved Expendable Launch Vehicle (EELV)

The EELV program at the Space and Missile Systems Center (SMC) is implementing an open systems approach in which EELV contractors are considering use of standards adopted by industry and defined through a consensus process (e.g. Industry standard bodies such as the Institute for Electronics and Electrical Engineers (IEEE)). The intent of the open systems approach is to implement a system design/architecture which facilitates integration and use of commercial products available from multiple sources. This approach discourages the use of proprietary or system unique interfaces.

C.5 Space Communications Protocol Standards (SCPS)

The SCPS program at SMC is implementing an open systems approach in which a set of integrated space/ground communication protocols for spacecraft command and telemetry data that will be used by missions that are cross-supported between Agencies. This initiative lowers the life cycle cost and improves system performance across numerous agencies. The SCPS program was initiated by U. S. Space Command and is in the process of being transferred to SMC.

C.6 Parts Management Best Practice (PMBP)

The PMBP at SMC facilitates open system implementation. The application of the PMBP is derived from the mission and systems performance requirements and details the "what" elements of an effective Parts Management process and not the detailed "how to". The document emphasizes the engineering and supplier management elements recognizing the DoD's acquisition reform objective to utilize the commercial industrial base and apply commercial practices and commercial solutions to the maximum extent practical. This Best Practice has been developed to assist in dealing more proactively with critical parts management issues and to provide guidance for developing comprehensive strategies to manage cost and schedule risk.

Chien Huo
703-578-6595
huoc@acq.osd.mil