Using the Department of Defense Information Enterprise Architecture (DoD IEA) as a Black-Box

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Abstract. The term Reference Architecture continues to be thrown around as if it is a panacea to solve our ailing architecture problems. Many executive agencies define their Top Level Architectures (TLAs) as a forcing function to facilitate compliance and an overall blueprint for the future. When executed correctly, these TLAs can actually be used to answer questions that are otherwise elusive. Unfortunately, the lack of specificity of these TLA makes it difficult, if not impossible to use as a reference to anything concrete – a program, system, solution or plan. This causes the failure of the TLA to serve its prime function as a forcing function and valued reference.

The Department of Defense (DoD) is moving toward a Joint Information Environment (JIE). A JIE is not only smart because it will allow the DoD and the supporting underlying service components to integrate and communicate more seamlessly, but it is a necessity as our DoD resources are dwindling under White House and Congressional pressure. The intent of the JIE is to be able to share and quickly access resources like networks, identity management, cyber security and data centers across service boundaries. In our view, before the JIE can move from the conceptual to the physical, the JIE needs a TLA which acts as a black-box. In order to open the black-box one needs only know a capability. With the capability in hand, the TLA should be able to answer a multitude of questions, letting one peak into the black-box and take out the things needed to act within/throughout the enterprise.

This paper will show how we use the DoD IEA as that black-box to answer questions like what standards do I need to implement to be allowed on the network(s)? What services are available in the enterprise that can be leveraged to quickly deploy the capabilities desired? Which data centers provide the capabilities needed and where are these capabilities located? Finally, how do the capabilities in the enterprise support the strategic vision of the DoD and to a further extent the United States?

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1. INTRODUCTION. The Department of Defense Information Enterprise Architecture (DoD IEA) is the authoritative source for DoD Chief Information Office (CIO) designated architecture governance bodies to determine compliance with the Information Enterprise (IE) vision in achieving mission effectiveness, cyber security, and efficiency goals. The intent of its content is for strategic planners and policy writers to incorporate DoD IEA content during development of their architectural artifacts.

Incorporating portions or a complete subset of the DoD IEA into a system(s) requires a comprehensive understanding, utilization and accommodation of disparate documents and technologies not normally available in a single repository. For this reason, architecture development and further, architecture compliance remains one of the most challenging aspects of the Clinger Cohen Act\(^1\).

Some of the tenets of the DoD IEA:

The DoD IEA provides a clear, concise description of what the IE must be and how its elements should work together to accomplish a transformation and deliver efficient, cost effective information and service sharing. The DoD IEA enables proper planning for shaping the DoD IT landscape, managing the acquisition of required resources, and effectively operating the resulting IT environment. The DoD IEA describes a future vision for the IE based on merging mission operational needs with the concepts previously embedded in separate net-centric strategies. It is subdivided into a manageable set of required capabilities which are discrete actions the IE must either perform or provide. Each of these capabilities is described in terms of activities, services, and rules necessary to ensure the capability is achieved. The DoD IEA outlines how capabilities are delivered by providing descriptions of services the IE must have to operate at optimum effectiveness. These services represent a collection of required information across the spectrum of Doctrine, Organization, Training, Leadership and education, Materiel, Personnel, and Facilities (DOTMLPF)\(^2\).

In order to facilitate the usage and viability of the DoD IEA as a physical more so than logical document, our team used a software framework to actualize its usage. The Enterprise Architecture Automated Framework (EA2F)\(^3\) provides architects, system analysts, cost analysts and executive decision makers a concrete method for making decisions based on any TLA

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2 DoD IEA. Vol. II. N.p.: Office of the Chief Information Officer, 2012. i. 2 vols. Print
available. This document’s goal is showing how architectures can be used to model, articulate and in key areas restrict the duplication of capabilities within an enterprise and at a lower level, force compliance of systems to the TLA.

2. THE BASIS FOR TLAs AND REFERENCE ARCHITECTURES. Why use a structure like the DoD IEA as a black-box? We can link this question back to our acquisition governance strategy; “The Joint Capabilities Integration and Development System (JCIDS).” JCIDS examines multiple concepts and alternatives to optimize the way the Department of Defense provides capabilities. The examination includes robust analyses that consider affordability, technology maturity, and responsiveness. Technologists and industry identify and protect promising technologies in laboratories, research centers, academia, and commercial sources; reduce the risks of introducing these technologies into the acquisition process; and promote coordination, cooperation, and mutual understanding of technology issues. The DoD IEA should be able to provide the initial peak into the enterprise to see if a new requirement coming into the DoD domain can be satisfied by capabilities we have in hand; in essence, it should support the genesis of a Capability Based Assessment (CBA).

With a viable and matured TLA like DoD IEA, targeted Reference Architectures (RAs) could be constructed to inform the combat developers and chief architects within DoD of possible solutions already available to them. The DoD community is currently attempting this by constructing RAs that can inform areas like:

- Enterprise-wide Access to Network & Collaboration Services RA (EANCSRA)
- Active Directory Optimization RA (ADORA)
- IT Infrastructure Optimization RA (ITIORA)
- Core Data Center RA (CDCRA)
- Network Optimization RA (NORA)
- Unified Capabilities RA (UCRA)
- Future Mission Network RA (FMNRA)

With the concept of a TLA and creating RAs from that TLA in mind, the next step is articulating the need for the TLA and RAs to provide answers to key questions. Initially, the TLA should identify extant capabilities, activities, system functions, services, data attributes, rules, standards, and costing information available within the TLA that might satisfy a new IT requirement. In this case the TLA should provide capability packages; constructed as black-boxes that enable the combat developer, architect, analyst, cost analyst and modelers to answer these sub-questions:

1. What capabilities are available within the enterprise to satisfy my requirements?
2. Is there costing information for similar capabilities available within the TLA that provide an estimate of what the projected services will cost?

3. What are the information exchange requirements, rules, data requirements and standards that constrain my new requirement in the enterprise?

In order to leverage the DoD IEA as a TLA in the manner explained above, the DoD IEA should provide the underpinning for conducting capability based assessments (CBA) in relation to the capabilities already acquired or built. The intent is for the team conducting the CBA to learn from the TLA what capability packages/black-boxes are already available that might satisfy their requirement (see Figure 2.0). A capability package denotes a set of the activities, functions, services, rules, standards, cost and data requirements required to deploy or build this capability. The capability package(s) in essence become a black-box to the proponent team, who can then query and deploy the package elements found within the black-box autonomously.

Another key question a TLA should answer is the linkage between an organization’s objectives/goals/missions and the objectives/goals/mission of its parent organization (see Figure 2.1). The DoD exists as an organization within the U.S. Federal Government and the various armed forces are organizations within DOD. Therefore, every acquisition should have specific traceability to the overall goals/objectives of that organization, and each goal of the organization should have such explicit traceability to the goals of its parent organization.
GAO⁴ explicitly mandates this traceability. For instance, an Army organization may own multiple systems/applications and on a yearly basis the organization may allocate funding for those IT investments. Those IT investments should align to the organization’s mission and objectives. This validates why this expenditure of money is necessary from both the organization’s perspective and from the perspective of all its parent organizations. In fact, the Investment Review Board (IRB) process was instituted to facilitate this type of mechanism.

Unfortunately, our current processes do not provide the explicit traceability to ensure this type of transparency. The TLA should have a forcing function to inform how IT investments support the goals of the service components (Army, Air Force, Navy and Marine) and its parent organizations. Such information can be gleaned only through the synchronization of a collection of documents, an expensive and time consuming tasks.

![Figure 2.1 – Using the TLA to inform on the organization mission/objectives](image)

The biggest driver for having and leveraging the DoD IEA as a TLA is the fact that resources are becoming increasingly scarce. Defense allocations are shrinking and spending cannot continue at current levels. For this reason, being able to use the DoD IEA to inform as to what is already available and how it can be integrated becomes increasingly valuable. A great case for a robust TLA can be illustrated in our network infrastructure environment; currently

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our service networks are silos; not able to communicate seamlessly on the battlefield. A proper TLA or RA facilitates development of a Joint Network Infrastructure. This core joint characteristic can provide a unified information environment that interconnects IE users securely, reliably, and seamlessly.

One of the recognized shortfalls in the current IE is the perpetual existence of disparate network, processing, and storage infrastructures across the DoD. This mixed environment impedes both internal and external collaboration and places warfighters and their support at the seams. The desired operational outcomes of this core characteristic are:

- Consolidated infrastructure enabling seamless information sharing and increased speed of action
- Shift away from a Military Service-centric network construct to a joint, operationally-focused construct
- A self-managed computing infrastructure limiting the need for human intervention and enabling the optimization of computing infrastructure resources

A properly defined and deployed TLA can give us these three characteristics and much more. Figure 2.2 provides an overview of the current and desired end-state conditions for this characteristic. Existing infrastructures across the DoD have been built to be compliant with federal and departmental regulations while serving specific needs relevant to particular DoD missions. They are based on their own unique requirements and result in disparate and proprietary networks which may be inaccessible and unusable by other DoD components, external agencies, or mission partners.

![Diagram of Current and End State Conditions](image)

**Figure 2.2 – Using the TLA to build the Joint Network Infrastructure**
3. USING EA2F TO ANALYZE THE DOD IEA TLA. Enterprise Architecture Automated Framework (EA2F) is a framework that allows the combat developer, architects, system/cost analysts and the executive decision makers to quickly assess the posture of the enterprise. EA2F is not an architecture development platform. The intent of EA2F is to leverage already built architecture views to conduct business intelligence analysis on those architectural views.

In this section we will walk through a simple use case that demonstrates how the DOD IEA can be analyzed using EA2F. The use case is based on a new requirement that came into a program office to provide identity management. The proponent (Program Manager) asks his chief architect to do a quick search of the DoD IEA and identify what capabilities are currently available to provide identity management. The Program Manager also wants to know any particular standards, rules, cost information, and data they can leverage to make an informed decision about either acquiring or building the new capability. The Program Manager also wants to make sure the requirement can show alignment with the goals of the parent command and further up to the Army Campaign Plan (ACP).

First, EA2F is using a grouping of Reference Architectures and the DoD IEA as a base. The DoD IEA has already been mapped based on the encyclopedia provided. What this means is that capabilities have been mapped to activities and activities have been mapped to rules, services, standards and data. With this information in hand, the architect logs into EA2F (https://ea2f.army.mil) and conducts the analysis to see what the capability packages/black-boxes (see Figure 3.0) related to identity management are available.

![Figure 3.0 – Using EA2F to find out what capabilities packages are available for the requirement(s)](image-url)
In Figure 3.0, item 1 illustrates the TLAs and RAs available within the framework. For this use case we used the DoD IEA to conduct our analysis. Once we select the DoD IEA, item 2 gets filled in with the available capability packages/black-boxes for the DoD IEA or RA. These capabilities are brought into EA2F as DoDAF 2.0 Capability Views (CVs); EA2F can ingest such views from a variety of source formats: OMG XMI\(^5\) or PES\(^6\) standard; simple XML, Excel workbooks, Encyclopedias, and web services. The selected packages in panel 2 are automatically reflected in panel 3. Once the architect is satisfied with the package selection the OK button is clicked, which populates panel 4. Panel 4 illustrates the items corresponding to these packages. For every package/black-box there are: activities, services, costs, data attributes and rules that are queried from the corresponding DoD IEA or RA. Clicking on any of the bars fills panel 5. Panel 5 provides a detailed view for the selected package item. In the view above, we selected the services bar; this displays all the services and cost associated with implementing those services. Clicking on the cost will bring up another view that allows the architect/analyst to drill-down on service versus planned cost; see Figure 3.1.

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Now, remember, we have not yet done a single thing with the Program Manager’s systems architecture or requirements; all we are doing is asking questions of the DoD IEA at this point. Once the architect is satisfied with what is needed or what can be leveraged in the enterprise, the architect can now bring in his/her architecture into EA2F and align it with the DoD IEA or any other architecture they need to integrate with in order to link and extract functionality (see Figure 3.2).

![Figure 3.2 – Using EA2F to map activities between system and the TLA](image)

In Figure 3.2 the architect has brought in the activities from their identity management system architecture (OV-5a) and is in the process of aligning them with the activities of the DoD IEA. The architect selects the TLA or RA they want to work with and selects the activities for the architecture that will be aligned to activities in the TLA. In this case, the architect is mapping the identity management activity of his system to the identity management activities of the DOD IEA. By doing this, the architect automatically inherits the capabilities, services, rules, data attributes, standards and cost as found in the DoD IEA. Panel 1 above illustrates the activities (OV-5a view) of the identity management systems. The architect can grab an activity from panel 1 and drop it on top of an activity (DoD IEA OV-5a activity) on panel 2. Once the architects does this, panel 3 and 4 will illustrate the activities that have been mapped for the selected system activity; if an encyclopedia from an architecture development tool is used and these mapping already exists, then when it is brought into EA2F no mapping is necessary because EA2F will pick-up the mappings automatically.
Once the architect finishes mapping and adjusting his/her architecture for the identity management systems, the system analyst or architect can go into EA2F and align his/her system activities to the organization lines of operation and to his/her parent organization’s lines of operation. As a result, when the architect maps the architecture to any of the available architectures in EA2F, they are also mapped to the service component’s (Army, Air Force, Navy, Marine) strategic missions/goals. One of the key benefits to mapping lines of operation is the ability of an executive to quickly find out where/how his lines of operations are supporting the enterprise; see Figure 3.3.

Figure 3.3 illustrates how EA2F takes advantage of internal mapping of capabilities packages to higher level mission and objectives to tie the systems to the overall mission of the organization. Panel 1 above allows the user to select one of the command’s architectures within EA2F. Once the user selects the organization/command, this will populate panel 2 with that organization/command’s lines of operations or objectives. Selecting one of the lines of operation/objectives will populate panel 3 and the map (illustrated by 4). Panel 3 illustrates the data centers where the capability supporting the lines of operation/objective is located. This information is transferred to the map on panel 4. Clicking on one of the push-pins on the map will bring up the system supporting that line of operation/objective and all the activities (OV-5a) supported by that system.
4. FOLLOW-ON WORK, RECOMMENDATIONS. A framework is only as good as the data it is analyzing. EA2F is more extensive than what this document illustrated but we kept the content at a high level to focus attention on the main point: using the DoD IEA as a black-box to answer questions about the DoD enterprise. Using a TLA and RA is a great approach to defining the enterprise, but without the ability to actually take the data found within these TLAs and RAs and analyzing them, we will just have another set of architectural artifacts. Their true value is realized only when they are operationally used.

The next step for EA2F is to actually have the capability of connecting to authoritative data sources like DARS, DOORS, ArCADIE, SADIE, DISR and DITPR; through web services (see Figure 4.0) or open standards so we can analyze across domain boundaries. As stated before, EA2F is not an architecture development environment, but an architectural analysis environment that can quickly analyze and tie/map architectures together so decision makers can make faster decisions.

![Figure 4.0 – Connecting EA2F to Authoritative Data Sources](image)