Network Centric Warfare Training – A Live Simulation Data Strategy

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ABSTRACT

NetOps is the operational construct that the Commander, U.S. Strategic Command will use to accomplish their Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) mission. NetOps enables Net-centricity by shifting the DOD from a "need to know" to a "need to share" paradigm. Net-centricity is the realization of a robust, globally interconnected network environment in which data is shared timely and seamlessly among users, applications and platforms. In today's Department of Defense (DOD) it is becoming vitally important to incorporate these NetOps and Net-centricity concepts within our training doctrine to effectively train our Soldiers in a simulated Network Centric Warfare (NCW) training environment. This will enable our Soldiers to train as they fight by being exposed to an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision-makers and Soldiers. This paper describes several initiatives at the U.S. Army Program Executive Office (PEO) Simulation Training and Instrumentation (STRI) which focus on two of the NCW tenets: Net-Centric Enterprise Services (NCES), and Net-centric Data Strategy. In particular, this paper will discuss how the Live Training Transformation (LT2) initiative at PEO STRI is beginning to address a net-centric strategy for "live" training by evolving current live training product-line assets to support a data and enterprise services strategy required to provide an effective NCW training environment for the Soldier. It is the intent of this paper to capture the experiences, to include successes and failures, while implementing this strategy to assist similar projects in the future and further the PEO STRI product line strategy.

ABOUT THE AUTHOR

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INTRODUCTION

This paper provides some background on the concepts of federated architectures, and how they support Network Centric Warfare (NCW). It goes on to describe steps the Live Training Transformation – Family of Training Systems (LT2-FTS) Product Line (PL) is taking to align itself with the DOD federated architecture concepts to begin addressing a net-centric strategy for "live" training. In essence it describes the LT2-FTS "desired" state for the Global Information Grid (GIG) interoperability, from a Net-Centric Enterprise Services (NCES), and Net-centric Data Strategy perspective, which is crucial to providing an effective NCW training environment for the Soldier.

BACKGROUND

NCW is no less than the embodiment of an information age transformation for the DOD. This transformation will span a quarter century or more, in part because it will involve ways of operating that have yet to be conceived, and will employ technologies yet to be invented. NCW represents a powerful set of warfighting concepts and associated military capabilities that allow Warfighters to take full advantage of all available information and bring all available assets to bear in a rapid and flexible manner (Chairman of the Joint Chiefs of Staff, 2000). It is becoming vitally important to incorporate these Net-centricity concepts within our training doctrine to effectively train our Soldiers in a simulated NCW training environment. This will enable our Soldiers to "train as you fight" by being exposed to an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision-makers and Soldiers.

Global Information Grid (GIG)

The DOD Transformation Planning Guidance (2003) defines the desired outcome of transformation as "fundamentally joint, network-centric, distributed forces capable of rapid decision superiority and massed effects across the battle space." The DOD's approach for transforming to net-centric operations and warfare aims to achieve four key attributes: reach, richness, agility, and assurance. This approach uses the GIG as "the organizing and transforming construct for managing information technology throughout the Department." It envisions moving to trusted network-centric operations through the acquisition of systems and families-of-systems that are secure, reliable, interoperable, and able to communicate across a universal Information Technology (IT) infrastructure, to include National Security Systems (NSS). This IT infrastructure includes data, information, processes, organizational interactions, skills, and analytical expertise, as well as systems, networks, and information exchange capabilities.

The GIG architecture is composed of the DOD's enterprise IT capabilities. As the Secretary of Defense's principal staff assistant for IT and information resources management, the DOD Chief Information Officer (CIO) develops, maintains, and uses the GIG Architecture and the Net-Centric Operations and Warfare Reference Model (NCOW-RM) to guide and oversee the evolution of the Department's IT-related investments to meet operational needs. The GIG Architecture describes the implementation component of the GIG, with integrated operational, systems, and technical views. The GIG Architecture fulfills, in part, the requirement to develop a Department-wide Enterprise Architecture (EA). This EA is the explicit description and documentation of the current and desired relationships among business and management processes and IT. The EA describes the "current architecture" and "target architecture," and provides a strategy that will enable an agency to transition from its current state to its target environment. All DOD architectures, including Warfighter, intelligence, business process, and enterprise management architectures, are part of the GIG Architecture. The current DOD overarching architecture description consists of three Components: GIG Architecture version 1.0, GIG Architecture version 2.0, and the NCOW RM version 1.1. The GIG Architecture version 1 provides the description of the

"current" DOD IT architecture. The GIG Architecture version 2 provides the description of the "target" DOD IT architecture. The NCOW-RM provides the means and mechanisms for the DOD and its combat developers, sponsors, domain owners, and Program Managers (PMs) to describe their transition from the current environment, described in the GIG Architecture version 1, to the future environment, described in GIG Architecture version 2.

Live Collective Training

Live training range systems provide the means to plan, prepare, execute and provide training feedback for Force on Force and Force on Target training. Live collective training range exercises are characterized by the following:

- Actual soldier/vehicle activity on actual terrain under simulated combat conditions.
- Force on Force weapon engagement with instrumented targets is conducted via Tactical Engagement Simulation and Force on Target is with actual targets and live fire.
- Position and tracking of training audience is done through the Instrumentation System.
- Training system allows analyst to link observations, events, and training reports to build Cause and Effect, and After Action Reviews (AARs).
- Training "Alerts" and safety "Alarms" can be triggered, for example, when soldiers/vehicles cross control measures and enter restricted areas.
- Human and Instrumentation System implemented battlefield events produce real and simulated visual and sound effects (e.g., vehicle kill indicators, smoke, pyrotechnics, barricaded bridges, etc.).

Live Training Transformation (LT2)

LT2 is an Army initiative to develop a live training range PL which synergizes training instrumentation, targets, and tactical engagement simulation systems to ensure the efficiency and effectiveness of live training within the Army. LT2 products are composed using a "family of components" approach, which maximizes software reuse, and provides common functionality, interfaces and standards. The Live Training Transformation Family of Training Systems (LT2-FTS) is the Army's family of interoperable live training systems based on the LT2 product-line strategy (Dumanoir, Rivera, 2005). The LT2-FTS domain, referred to as the "Live PL" from here on, includes several products which provide different levels of common live training range capabilities to Combat

Training Centers (CTCs), Homestation instrumentation training ranges, and deployed training ranges. All Live PL GIG interfaces are controlled through the common instrumentation system architecture framework called the Common Training Instrumentation Architecture (CTIA). The Live PL architecture framework provides all the interfaces to virtual and constructive training domain systems, the Army's C4ISR infrastructure systems, Future Combat Systems (FCS) platforms (Dumanoir, Pemberton, 2006), and to components of the Army Training Information Architecture (ATIA), and the Joint National Training Capability (JNTC).

Initial analysis has identified GIG data that would be relevant to the Live PL would be used to support training data collection plan, battle roster, force structure and tactical overlays type data. On the other hand, the Live PL data that would need to be uploaded to the GIG would be focused on individual/unit training performance measures.

Currently there are several products, within the Live PL, defining their integrated architectures and corresponding data strategy within a "bottom-up" approach. In other words, these integrated architectures describe how these different Live PL products use the CTIA, common software components, interfaces and standards, to provide a specific product instantiation of the Live PL. Currently; the Live PL depends on evolving overarching DOD enterprise guidance to adjust their integrated architectures as needed to meet DOD GIG interoperability policy. Subsequent sections herein provide descriptions of what the Live PL is doing to support DOD interoperability requirements as it relates to architectures and data strategy.

FEDERATED ARCHITECTURES

One of the primary objectives of enterprise architectures is to describe the enterprise so that decision makers can make informed decisions based on or within a common context. Although there have been recent advancements in both the architecture and stakeholder communities that use architecture information, architecture products are presently not as sufficiently discoverable and accessible as needed to support decision making. Today's integrated architectures are built for specific purposes and viewpoints; they do not normally refer to or relate to each other as they should to gain maximum value from the architecture investment. As a remedy, the DOD has chosen architecture federation as a new GIG architecture paradigm. The goal is for the DOD Federated EA to represent the "next generation" GIG Architecture. This next generation GIG architecture

will be constructed by federating the separate integrated architecture artifacts throughout the DOD and employ a set of EA Services for registering, discovering, and utilizing architecture data to support key DOD decision processes (DOD CIO, 2006).

Both integrated and enterprise types of architectures are of value to the user. Integrated architectures enable a broader perspective of the mission by representing architecture data elements through multiple views. Federated architectures support decision making at program, DOD Component, mission, and enterprise levels by linking architectures across the enterprise, providing a holistic enterprise view that allows for the assessment of interoperability, identification of duplication and gaps, or determination of reusability. Both integrated architectures and federated architectures support net-centricity by enabling the semantic and structural alignment of data across disparate architectures in a useful manner for the improved reliability and efficiency of decisions, thus resulting in improved mission outcomes.

Figure 1 provides a notional representation of the GIG Architecture Federation framework. In this framework the top level GIG Architecture vision is supported by several key enablers, for example: DOD EA Reference Models, (RMs), GIG Capability Increments, DOD Architecture Registry System (DARS), DOD IT Standards Registry (DISR), and the NCOW-RM.
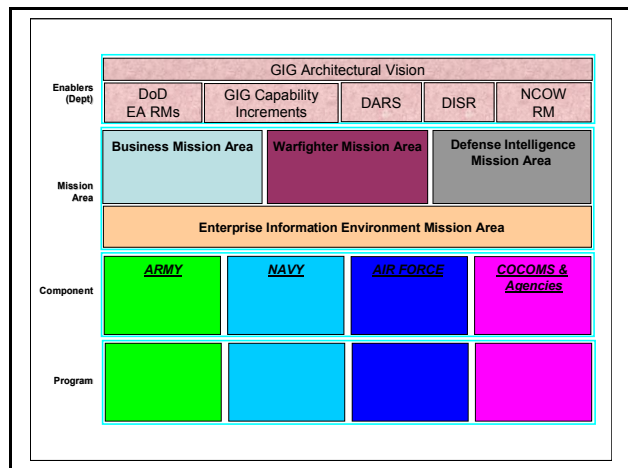

Figure 1. GIG Architecture Federation (Notional)

The bottom layers represent specific programs, within each Service component, which develop their integrated architectures and subsequently register and align these integrated architectures within a searchable registry of Cross-Mission Area, Cross-Component, and Cross-Program architecture data. The intent is for this transfer, registration, and federation of architecture

data to be done through the DARS to provide the linked architecture data required to support Commanders, Warfighters, and decision makers.

Mission Areas

Within the EA framework, a mission area is a defined area of responsibility with functions and processes that contribute to mission accomplishment. The DOD, and subsequently Army Enterprise are composed of four mission area portfolios: 1) Warfighting Mission Area (WMA), 2) Business Mission Area, 3) DOD portion of Intelligence, and 4) Enterprise Information Environment (EIE). This paper focuses on the WMA, which includes IT and NSS investments (programs, systems, and initiatives) that support and enhance the Chairman's joint Warfighting priorities. Each Mission Area is composed of domains which represent a common collection of related, or highly dependent, information capabilities and services. Managing these related information capabilities and services within domains improves coordination, collaboration, integration, and consistency of processes and interfaces for information sharing. Figure 2 identifies the eight domains within the WMA, which include: (1) Battlespace Awareness, (2) Force Application, (3) Protection, (4) Focused Logistics, (5) Net-Centric (6), Force Management, (7) Command and Control, and (8) Training. Each domain has an Army lead organization responsible for all matter related to that domain and its relationship to the EA and GIG. The Army lead for the Training domain is the Army Modeling and Simulation (M&S) [G-3/5/7] office.
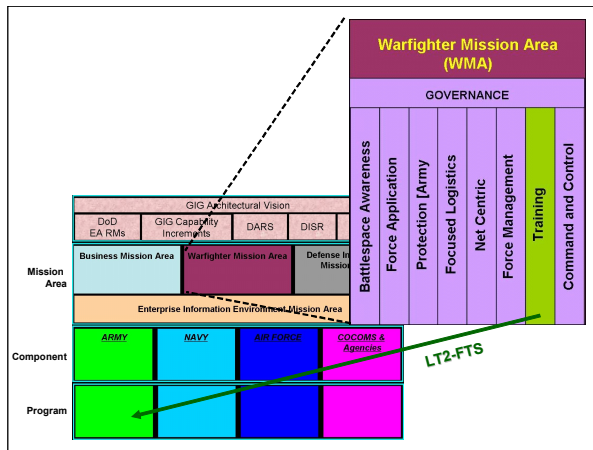

Figure 2. Warfighter Mission Area Domains

PEO STRI training products, such as the ones included in the Live PL, are part of this Training domain. The objective for those Army training products, and the integrated architectures that describe those products, is

to be federated with other Service/Component products, as needed, in support of the DOD Joint Training architectures, and a larger DOD EA strategy.

EA Federation Concepts

There are several key concepts that define federated enterprise architecture elements. A brief description of some of these concepts and how they are useful in supporting decision making and tiered accountability is provided below.

Tiered accountability is distribution of authority and responsibility of an element of the enterprise architecture to an organization.

High-level taxonomy is a structure or model that spans the enterprise. At the highest level of the enterprise, the DOD Activity High-level Taxonomy sets the context for the alignment of the Mission Areas' activities and associated reference models. At the DOD Component level, it is used to categorize and organize the DOD Component's architectures to depict boundaries and provide context for federation.

Architecture Categorization. DOD EA Components' architectures need to be categorized to facilitate alignment (mapping and linking), cataloging, navigating and searching disparate architecture in a DOD registry of holdings, and providing a framework for aligning architectures. Figure 3 identifies four major levels of echelon and taxonomies to be used for categorization: (1) Department (OSD, JCS, etc.), (2) DOD Mission Area, (3) DOD Component (Army, JFCOM, Navy, etc.), and (4) Program (NECC, FCS, Live PL programs, etc).
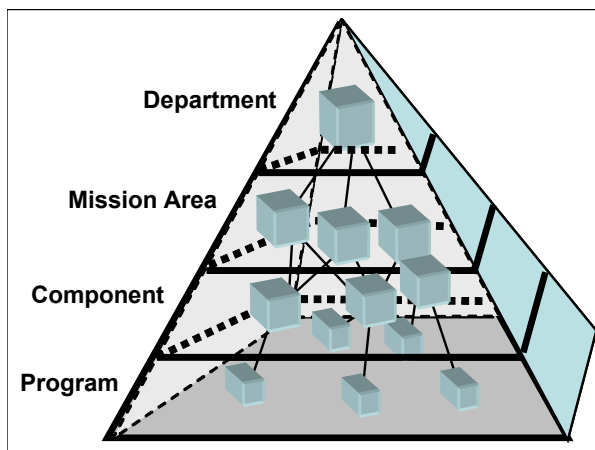

Figure 3. Architecture Levels for Tiered Accountability

Context defines the environment of the enterprise architecture. The context is part of the architecture's

metadata, which can be used for discovery, semantic alignment, and contextual comparison with other architecture efforts.

Boundaries for Tiers. Each enterprise tier – Department, Mission Area, DOD Component, and Program – has specific goals, as well as responsibilities to the tiers above or below them that are used to determine the level of detail (or abstraction) necessary for their architecture.

Semantic Alignment. The Federated EA will be based on the semantic alignment of tier-level architecture elements with elements of federation high-level taxonomies. Semantic alignment refers to the relationship specified between the meanings of taxonomy elements.

LIVE PRODUCT LINE INTEROPERABILITY WITH THE GIG

IT and NSS interoperability includes both the technical exchange of information and the end-to-end operational effectiveness of that exchanged information as required for mission accomplishment. The Live PL is focusing on several EA products to facilitate its GIG interoperability. This section describes essential EA products and how the Live PL is beginning to address NCW by using these products.

Net-Centric Operations and Warfare Reference Model (NCOW-RM)

The NCOW RM represents the strategies for transforming the enterprise information environment of the DOD. It is an architecture-based description of activities, services, technologies, and concepts that enable a net-centric enterprise information environment for warfighting, business, and management operations throughout the DOD. Included in this description are the activities and services required to establish, use, operate, and manage this net-centric enterprise information environment. The NCOW-RM incorporates net-centric environment elements such as the NCES Strategy, the DOD Net-Centric Data Strategy, and the DOD Information Assurance (IA) Strategy to share information and capabilities. The NCOW-RM provides the means and mechanisms for acquisition PMs to describe their transition from the current environment, described in GIG Architecture Version 1, to the future environment, described in GIG Architecture Version 2. In addition, the NCOW RM is a key tool used during program oversight reviews for examining integrated architectures to determine the degree of net-centricity a program possesses and the degree to which a program can evolve to increased net-

centricity. Compliance with the NCOW RM is one of the four elements that comprise the Net-Ready Key Performance Parameter (NR-KPP) (DODI, 2004).

Currently, programs/systems within the Live PL are in the infancy stage of understanding the current NCOW RM, assessing compliance requirements, and considering how a training-specific NCOW-RM could be proposed to possibly address training-specific aspects related to GIG interoperability not currently considered from a pure tactical perspective. In particular, consideration is being given to propose a "Net-Centric Training Operations Reference Model" for implementation of a "training GIG". This would allow the training community to address issues such as using actual C4ISR mission data while having to meet GIG IA requirements for integrity and non-repudiation of data and systems. It might also compel the training community to design NCW concepts into the training systems to address not only "pulling" the information from the GIG, but also provide a means for the trainers to assess whether the right information is being "pulled" from the GIG.

The following list summarizes the requirements being analyzed for demonstrating Live PL compliance with the NCOW-RM:

- Have the activities listed in the integrated architecture OV-5 (for each Live PL system) been mapped to the NCOW-RM node tree OV-5 activities? These OV-5 activities should be characterized by use-case diagrams grouped under the applicable GIG Core Enterprise Services (e.g., Discovery, Messaging, Mediation, Collaboration, etc.) to meet net-centric capabilities requirements for managing the net-centric information environment.
- Have NCOW-RM OV-5 activities been used to identify requirements for data correctness, data availability, and data processing necessary for posting data/information elements within a specific joint integrated architecture?
- Has the SV-4 system's functionality been mapped to the applicable GIG Core Enterprise Services?
- Are the IT standards in the NCOW-RM Target Technical View included in the Draft TV-1 for the applicable capability integrated architecture?

DOD Architecture Registry System (DARS)

In order to make the EA visible, accessible, and understandable, EA services will be implemented using Web Services, in which specific content and/or functionality is provided by one user for others, many

of whom may be unanticipated by the provider. The return on investment in the Federated EA will result from DOD providers continually populating the Federated EA with architecture data and products that satisfy a variety of anticipated and unanticipated consumer needs. This will require the following development of standards and services:

- A set of standard <u>metadata</u> will be maintained for all architectures in confederating repositories and Web service specifications (Web service definition language [WSDL]) for discovery and registration.
- A <u>registration</u> service will enable cataloging and linking of architectures in federated repositories.
- A <u>discovery</u> service will enable users to execute a federated search for architecture holdings meeting specified search parameters. The two primary modes of discovery are registry browsing and searching.

Figure 4 illustrates the concept for the proposed Core Enterprise EA Services/DARS implementation for the DOD Federated EA Services. It illustrates metadata registration and discovery of architecture content within the federated repositories required to make the enterprise architecture data visible, accessible, and understandable for the DOD community. The Live PL has begun to acquire DARS accounts and are starting to become familiar with the DARS concepts and repositories so they are ready to support as DARS continues to evolve.
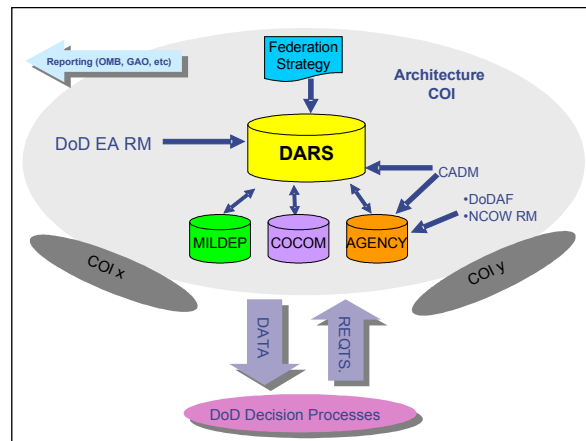

Figure 4 DARS Implementation Concept.

Core Architecture Data Model (CADM)

The DOD Core Architecture Data Model (CADM) is intended to be used by DOD architecture planners as the basic set of standardized entities for building architectures and architecture databases in

conformance with the DOD Architecture Framework (DODAF), V1.5 (2007). CADM provides structured data requirement specifications (in the form of a conceptual data model) for the essential elements of information contained in DOD architectures. The CADM has been adopted for use in the DOD DARS and for the GIG Integrated Architecture. The goal is to improve the potential for exchange of such information among architectures and specifically between architecture development tools. By facilitating the exchange, integration, and comparison of architecture information throughout DOD, this common approach should help improve Command/Service/Agency (C/S/A) interoperability. As a core architecture data model, the CADM contains data requirements common across functional areas. This means that specifics pertaining only to individual C/S/As are not made part of the "core," but can be readily added to the "core" in order to satisfy those unique requirements identified by the user. Interoperability based on the extended data model would require agreement across the C/S/As on extensions that affect more than one of the architecture developers.

CADM is a logical as well as a physical data model. Thus, it provides a conceptual view of how information is organized, defined, described, and related; and it provides all the implementation details required to develop a physical schema for an architecture database. However, the CADM does not prescribe an implementation technology or methodology, nor does it describe how the data is actually stored in the database implementation. What is important is that an implementation conforming to the CADM enables the input and output of data structured as in the CADM, and that the primary keys of entities in the CADM are maintained. Thus, CADM provides data standards (including XML tags) for the exchange of architecture and architecture-related data.

Although Live PL products have not made CADM compliance a criterion for developing their physical and logical data models, they are considering it as a product improvement necessity. Before this compliance issue is addressed by the Live PL products, some training-specific CADM questions should be addressed by a Training Community Of Interest (COI). For example "what training-specific data objects might need to be included as part of CADM "core" (if any)?", and/or "how best to extend the CADM "core" to address training system interoperability with other training systems and/or tactical systems?"

DOD IT Standards Registry (DISR)

DISR is an online repository for a minimal set of primarily commercial IT standards that are used as the "building codes" for all systems being procured by the DOD. Use of these building codes facilitates interoperability among systems and integration of new systems into the GIG. In addition, the DISR provides the capability to build profiles of standards that programs will use to deliver net-centric capabilities. When building Live PL products, DODAF Technical Views (TVs) 1 and 2 are reviewed as part of the Initial Capabilities Documents (ICDs), Capability Development Documents (CDDs), and Capability Production Documents (CPDs) to ensure the required IT standards are being used.

DOD Architecture Framework (DODAF)

Currently, DOD prescribes the DODAF version 1.0 (2004) as the basis for integrated architecture descriptions developed for systems within the DOD. DODAF-based architecture descriptions are required to be consistent with the GIG Architecture and NCOW RM. These architecture artifacts are used to assess information exchange and in developing the NR-KPP and preparing the Information Support Plan (ISP).

As the Department takes appropriate strides to ensure advancement of its IT environments, it is essential for the DODAF to transform to sufficiently support new technologies, such as the ones required to support NCW. DODAF v1.5 (2007) is a transitional version that responds to the DOD's migration towards NCW. It applies essential net-centric concepts in transforming the DODAF and acknowledges the advances in enabling technologies – such as services within a Service Oriented Architecture (SOA) – are fundamental to realizing the DOD's Net-Centric vision. DODAF v1.5 maintains backward compatibility with DODAF v1.0, and in addition to net-centric guidance, it places more emphasis on architecture data, rather than the products, introduces the concept of federated architectures, and incorporates the CADM as an integral component of the DODAF.

Currently, two of the Live PL products, the Combat Training Center – Objective Instrumentation System (CTC-OIS), and the One Tactical Engagement Simulation Systems (OneTESS), are in the process of finalizing DODAF artifacts (based on DODAF V1.0) to support their CPD requirements. The challenge for the Live PL will be to address changes in these different DODAF versions to support a more efficient and flexible use and reuse of architecture data, consistent with DOD's migration towards NCW. The following list summarizes the questions being analyzed

for demonstrating DODAF compliance and NCW alignment:

- Does the AV-1 describe a net-centric environment?
- Has the TV-1 been prepared using applicable information technology standard profiles contained in the DISR?
- Have all the interfaces listed in the OV-2 and SV-6 been appropriately labeled with the GIG core enterprise services needed to meet the requirements of the applicable capability-integrated architecture?
- Have all the applicable OV-5 activities identified in the specific capability integrated architecture been appropriately described at each critical or enterprise level interface in terms of policy enforcement controls and data enterprise sharing activities in the NCOW RM, Node Tree OV-5?
- Have specific capability-integrated architecture OV-6c time event parameters been correlated with GIG architecture OV-6c?
- Have verifiable performance measures and associated metrics been developed using the integrated architectures, in particular, the SV-6?

INITIAL CONSIDERATIONS RELATED TO NET-CENTRIC DATA

Net-centricity compels a shift to a "many-to-many" exchange of data, enabling many users and applications to leverage the same data, extending beyond the previous focus on standardized, predefined, point-to-point interfaces. Hence, the net-centric data objectives are to ensure that all data are visible, available, and usable-when needed and where needed-to accelerate decision cycles. The DOD Net-Centric Data Strategy (2003) addresses the challenges of finding and using information on the GIG, and defines a vision in which information is easily made visible, accessible, and understandable. The draft GIG Enterprise Services Strategy espouses a dual path approach to achieving these goals. It advocates that DOD Components—Combatant Commands, Services, and Agencies (C/S/As)—continue to provide and consume services and embrace SOA principles. In addition, it drives the enterprise to identify and adopt the necessary services, standards, policies, and processes to federate C/S/As services and SOAs for the benefit of the Department and its partners.

The activities areas and activities described in this section help to guide architects and program managers in establishing a net-centric data foundation for their

program. These activities and how they are being addressed by Live PL are summarized below.

Data Strategy Activities

Data strategy activities are separated into four key areas: Data Planning, Manage Data Infrastructure, Provide Enterprise Data Assets and Govern Data Activities. These activities can be conducted across the span of program milestones; however, the general groupings of these activities will for the most part dictate the phase in which they are conducted (2003).

The "Data Planning" activity area describes activities that result in data plans, standards, specifications, guidance, and policy. Specific activities include:

- Define Net-Centric Data Sharing Plan. This activity relates to the development of a comprehensive net-centric plan to share data assets within a program/ organization and to the Enterprise. This includes metadata catalog plans, registry plans, interoperability plans, etc. In essence, this Net-Centric Data Sharing Plan should be the program's / organization's plan to accomplish the goals of the DOD Net-Centric Data Strategy. This is a key product and will drive most data activities and architectures. The Army Training Domain owner should develop these plans at a broad, strategic level to ensure that architectures for programs and sub-organizations associated with the different training PLs include net-centric data components. The Live PL is considering developing a more detailed data sharing plan that outlines how its information architecture(s) make the data and processes discoverable, accessible, and understandable to both known and unanticipated users. This Live PL data sharing plan will ensure that the Live PL products align accordingly with, and make use of, enterprise net-centric data sharing capabilities such as those envisioned/planned under the NCES.

- Define Data Guidance. This activity begins by evaluating information from sources such as compliance reports, incentive plan reports, policy, and user needs to create net-centric data guidance documents. Data guidance is the policy, specifications, standards, etc., used to drive data activities within the program/organization. It differs from a net-centric data plan in that the plan is more strategic in nature. Data guidance may be a subset of an overall net-centric data sharing plan. The Army Training Domain owner should develop appropriate guidance and standards to ensure that

incentives, metrics, and direction are in place to drive the transition to net-centricity. The Army Training Domain owner should also establish policy and governance to ensure that the Training Domain programs and sub-organizations have a voice in the development of standards, specifications, and processes (e.g. empowering a program to insert its metadata requirements into an overall Training Domain metadata model). The Live PL is planning to work with the Army Training Domain owner to define this data guidance and eventually consider as part of the overall data sharing plan.

- Define Net-Centric Data Architectures. This activity builds upon existing and revised architectures and plans to describe the architecture to support data sharing objectives. The architecture should depict components that emphasize the use of discovery, services-based approach to systems engineering, use of metadata to support mediated information exchange, web-based access to data assets, etc. The Live PL is assessing what and how net-centric concepts, activities, and processes should be included into their architectures and ensure that net-centric components are integrated into the Live PL architecture products. The Army Training Domain owner should ensure that these training architectures support the Training Domain-level architectures and are developed in a manner that is appropriate for governing under a capabilities-based portfolio management process.

- Identify Data Assets. This activity determines what data assets (documents, images, metadata, services, etc.) are produced or controlled within a program or organization. This is primarily an inventory of data assets, which should include both structured and unstructured data sources. The Army Training Domain owner should identify major data assets, within the Training Domain. This asset listing will assist the Live PL in the development of visibility, accessibility, and understandability strategic plans (i.e., based on the composition of the major data assets within the Training Domain, the planning products can reflect the most appropriate approach in supporting net-centric data strategy goals). The Live PL is evaluating the best way to inventory the data assets created or managed by the Live PL products, and use this asset listing to plan their strategy and implementation approach for making these assets net-centric.

- Prioritize Data Assets. This activity assesses the data asset inventory to identify key data products that are of greatest value to known users and are likely to be of value to unanticipated users. This list should be used to determine what data assets the Live PL products should make initial efforts at exposing as enterprise data assets. The Live PL is planning to work with the Army Training Domain owner to analyze and prioritize which data assets are most valuable, initially, to be exposed as enterprise data assets.

- Define Communities of Interest (COIs). This activity identifies appropriate groups of people who should come together to support common Warfighter mission objectives. COIs are an appropriate construct for defining information exchange formats and metadata definitions as well as vocabularies used to communicate within the COI. This activity does not include the 'establishment' of actual COIs. This is simply the process of identifying COIs that exist or should exist. DOD CIO has already defined a Training COI as a major COI that could benefit missions within the Training Domain. The Live PL has begun participating in this Training COI to understand how to federate Live PL architectures and data within the Training Domain.

The "Manage Data Infrastructure" activity area describes activities that pertain to the establishment and management of components that were planned for in the Data Planning Activity Area. In these activities, software/hardware solutions are identified, established, and operated and maintained. Additionally, the infrastructure activities include the development of metadata products that support data sharing within a program, system, or enterprise.

- Manage Discovery Metadata Catalog(s). This activity identifies/establishes and maintains searchable catalogs used to locate data assets within the program, organization, or enterprise. Metadata stored within these catalogs facilitates discovery, and includes descriptive information about each shared data asset. The Army Training Domain owner should establish Training Domain-level metadata catalogs that allow for the search of data assets across the Training Domain. Distributed, federated approaches should be used in developing this capability. The Live PL is evaluating the most efficient way to assess the Live PL training data context within these Training Domain-level metadata catalogs, and ensuring their data is tagged and posted to

metadata catalogs that are tied into these Training Domain metadata catalogs.

- Manage Metadata Registry(ies). This activity identifies and/or establishes metadata registries that can be used to maintain, manage, and/or search for metadata artifacts such as schema and data definitions. Metadata stored in metadata registries are typically for developers, business analysts, and architects. Metadata registries are a type of metadata catalog specifically designed to support developers/business analysts. The Army Training domain owner will help ensure that metadata products within the Training Domain are registered into the DOD Metadata Registry. Training Domain COIs are likely to be structured around the functional areas for which metadata is registered. The Live PL is planning to make the appropriate Live PL metadata available for registration in the DOD Metadata Registry and maintenance.

- Manage Service Directory(s). This activity identifies and/or establishes service directory(ies) that can be used to maintain, manage, and/or search for callable, reusable services from which net-centric capabilities are built. Metadata stored in service directories gives information as to the services available, how to call them, and possibly, expected service levels. Service directories include Universal Description, Discovery and Integration (UDDI) Directories used to maintain Web Services information. This is a key component of establishing a SOA that supports net-centric data tenets. The Army Training domain owner will help ensure that services created or managed within the Training Domain (including associated programs and sub-organizations) are registered into the DOD Services Registry (i.e. as an increment of NCES Discovery capability). The Live PL should ensure that appropriate Live PL CTIA services are registered in the DOD Services Registry.

- Manage Interoperability Components. This activity includes development of metadata artifacts used to enable the interchange of data and information including document vocabularies, taxonomies, common data models, schema, formats, mediation components, and interface specifications. The Army Training domain owner should establish Training Domain-level metadata models to facilitate the loosely-coupled exchange of information between systems. The Live PL should develop metadata models (e.g., data structures, schema, etc.) pertinent to the Live PL

products, which include tagging models, service schema, and mapping models to the Training Domain metadata model.

- Develop/Acquire Data Access Mechanism(s). This activity includes posting data assets to an information sharing application (e.g., end-user web site, a file system, a document repository) or through the use of web services to provide system-to-system access, etc. The Army Training domain owner should establish shared space, as necessary, to support Programs within its scope. The Live PL is assessing how web-enabled services could provide access to valuable Live PL products/systems data and processes.

- Manage COIs. This activity encompasses establishing COIs, registering COIs in the Enterprise COI Directory and COI participation. The outcomes of this activity will ensure that COIs can be located and managed throughout the enterprise. The Live PL is planning to work with the Army Training Domain owner to establish, register, and maintain training specific COIs as needed, to aid in the establishment of NCW training concepts.

The "Provide Enterprise Data Assets" activity area describes activities that ensure that data assets can be discovered and accessed in the net-centric environment. This includes providing semantic and/or structural metadata, and ensuring data assets are visible by enterprise search capabilities, and the data asset is physically accessible through common methods employed on the GIG (such as through web-based technologies).

- Provide Discovery Metadata. This activity includes associating or generating discovery metadata for data assets. This activity is the "tagging" of data assets to provide value-added information about data assets that can be used to support discovery, accessibility, IA, and understandability. The Live PL should ensure that necessary discovery metadata is provided for all data assets created/managed by the Live PL products.

- Post Discovery Metadata. This activity provides, or posts, discovery metadata to catalogs, registries, etc., that can be searched. It is through "posting metadata" that metadata catalogs are populated. This activity allows data assets to be discovered (but does not guarantee access to the data asset). The Live PL is assessing how best to ensure that

discovery metadata associated with each data asset is posted to searchable metadata catalogs (as established by the Training Domain and the Live PL products).

The "Govern Data Activities" activity area describes activities that track compliance to policy and guidance and participation in oversight processes. Additionally, this activity area includes advocating the data strategy to stakeholders. The Live PL, in conjunction with the Army Training Domain owner plans to participate in GIG governance activities to ensure processes are followed, and to be able to enforce established data guidance.

CONCLUSION

The Live PL common architecture (CTIA) is in the midst of defining an efficient and affordable data strategy that will allow the Soldier to "train as you fight" in a live training range environment. The objective is for this strategy to support NCW training concepts which are consistent with DOD Net-Centric Data Strategy goals. This data strategy is centered on utilization of key EA products identified in previous sections, and architecture concepts which are "agile" and employ new paradigms such as SOA to support the Warfighter and decision makers. In order to develop and implement a Live PL data strategy which is consistent with DOD Net-Centric Data Strategy goals, PEO STRI must work with the Army G3/5/7TR office to reconcile training-specific Army COI activities with DOD COI guidance. In particular, PEO STRI PMs need to collaborate with Army G3/5/7/TR, as the designated Army Training Domain owner, to establish an Army Training COI to address training-specific data strategy activities. In addition, continued socialization with other Services is essential to leverage training specific experiences in this NCW arena.

One logical starting point is for PEO STRI PMs, which manage PLs similar to the Live PL, to build on efforts underway to support the Army WMA in selection and extension of a common data standard supporting battle command functions. PEO STRI PMs are currently analyzing how to best align and extend their training systems data models with the Command and Control Information Exchange Data Model (C2IEDM), which provides excellent coverage of Battle Command / Command and Control (BC/C2) information requirements, and is an integral part of the Army WMA Data Strategy.

The Live PL products are in the process of coordinating with the Training Doctrine Command

(TRADOC), who is responsible for OV-7 Logical Data Model (LDM) artifact, to evolve and standardize a LDM for Live PL which supports NCW concepts. This evolution and standardization process should be based on a phased adoption strategy that follows a coordinated Live PL net-centric data sharing plan. This phased approach could potentially start by defining key data and services that should be shared between the tactical and training communities. The main use case for this initial phase would center on accessing the required tactical digital messages to support Army and Joint Combat Training Center (CTC) training or mission rehearsal events. This Live PL net-centric data sharing plan should also include integration and coordination with the FCS and JC2/JFCOM data modeling efforts.

Although there are several complex challenges ahead for achieving the proposed data compliance strategy, the main objective for the Live PL will continue to focus on providing a training solution through the fielding of Live PL products, which offers the desired seamless interoperability and ultimately affords our Soldiers a decisive edge during war by allowing them to train as they fight.

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