ABSTRACT

The Army Technical Reference Model (TRM) is a fundamental component of the Army Enterprise Architecture suite of reference models. This paper describes the TRM, how it facilitates enterprise architecture integration and system interoperability, how it maps to other key DoD architecture models, and its value to the acquisition community. It describes how it supports Program Managers for efficiently and effectively building Technical Standards Views prescribed by the Department of Defense Architecture Framework (DoDAF). It describes how the TRM supports the building of TV-1s/2s for individual systems, a systems-of-systems, or an enterprise. It shows how the TRM helps enable system interoperability in net-centric environments. It illustrates how technology forecasts leverage the TRM and how the TRM illuminates the need to accelerate the process of updating the DoD IT Standards Registry (DISRonline) to include new and improved technical standards to support the new capability requirements included in the Army Enterprise Architecture.

OBJECTIVES

The key objective of the Army TRM is to provide guidance to Army systems developers for expeditiously selecting technical standards using a common standardized vocabulary.

In addition, the following are included among the Army TRM ‘corollary’ objectives:

- Facilitate the convergence of conventional system/technical architectures development with the RM approach
- Provide a contiguous thread from the FEA RM to each Army TRM Service Standard Profile
- Assist program offices in complying with the Joint Capabilities Integration and Development System (JCIDS) [5] process, the Information Support Plan

organizations with an emphasis on Information Technology (IT) investments in a business-driven, information-focused execution of the organization’s mission.

The TRM [1] is a part of the overarching set of Army Reference Models (RMs), which together provide a high-level abstraction of the Army EA. The Army EA RM suite is derived from the Federal Enterprise Architecture (FEA) [2] which consists of a similar set of RMs. The Army TRM is one of the components RMs that are part of the framework of the Army set of RMs. In addition, the TRM’s usefulness has been extended by mappings to other DoD architecture entities such as the Current Modular Force (CMF) Systems [3], Joint Common System Function List (JCSFL), Joint Capability Area (JCA), and the LandWarNet Capability Sets (LWN CS). In addition, as a component-driven, technical framework categorizing standards and technologies, the Army TRM supports and enables the delivery of services and service components.
(ISP)/Technical Standards View (TV) process facilitating net-centricity [6]

- Support DISR implementation for updating technical standards essential in meeting evolving Army C4ISR systems requirements
- From a domain or enterprise perspective, support development of a System of Systems (SoS) TV-1. This is dependent upon a technical assessment of the functions provided by the component systems of the SoS and can identify an overlap in functionality, or a repetition of services, as well as opportunities for information sharing and service re-use

**ARMY TECHNICAL REFERENCE MODEL (TRM)**

The Army TRM adheres to the Federal Enterprise Architecture (FEA) Technical Reference Model (TRM) and its hierarchy of Service Area, Service Category, and Service Standards. There are three levels of categorization as defined in the FEA TRM: Service Area, Service Category, and Service Standard.

The FEA RMs [2] include the Performance Reference Model (PRM), the Business Reference Model (BRM), the Service Component Reference Model (SRM), the Technical Reference Model (TRM) and the Data Reference Model (DRM). Figure 1 shows the relationships among the RMs. As shown in Figure 1, the Army TRM is interrelated and aligns with the development of the other RMs.

**SERVICE STANDARD PROFILES**

The Army TRM uses a Service Standard Profile structure, in which almost all of the standards presented in the Army TRM are appropriately packaged into profiles at the Service Standard level (refer to Figure 2 for TRM Structure).

The advantages of the profile structure include:

- Each of the Service Standard Profiles contains, in most cases, a minimum set of the standards that support a particular system function that supports an associated capability. In all other cases, the Service Standard Profiles contains a list of standards from which to select
- Applicable Service Standard Profiles can be chosen to construct a TV-1 as part of the Profiling Methods provided by the DISRonline
- Service Standard Profiles provide a commercial-ready, standard-supported implementation of Service Components that can be used for construction of an SOA

**Figure 1: Overview of Reference Models**

The Army TRM is a component-driven, classification model. It identifies the standards that support the development and implementation of Service Components to be defined in the SRM. A component-based model supported by standards may be leveraged to construct a Service Oriented Architecture (SOA).
Each of the Service Standard Profiles defined in the Army TRM is associated with one or more target Service Components to be defined in the Army SRM.

RELATIONSHIP WITH CMF, JCSFL, JCA, AND RMs

As the Army sharpens its focus on a federated approach to Enterprise Architecture and a portfolio management approach for IT investments, a common structure and predictable and consistent process is required to maintain alignment among strategy, capabilities, architecture, and IT investments. The Army has begun developing RMs at both Enterprise and Mission Area/Domain levels to support this. The extension of the FEA RMs as the foundation for the Army RMs increases the utility of the Army RMs to support investment alignment and portfolio management. It also supports the identification and governance of bricks and patterns, and provides a consistent means for describing operational demand and the required supply.

ARMY TRM EXTENSIONS

On a practical level, the Army TRM already has many of its own extensions. These extensions provide mapping and integration with accepted DoD architecture information, such as the CMF, JCSFL, and Joint Capability Area (JCA). This increases the range of situations in which a technical architecture can be derived, at least in part, from other known architecture information. This can be best explained by looking at the Standard-Component Overlay and Service Components, and why they are important underpinnings of the Army TRM approach.

STANDARD-COMPONENT OVERLAY AND SERVICE COMPONENTS

Service Components are well-defined bundles of functionality complete with supporting technology underpinnings. In practice, Service Components need to relate to the Army TRM Service Standard Profiles. With no SRM at this time, the Army TRM includes a Standard-Component Overlay that facilitates the identification of target Service Components, which are standard-ready and commercially supported.

The Standard-Component Overlay provides a mapping between the TRM Service Standard Profiles, the CMF SV-4 Systems Functionality list, and the JCSFL. In the future, the Army TRM will integrate with and map directly to the Army SRM.

Figure 3 shows the current view of the Army TRM development and its relationship with the other development components.

Figure 3: Army TRM Current View

The Army TRM integrates information from all areas and functions of the DISR, the Standard-Component Overlay, and resources as described in subsequent paragraphs. The Standard-Component Overlay enables mapping between the Service Standard Profiles and the system functions from the various function lists. The Standard-Component Overlay supports the following:

- Facilitates a generic association between the Army TRM Service Standard Profiles and the target SRM-based system services/functions that PMs will implement. Each TRM Service Standard Profile will support an associated system service/function (i.e. Service Components in SRM)
- Provides TV-1 developers with a path for gathering requirements for system functions and service components
- Helps to build or verify SV-4s, the standards-supported system services/functions, with one-to-one mapping to the Service Standard Profiles in the Army TRM
- Saves IT investment because these standards-supported services/functions can be reused and shared in a SOA environment. Enhances developers’ functional/capability awareness of currently available, mandated technologies/standards to reduce rework
- Bridges the relationship between the TRM and the target SRM in the AEA RM

MAPPINGS TO SERVICE STANDARD PROFILES

Figure 3 shows as a mapping between Service Standard Profiles and system functions as identified in the CMF SV-4 and JCSFL.
he/she can then see a list of all the available JCSFL Level 1 Functions.

Figure 5: Army TRM Tool - JCSFL

Each of the Level 1 Functions provided is linked to the TRM Service Standards Profiles. The user can locate Military Email function/TRM profile under the Communications / Provide Ability to Communicate / Manage E-Mail and Instant Messaging (IM) function/TRM profile under the Enterprise IT/Network Infrastructure / Enterprise Collaboration Services / Perform Collaboration. Lastly, the Web Services function/TRM profile is under the Enterprise IT/Network Infrastructure / Network Services / Provide Web Applications. Figures 6 and 7 illustrate the profile selections from the JCSFL function list.

Figure 6: Army TRM Tool - JCSFL Function List

In this example, the user will select JCSFL and generate a TV-1 for the Military Email, Instant Messaging (IM), and Web Services system functions. Figure 5 illustrates the user selected JCSFL from the TRM Web-based tool,
Once the user has completed their selections, they can click on the “Create TV-I” button in the Selected Functions area to generate the TV-I. Figure 9 illustrates the TV-1 generated by the TRM web-based tool consistent with the DISR TV-I format.

By selecting applicable Service Standard Profiles provided in the Army TRM to represent a respective capability, system function, or service/service component in their architecture and repeating this selection process for all their system requirements, developers will be able to efficiently and effectively build and register TV-1s.

**ENSURING INTEROPERABILITY AMONG SYSTEMS, SERVICES, and COMPONENTS in NET-CENTRIC ENVIRONMENTS**

DOD Combatant Commands/Services/Agencies (C/S/A) play a key role in assuring that interoperability is appropriately considered in a capability’s life cycle. The C/S/A will provide appropriate controls to assure the interoperability of all capabilities and to verify compliance and alignment of development activities that support this policy.

All new Information Technology (IT) and National Security Systems (NSS) and any modifications to existing IT and NSS that impact the interoperability of capabilities in this program shall comply with DoD
regulations and policies (references c through j and u through w). The NR-KPP is a mandatory element in the Capability Development Documents (CDDs), Capability Production Documents (CPDs), Information Support Plans (ISPs) and Tailored Information Support Plans (TISP) for all IT and NSS that communicate with external systems. Establishing and maintaining Interoperability and Supportability (I&S) in a DoD system is a continuous process that must be managed throughout the lifecycle of the system.

Interoperability hinges on the alignment of the enterprise architecture with the solution architecture. The DoD Information Enterprise Architecture provides a DoD-wide context and the guidelines that pertain to each of the solution architectures. Alignment with other relevant solution architectures enables a more detailed analysis of the information requirements. The solution architecture should describe the internal and external information flows in sufficient detail to enable the assessment of interoperability requirements.

Rather than utilize a set of inflexible tightly-integrated system-centric service components to mimic well-defined real-time system behavior, as was done in the past, an alternate approach is to look closely at system functional level design. The purpose of the Army EA RMs is to facilitate the dynamic, cooperative interaction of autonomous service processes. In this respect, the system function-centric Army TRM is capable of providing the appropriate system standard profiles to foster net-centric interoperability.

CONCLUSION

This paper has described how the Army TRM has emerged as one of the foundational components for the Army Enterprise Architecture, adhering to the FEA RMs and its hierarchy of Service Area, Service Category, and Service Standards. Each TRM Service Standard Profile is created using a minimum set of technical standards that advance interoperability and foster a net-centric operations environment. Acquisition PMs can leverage the Army TRM to facilitate enterprise integration and system interoperability by building quality technical standard views (TV-1/2) that include a foundational minimum set of technical standards as a starting point.

The process for mapping among capabilities, system functions, and technical standards of JCA, JCSFL, CMF support the system-of-system engineering and interoperability interests for the LandWarNet enterprise and its domains and segments. Moreover, the approach for integration among the Army EA PRM, BRM, SRM, and TRM has been shown. In addition to building of TV-1s/TV-2s, the Army TRM can be used for traceability to system and service views.

REFERENCES

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