

## ARMY ENTERPRISE ARCHITECTURE TECHNICAL REFERENCE MODEL FOR SYSTEM INTEROPERABILITY

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### **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.*

### **INTRODUCTION**

The Army Enterprise Architecture (EA) describes a networked information environment composed of interoperable computing and communications components. The development and implementation of the EA is facilitated by Reference Models (RMs). The EA facilitates business-driven collaboration strategies that use RMs to equip portfolio managers with a common framework and language to describe and analyze Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR) acquisition program investments. The interrelated suite of Army RMs includes Performance (PRM), Business (BRM), Technical (TRM), Services (SRM), and Data (IDRM) Reference Models. These Army RMs describe the relationships of major components of Army

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.

### **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

(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.

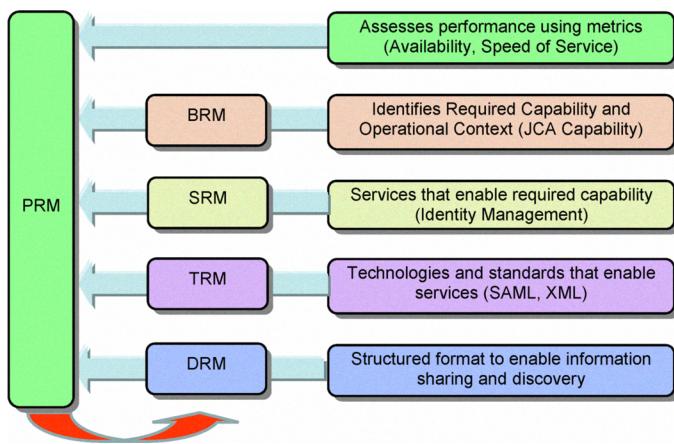


Figure 1: Overview of Reference Models

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).

## TRM STRUCTURE

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*, as shown in Figure 2.

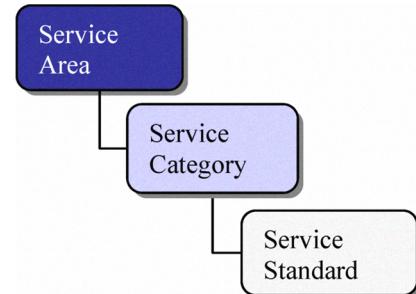


Figure 2: Technical Reference Model (TRM) Structure

The structure is organized into four *Service Areas*, including: Service Access and Delivery; Service Platform and Infrastructure; Component Framework; and Service Interface and Integration. The terminologies and definitions of terms contained in the Army TRM are the same as those of the FEA.

## 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

- 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.

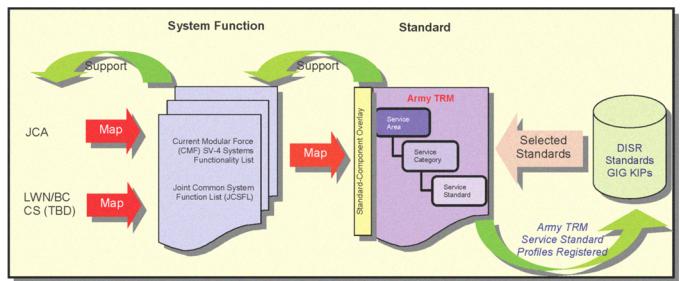


Figure 3: Army TRM Current View

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.

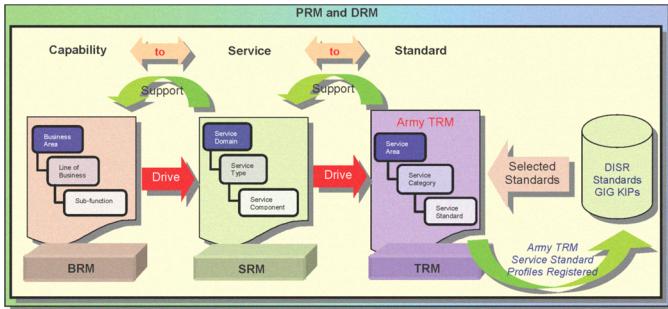


Figure 4: Army TRM Proposed Approach

Figure 4 illustrates the proposed development approach of the Army TRM in concert with the other components of the Army RM. The Army BRM is aligned with the Army Enterprise Architecture Federation Model and includes JCA Tier 1/Tier 2 capabilities and Army Enterprise and Domain Segments. Traceability among the individual reference models and their components facilitates RM/traditional architecture convergence and fosters implementation from the program/system level to system-of-system level to the domain/enterprise level. As development of each of the component RMs proceeds, subsequent versions of the TRM will provide increased granularity and better demonstrate implementation of the Army RM. That is, the SRM and TRM will reflect the capabilities as identified in the BRM and metrics as indentified in the PRM, thus providing “traceability” among the individual reference models.

### ARMY TRM WEB-BASED APPLICATION

The Army TRM web-based application (tool) is currently in development. The tool is designed to assist program managers/system developers in construction of the TV-1 and will significantly add to the efficiency of registering the TV-1 on DISRonline. It includes five Use Cases for creating TV-1s using the LWN CS, Army TRM Profiles, CMF SV-4, JCSFL, and JCA. Note: The implementation of the web-based application has not been finalized but direction and guidance on its use will be provided by HQ DA CIO/G6.

Here is an illustration of the process to create a TV-1 in the DISRonline format by using the TRM web-based application and the Use Case involving systems functions from the JCSFL.

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,

he/she can then see a list of all the available JCSFL Level 1 Functions.

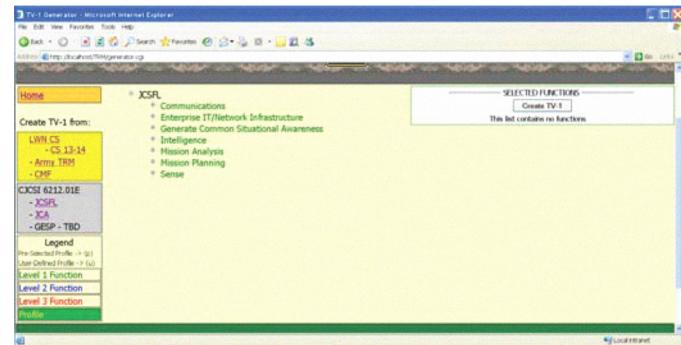


Figure 5: Army TRM Tool - JCSFL

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.

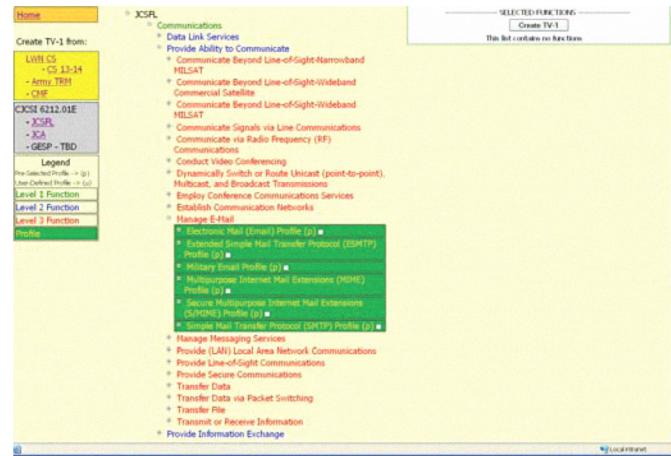


Figure 6: Army TRM Tool - JCSFL Function List



Figure 7: Army TRM Tool - JCSFL Function List

Figure 8 illustrates once these functions/TRM profiles are selected, they will be highlighted in a “shopping cart” list and identified in the **Selected Functions** area. At this point, a TV-1 is ready to be generated or the user can continue to select other functions.

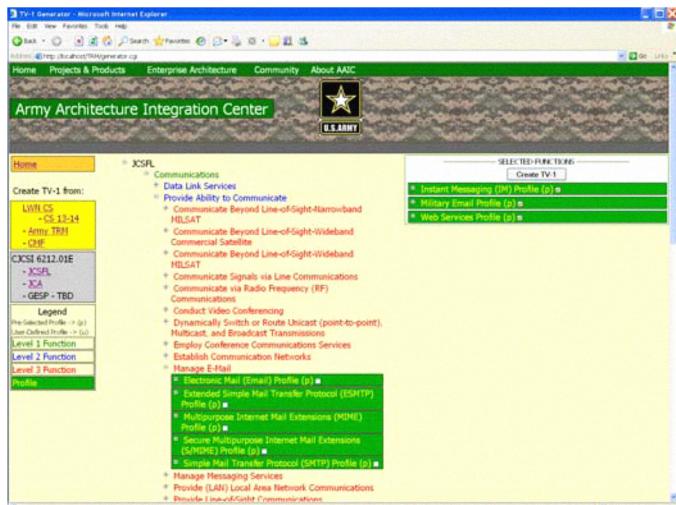


Figure 8: Army TRM Tool - Create TV-1

Once the user has completed their selections, they can click on the “Create TV-1” button in the **Selected Functions** area to generate the TV-1. Figure 9 illustrates the TV-1 generated by the TRM web-based tool consistent with the DISR TV-1 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.

UNCLASSIFIED																							
Technical View (TV) Printed by ASEO on Aug 11 2009 System Profile: - System Description: - Created By: ASEO Last Updated: Aug 11 2009 CDD or ISP Stage 1? no																							
TV-1 IT Profiles																							
<b>IT PROFILE:</b> Instant Messaging (IM) Profile (p) <b>IT Description:</b> Evolving to systems and capabilities that support the concept of immediate response. Supports flash traffic and other high-priority messages. Utilizes notification (push) and a awareness service (pull) capabilities. <b>Last Updated:</b> Aug 11 2009																							
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<b>IT PROFILE:</b> Military Email Profile (p) <b>IT Description:</b> The Defense Messaging System (DMS) is a deployment of secure electronic mail and directory services in the United States Department of Defense. <b>Last Updated:</b> Aug 11 2009																							
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Figure 9: Army TRM Tool - TV-1

## 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.

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