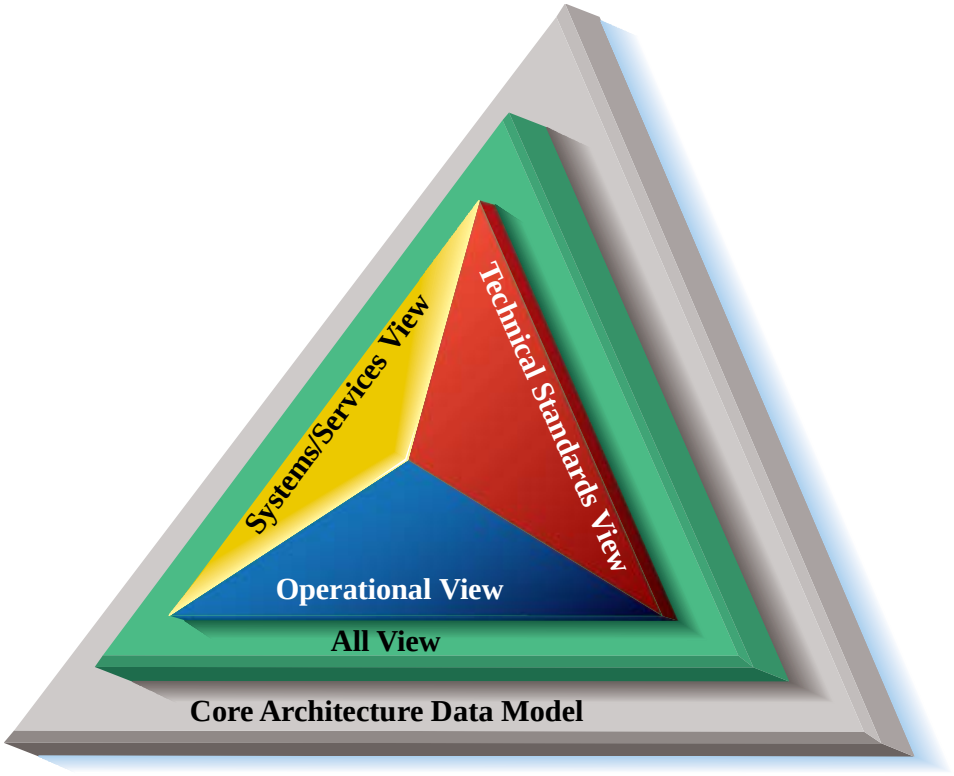
# DoD Architecture Framework
# Version 1.5




# Volume II: Product Descriptions

**23 April 2007**

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## EXECUTIVE SUMMARY

> **Architecture**: the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time.
>
> DoD Integrated Architecture Panel, 1995, based on IEEE STD 610.12

Architectures within the Department of Defense (DoD) are created for a number of reasons. From a compliance perspective, the DoD is compelled by law and policy (i.e., Clinger-Cohen Act, Office of Management and Budget (OMB) Circular A-130) to develop architectures. From a practical perspective, experience has demonstrated that the management of large organizations employing sophisticated systems and technologies in pursuit of joint missions demands a structured, repeatable method for evaluating investments and investment alternatives, implementing organizational change, creating new systems, and deploying new technologies. Towards this end, the DoD Architecture Framework (DoDAF) was established as a guide for the development of architectures.

The DoDAF provides the guidance and rules for developing, representing, and understanding architectures based on a common denominator across DoD, Joint, and multinational boundaries. It provides external stakeholders with insight into how the DoD develops architectures. The DoDAF ensures that architecture descriptions can be compared and related across programs, mission areas, and ultimately, the enterprise, thus, establishing the foundation for analyses that supports decision-making processes throughout the DoD.

As the Department takes appropriate strides to ensure advancement of the Information Technology (IT) environment, it becomes essential for the DoDAF to transform to sufficiently support new technologies. A significant evolution occurring today is the Department's transformation to a new type of information intensive warfare known as Net-Centric Warfare (NCW). NCW focuses on generating combat power from the effective linking or networking of the warfighting enterprise, and making essential information available to authenticated, authorized users when and where they need it. This ability is at the heart of net-centricity and essential to achieving Net-Centric Operations (NCO).

DoDAF v1.5 is a transitional version that responds to the DoD's migration towards NCW. It applies essential net-centric concepts[1] in transforming the DoDAF and acknowledges that the advances in enabling technologies – such as services within a Service Oriented Architecture (SOA) – are fundamental to realizing the Department's Net-Centric Vision[2]. DoDAF v1.5 addresses the immediate net-centric architecture development needs of the Department while maintaining backward compatibility with DoDAF v1.0.

In addition to net-centric guidance, DoDAF v1.5 places more emphasis on architecture data, rather than the products, introduces the concept of federated architectures, and incorporates the Core Architecture Data Model (CADM) as an integral component of the DoDAF. These aspects

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[1] Reference DoDAF v1.5 Volume II for further information on the following net-centric concepts and their application to DoDAF: 1) Populate the Net-Centric Environment , 2) Utilize the Net-Centric Environment , 3) Accommodate the Unanticipated User, 4) Promote the Use of Communities Of Interest (COI), 5) Support Shared Infrastructure

[2] 2005 National Defense Strategy

prepare the way for more efficient and flexible use and reuse of architecture data, enabling broader utility for decision makers and process[3] owners.

The DoDAF is a three-volume set that inclusively covers the concept of the architecture framework, development of architecture descriptions, and management of architecture data.

- Volume I introduces the DoDAF framework and addresses the development, use, governance, and maintenance of architecture data.
- Volume II outlines the essential aspects of architecture development and applies the net-centric concepts to the DoDAF products.
- Volume III introduces the architecture data management strategy and describes the pre-release CADM v1.5, which includes the data elements and business rules for the relationships that enable consistent data representation across architectures.

An Online Journal, hosted on the DoD Architecture Registry System (DARS) website (https://dars1.army.mil), replaces the DoDAF v1.0 Desk Book and is designed to capture development best practices, architecture analytical techniques, and showcase exemplar architectures.

The DoDAF will continue to evolve to meet the growing needs of decision makers in the Net-Centric Environment (NCE). Going forward, architectures will need to capture the development of a new generation of net-centric capabilities stemming from operational insights gained in Afghanistan and Iraq. As the maturation of the Global Information Grid (GIG) continues through GIG Capability Increments (an incremental time frame approach to the delivery of GIG-enabling capabilities), architectures will be a factor in evaluating increment investments, development, and performance at the mission portfolio levels. As the DoD increases its use of architecture data for decision-making processes, architects will need to understand how to aggregate the data for presentation purposes at the enterprise level. The DoDAF plays a critical role in the development of architectures and will continue to improve its support for the increasing uses of architecture data.

[3] CJCS Instruction 3170.01E, Joint Capabilities Integration and Development System (JCIDS); DoD Directive 7045.14, Planning, Programming, Budgeting, and Execution (PPBE); DoD Directive 5000.1, The Defense Acquisition System (DAS); DoD Directive 8115.01, Information Technology Portfolio Management (PfM)

# 1 INTRODUCTION

## 1.1 VOLUME II PURPOSE AND INTENDED AUDIENCE

The purpose of the DoDAF v1.5 Volume II is to define, provide a purpose for, and describe in detail each Framework product. This volume is organized with various readers in mind.

For the **manager** who needs to lead architecture development projects and who may need to use an architecture to make acquisition, budgeting, or resourcing decisions, **product definition** and **product purpose** subsections are provided in each product section to:

- Help these managers understand the architecture components or products.
- Provide an appreciation of the potential level of effort involved in developing architectures.
- Assist in discerning the potential uses of an architecture.

For the **architect and engineering team** who need to develop architecture products for high-level decision makers for use in decision support analysis, a **detailed product description** and an architecture **data element table** subsection are provided in each product section to:

- Enable the architect and his team to identify products to be included in the architecture based on the architecture's intended use (see Figure 2-2, Architecture Products by Use).
- Determine architecture data needs.
- Identify sources for the architecture data.
- Analyze and relate the architecture data gathered.
- Compose the architecture data into architecture products.

A Net-Centric Guidance subsection is provided in each product section. With the same architectural vision, the program manager, Component-level CIOs, and chief architects who are guiding the development of architectures, which include net-centric components, should view the Net-Centric Guidance subsections with their individual perspectives and duties to:

- Assist in developing architecture products that show how programs and Component organizations are:
  - Using and consuming information and capabilities from the NCE
  - Facilitating widespread use of information and capabilities beyond their initial predefined set of users
  - Utilizing collaborative communities to make information and capabilities more understandable in the NCE
  - Providing and consuming shared infrastructure
- Aid in developing net-centric architectures compliant with the Net-Centric Operations and Warfare Reference Model (NCOW RM)
- Support program level architecture reviews in support of the Warfighter, Business, Intelligence, and Enterprise Information Environment Mission Areas portfolios

This document is organized in the following manner:

| Section | Content |
|---|---|
| Section 1 | *Introduction* – Identifies the purpose and intended audience of Volume II. Provides a brief overview of DoDAF terms. |
| Section 2 | *Architecture Basics – Views, Products, and Architecture Data* – Provides an overview of basic concepts of the DoD architecture approach and introduces the net-centric concepts. |
| Section 3 | *All-Views Products* – Provides All-View product descriptions. |
| Section 4 | *Operational View Products* – Provides Operational View product descriptions. |
| Section 5 | *Systems and Services View Products* – Provides Systems and Services View product descriptions. |
| Section 6 | *Technical Standards View Products* – Provides Technical Standards View product descriptions. |
| Section 7 | *Framework Architecture Data Element Relationships* – Contains details of the architecture data element and product relationships. |

**Table 1-1 Organization of Volume II**

The product definitions are provided according to the format described below.

### 1.1.1 Product Description Structure

Products for each view are presented individually, with the following separate subsections:

1. A product overview (what is it)
2. A brief statement on the purpose of the product (why is it useful)
3. A detailed description that includes:
   - Narrative details about the product and its representation in Structured Analysis (SA) and in Object-Oriented (OO) notation, where applicable
   - One or more generic templates and/or examples (For most of the products, one or more generic templates are shown to illustrate the basic format of the product; when a generic template is not appropriate, one or more examples are shown.)
4. Net-centric guidance that includes:
   - An updated purpose of the view in a NCE
   - Detailed guidance for tailoring the product to the net-centric concepts
   - Example net-centric product diagrams, as applicable
5. CADM information space and model, and as applicable, data element and relationship table

## 1.2 OVERVIEW

The DoDAF v1.5 defines a common approach for DoD architecture description development, presentation, and integration. The DoDAF v1.5 is a net-centric update to the framework which provides a common approach to DoD net-centric architecture development and includes

guidance to programs, managers, and architects who are developing systems that operate in the NCE as mandated by DoD CIO policies, guidance, and instruction. The net-centric update of DoDAF v1.5 leverages the previous DoDAF v1.0 to describe three types of architectures: Traditional, Net-Centric, and Hybrid (a mix of traditional and net-centric).

An architecture description is a representation of a defined domain, as of a current or future point in time, in terms of its component parts, how those parts function, the rules and constraints under which those parts function, and how those parts relate to each other and to the environment. Within the DoDAF, architectures are described in terms of four views: Operational View (OV), Systems and Services View (SV), Technical Standards View (TV), and All-View (AV). An architecture description is composed of architecture products that are interrelated within each view and are interrelated across views. Architecture products are those graphical, textual, and tabular items that are developed in the course of:

- Gathering architecture data
- Identifying their composition into related architecture components or composites
- Modeling the relationships among those composites

Underlying the products is the CADM, which defines a standard set of architecture data entities and relationships for architecture data.

The term *architecture* is generally used both to refer to an architecture description and an architecture implementation. An architecture description is a representation of a current or postulated real-world configuration of resources, rules, and relationships. Once the representation enters the design, development, and acquisition portion of the system development life-cycle process, the architecture description is then transformed into a real implementation of capabilities and assets in the field. The Framework itself does not address this representation-to-implementation transformation process but references policies that are relevant to that process.

Hereafter in this document, the term *architecture* will be used as a shortened reference to *architecture description*. Occasionally, the term *architecture description* is used for emphasis.

# 2 ARCHITECTURE BASICS - VIEWS, PRODUCTS, AND ARCHITECTURE DATA

## 2.1 ARCHITECTURE VIEWS

As defined in Volume I, the term *integrated architecture* refers to one in which architecture data elements are uniquely identified and consistently used across all products and views within the architecture. In most cases, an integrated architecture description has an OV, SV, TV, and an All View (AV) that are integrated with each other (i.e., there are common points of reference linking the OV and SV and also linking the SV and TV). The Operational Activity to Systems Functionality Traceability Matrix (SV-5), for example, relates operational activities from the Operational Activity Model (OV-5) to system functions from the Systems Functionality Description (SV-4); the SV-4 system functions are related to systems in the Systems Interface Description (SV-1), thus bridging the OV and SV. An architecture is defined to be an *integrated architecture* when products and their constituent architecture data elements are developed, such that architecture data elements defined in one view are the same (i.e., same names, definitions, and values) as architecture data elements referenced in another view.

**Figure 2-1** illustrates the major relationships.

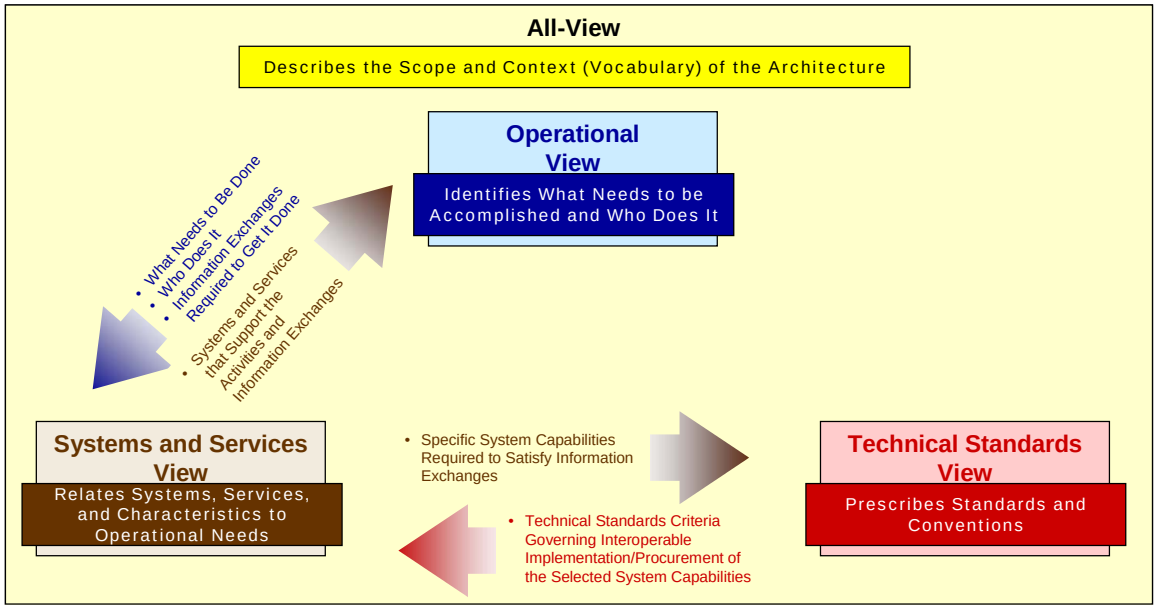


**Figure 2-1: Fundamental Linkages Among the Views**

### 2.1.1 Definition of the Operational View

The OV captures the operational nodes, the tasks or activities performed, and the information that must be exchanged to accomplish DoD missions. It conveys the types of information exchanged, the frequency of exchange, which tasks and activities are supported by the information exchanges, and the nature of information exchanges.

### 2.1.2 Definition of the Systems View

The SV captures system, service, and interconnection functionality providing for, or supporting, operational activities. DoD processes include warfighting, business, intelligence, and infrastructure functions. The SV system functions and services resources, and components may be linked to the architecture artifacts in the OV. These system functions and service resources

support the operational activities, and facilitate the exchange of information among operational nodes.

### 2.1.3 Definition of the Technical Standards View

The TV is the minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements. Its purpose is to ensure that a system satisfies a specified set of operational requirements. The TV provides the technical systems implementation guidelines upon which engineering specifications are based, common building blocks are established, and product lines are developed. It includes a collection of the technical standards, implementation conventions, standards options, rules, and criteria that can be organized into profile(s) that govern systems and system or service elements for a given architecture.

### 2.1.4 Definition of the All-Views

There are some overarching aspects of an architecture that relate to all three views. These overarching aspects are captured in the AV products. The AV products provide information pertinent to the entire architecture but do not represent a distinct view of the architecture. AV products set the scope and context of the architecture. The scope includes the subject area and time frame for the architecture. The setting in which the architecture exists comprises the interrelated conditions that compose the context for the architecture. These conditions include doctrine; tactics, techniques, and procedures (TTP); relevant goals and vision statements; concepts of operations (CONOPS); scenarios; and environmental conditions.

## 2.2 ARCHITECTURE PRODUCTS

Architecture products that describe characteristics pertinent to the architecture purpose are those graphical, textual, and tabular items that are developed in the course of:

- Gathering architecture data
- Identifying their composition into related architecture components or composites
- Modeling the relationships among those composites

Choosing which products to develop for a given architecture description depends on the architecture's intended use.

**Table 2-1** lists products. The first column indicates the view applicable to each product. The second column provides an alphanumeric reference identifier for each product. The third column gives the formal name of the product. The fourth column indicates if the product's definition and purpose were augmented to incorporate net-centric concepts. The fifth column captures the general nature of the product's content. The sequence of products in the table does not imply a sequence for developing the products.

Additional products may be developed for a given architecture description depending on the intended use of the architecture (see **Figure 2-2**). Figure 2-2 identifies several categories for architecture usage and the product data that provide pertinent input to that use. The listed items are not meant to be exhaustive or all inclusive, but are illustrated to provide a starting point for determining the architecture data needed to address a particular area. The architecture data appropriate for any individual use case are highly dependent on the specific situation, objectives, and scope of the effect. Therefore, architects should consider the guidelines provided in the use matrix but make decisions based on the specifics of their particular architecture and its intended use.

**Table 2-1: List of Products**

| Applicable View | Framework Product | Framework Product Name | Net-Centric Extension | General Description |
|---|---|---|---|---|
| **All View** | **AV-1** | Overview and Summary Information | ✓ | Scope, purpose, intended users, environment depicted, analytical findings |
| **All View** | **AV-2** | Integrated Dictionary | ✓ | Architecture data repository with definitions of all terms used in all products |
| **Operational** | **OV-1** | High-Level Operational Concept Graphic | ✓ | High-level graphical/textual description of operational concept |
| **Operational** | **OV-2** | Operational Node Connectivity Description | ✓ | Operational nodes, connectivity, and information exchange need lines between nodes |
| **Operational** | **OV-3** | Operational Information Exchange Matrix | ✓ | Information exchanged between nodes and the relevant attributes of that exchange |
| **Operational** | **OV-4** | Organizational Relationships Chart | ✓ | Organizational, role, or other relationships among organizations |
| **Operational** | **OV-5** | Operational Activity Model | ✓ | Capabilities, operational activities, relationships among activities, inputs, and outputs; overlays can show cost, performing nodes, or other pertinent information |
| **Operational** | **OV-6a** | Operational Rules Model | ✓ | One of three products used to describe operational activity—identifies business rules that constrain operation |
| **Operational** | **OV-6b** | Operational State Transition Description | ✓ | One of three products used to describe operational activity—identifies business process responses to events |
| **Operational** | **OV-6c** | Operational Event-Trace Description | ✓ | One of three products used to describe operational activity—traces actions in a scenario or sequence of events |
| **Operational** | **OV-7** | Logical Data Model | ✓ | Documentation of the system data requirements and structural business process rules of the Operational View |
| **Systems and Services** | **SV-1** | Systems Interface Description<br>Services Interface Description | ✓ | Identification of systems nodes, systems, system items, services, and service items and their interconnections, within and between nodes |
| **Systems and Services** | **SV-2** | Systems Communications Description<br>Services Communications Description | ✓ | Systems nodes, systems, system items, services, and service items and their related communications lay-downs |
| **Systems and Services** | **SV-3** | Systems-Systems Matrix<br>Services-Systems Matrix<br>Services-Services Matrix | ✓ | Relationships among systems and services in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc. |
| **Systems and Services** | **SV-4a** | Systems Functionality Description | | Functions performed by systems and the system data flows among system functions |
| **Systems and Services** | **SV-4b** | Services Functionality Description | ✓ | Functions performed by services and the service data flow among service functions |
| **Systems and Services** | **SV-5a** | Operational Activity to Systems Function Traceability Matrix | | Mapping of system functions back to operational activities |
| **Systems and Services** | **SV-5b** | Operational Activity to Systems Traceability Matrix | | Mapping of systems back to capabilities or operational activities |
| **Systems and Services** | **SV-5c** | Operational Activity to Services Traceability Matrix | ✓ | Mapping of services back to operational activities |
| **Systems and Services** | **SV-6** | Systems Data Exchange Matrix<br>Services Data Exchange Matrix | ✓ | Provides details of system or service data elements being exchanged between systems or services and the attributes of that exchange |

| Applicable View | Framework Product | Framework Product Name | Net-Centric Extension | General Description |
|---|---|---|---|---|
| **Systems and Services** | **SV-7** | Systems Performance Parameters Matrix<br>Services Performance Parameters Matrix | ✓ | Performance characteristics of Systems and Services View elements for the appropriate time frame(s) |
| **Systems and Services** | **SV-8** | Systems Evolution Description<br>Services Evolution Description | ✓ | Planned incremental steps toward migrating a suite of systems or services to a more efficient suite, or toward evolving a current system to a future implementation |
| **Systems and Services** | **SV-9** | Systems Technology Forecast<br>Services Technology Forecast | ✓ | Emerging technologies and software/hardware products that are expected to be available in a given set of time frames and that will affect future development of the architecture |
| **Systems and Services** | **SV-10a** | Systems Rules Model<br>Services Rules Model | ✓ | One of three products used to describe system and service functionality—identifies constraints that are imposed on systems/services functionality due to some aspect of systems design or implementation |
| **Systems and Services** | **SV-10b** | Systems State Transition Description<br>Services State Transition Description | ✓ | One of three products used to describe system and service functionality—identifies responses of a system/service to events |
| **Systems and Services** | **SV-10c** | Systems Event-Trace Description<br>Services Event-Trace Description | ✓ | One of three products used to describe system or service functionality—identifies system/service-specific refinements of critical sequences of events described in the Operational View |
| **Systems and Services** | **SV-11** | Physical Schema | ✓ | Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schema |
| **Technical Standards** | **TV-1** | Technical Standards Profile | ✓ | Listing of standards that apply to Systems and Services View elements in a given architecture |
| **Technical Standards** | **TV-2** | Technical Standards Forecast | | Description of emerging standards and potential impact on current Systems and Services View elements, within a set of time frames |

The following legend is used in **Figure 2-2**:

- A solid black circle (●) indicates the data are highly applicable to the indicated use (i.e., the data should be developed when the architecture is intended to support the indicated use).
- A white circle with a center black dot (⊙) indicates the data are often or partially applicable to the indicated use (i.e., the data should be developed when the architecture is intended to support the indicated use).
- A blank cell indicates that the data are usually not applicable (i.e., there is usually no need to develop the designated data when the architecture is intended to support the indicated use).

The list of uses is not exhaustive; instead, it is intended to provide initial insight into the use of the various architecture product data in supporting DoD processes. Future versions of the Framework are expected to expand the uses described.

| | Applicable Architecture Product Data | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All View | | Operational View (OV) | | | | | | | Systems and Services View (SV) | | | | | | | | | | | Tech Stds View | |
| **Uses of Architecture Data** | 1 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 1 | 2 |
| Analysis & Assessment | | | | | | | | | | | | | | | | | | | | | | |
| Capabilities | | | | | | | | | | | | | | | | | | | | | | |
| - Gaps/Shortfalls | | | | | ◉ | | ● | | | | | | ● | ● | | | | | | | | |
| - Mission Effects & Outcomes, Operational Task Performance | ● | ● | ● | ● | ● | ◉ | | ● | | ● | ● | | | | ● | ● | | | ● | ◉ | | |
| - Trade-Offs | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | ● | ● | | | ● | ◉ | ● | ◉ |
| - Functional Solutions | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | ● | ● | | | ● | ◉ | ● | ◉ |
| | | | | | | | | | | | | | | | | | | | | | | |
| Operations | | | | | | | | | | | | | | | | | | | | | | |
| - Process Re-engineering | ● | ● | | ● | ● | | ● | ● | | | | | | | | | | | | | | |
| - Personnel &Organizational Design | ● | ● | ● | ● | ● | ● | ● | ● | ◉ | ◉ | ◉ | ◉ | | | ◉ | | | | | | | |
| - Doctrine Development/Validation | ● | ● | ● | ● | ● | | ● | ● | | | | | | | | | | | | | | |
| - Operational Planning (CONOPS and TTPs) | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ◉ | ◉ | ◉ | ◉ | | | | | | | ◉ | |
| | | | | | | | | | | | | | | | | | | | | | | |
| Systems/Services | | | | | | | | | | | | | | | | | | | | | | |
| - Communications | ● | ● | | | | | | | | ● | ● | ● | | | | | | | ◉ | | ● | ◉ |
| - Interoperability and Supportability | ● | ● | ● | ● | ● | ◉ | ● | ● | ◉ | ● | ◉ | | ● | | ● | ◉ | ● | | | ◉ | ● | ◉ |
| - Evolution/Dependencies | ● | ● | | | | | | | | | ● | ● | ● | | ● | | ● | | | ● | ● | ● |
| - Materiel Solutions Design & Development | ● | ● | | ● | ● | | ● | ● | ◉ | ● | ● | ● | ● | ● | ● | ● | ● | ◉ | ◉ | ◉ | ● | ◉ |
| - Facilities Packaging | ● | ● | | ● | | | ● | ● | | ● | ● | | ● | ● | | | | | | | ● | ◉ |
| - Performance | | | | | | | ● | ● | | | | | | ● | | ● | | | ● | | | |
| Socialization/Awareness/Discovery | | | | | | | | | | | | | | | | | | | | | | |
| - Training | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ◉ | ◉ | ◉ | ◉ | | | | | | | |
| - Leadership Development | ● | ● | ● | ● | | ● | ◉ | ● | | ● | | | ● | ◉ | | | | | | | | |
| - Metadata (for federation) | ● | ◉ | | | | | | | | | | | | | | | | | | | ◉ | ◉ |

● = Data Highly Applicable
◉ = Data is Often or Partially Applicable
= Data is Usually Not Applicable

**Figure 2-2: Architecture Products by Use**

## 2.3 ARCHITECTURE PRODUCT DEVELOPMENT

The Framework products portray the basic architecture data elements and relationships that constitute an architecture description. In Volume I of the Framework, a process is described for developing architecture descriptions. The six steps of the architecture development process consist of (1) Determine Intended Use of Architecture, (2) Determine Scope of Architecture, (3) Determine Data Required to Support Architecture Develoopment, (4) Collect, Organize, Correlate, and Store Architecture Data, (5) Conduct Analysis in Support of Architecture Objectives, and (6) Document Results in Accordance with Architecture Framework. These steps are independent of any methodology[4] that might be used in designing the architecture, and require the involvement of the architect and the necessary stakeholders to determine these overarching architecture drivers.

### 2.3.1 Product Development Methodology Support

Step six of the architecture development process (described in Volume I) consists of building the requisite products. The Framework does not advocate the use of any one methodology (e.g., structured analysis vs. object orientation) or one notation over another (e.g., IDEF1X or Unified Modeling Language (UML) [2005] notation) to complete this step, but products should contain the required instances of architecture data elements and relationships (i.e., those marked with an asterisk [*] in the data element tables). However, the need for a well-defined and rigorous methodology is acknowledged. There are several candidate methodologies available for consideration, and the choice is ultimately governed by the nature of the architecture being defined, the expertise and preferences of the architecture team, the needs of the customer, and the architecture end users.

The actual gathering, analysis, and synthesis of information into an integrated architecture may be conducted using an integrated tool or set of tools that allow for the development of the products and accompanying text. The use of an integrated tool or tool suite is highly recommended for developing an integrated architecture for consistency and version control. The selected tool(s) should allow the architect to produce consistent products/views by performing cross-product checking. The selected tool(s) should include a mechanism for storing, updating, and retrieving architecture data and their relationships and an ability to automatically generate an integrated dictionary. The tool should be capable of importing/exporting from a CADM-conformant database.

Before selecting a specific architecture tool-set, the architecture team needs to determine the best method (i.e., object-oriented or structured analysis) to implement the purpose of the architecture. If the purpose of the architecture is to design a system largely for software development, then UML tools are likely the best choice. Alternately, if the purpose of the architecture is to analyze business processes, then IDEF tools are likely a good option. The architecture team must carefully select the best method, because there are no known automated tools to convert one method to another (i.e., IDEF to UML, UML to IDEF). IDEF favors process while UML favors objects. These considerations must also include the experience of the architecture staff, because extensive architecture training and mentoring is required for success

[4] The Webster's II New College Dictionary 2001, defines methodology as 1) the system of principles, procedures, and practices applied to a particular branch of knowledge and 2) the branch of logic dealing with the general principles of the formation of knowledge. While the Framework defines an approach for developing architecture descriptions, it does not specify a methodology for developing an architecture description.

regardless of the method. For example, an architect team well versed in IDEF is not likely to succeed in UML without experienced object-oriented leadership and vice versa. There are significant differences between the two methods.

Structured analysis typically creates a hierarchy employing a single abstraction mechanism. The structured analysis method employs IDEF (**Figure 2-3**), is process driven, and starts with a purpose and a viewpoint. This method identifies the overall function and iteratively divides functions into smaller functions, preserving inputs, outputs, controls, and mechanisms necessary to optimize processes. Also known as a functional decomposition approach, it focuses on cohesion within functions and coupling between functions leading to structured data.

The functional decomposition of the structured method describes the process without delineating system behavior and dictates system structure in the form of required functions. The method identifies inputs and outputs as related to the activities.

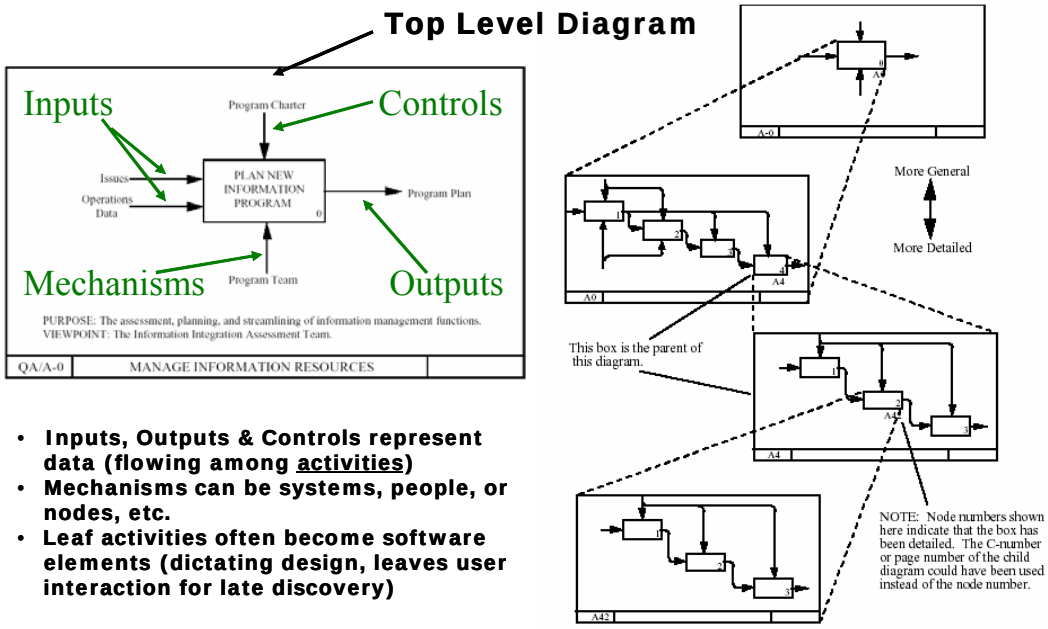


**Figure 2-3: Example Structured Analysis**

One reason for the popularity of structured analysis is its intuitive ability to communicate high-level processes and concepts, whether single system or enterprise levels. Discovering how objects might support functions for commercially prevalent object-oriented development is unclear.

In contrast to IDEF, the UML is interface driven with multiple abstraction mechanisms useful in describing service-oriented architectures (SOAs). The object-oriented method (**Figure 2-4**) starts with the stakeholder and the operational activities required. The method identifies a *use case* (ways the user employs or makes use of the system) to generate important results – also known as *results of value* (ROV), thereby achieving warfighter desired effects. The method assigns required *behavior* (the way – machines or systems operate or interact) to the systems as described by the *use case*. The process iteratively allocates behavior to smaller system elements (products, services, classes, objects, etc.) while optimizing and identifying reuse opportunities.

The object-oriented method and associated UML tools[5] provide object decomposition focused on operational objects and generalization (*inheritance*[6]). This practice creates a flexible interdependent web of elements with inherited properties and relationships. In addition, well-designed object-oriented tools provide an architecture environment where multiple architecture teams can share visionary process consistency and architectural artifacts, such as *use cases* and classes, while managing the evolution of the architecture over time.

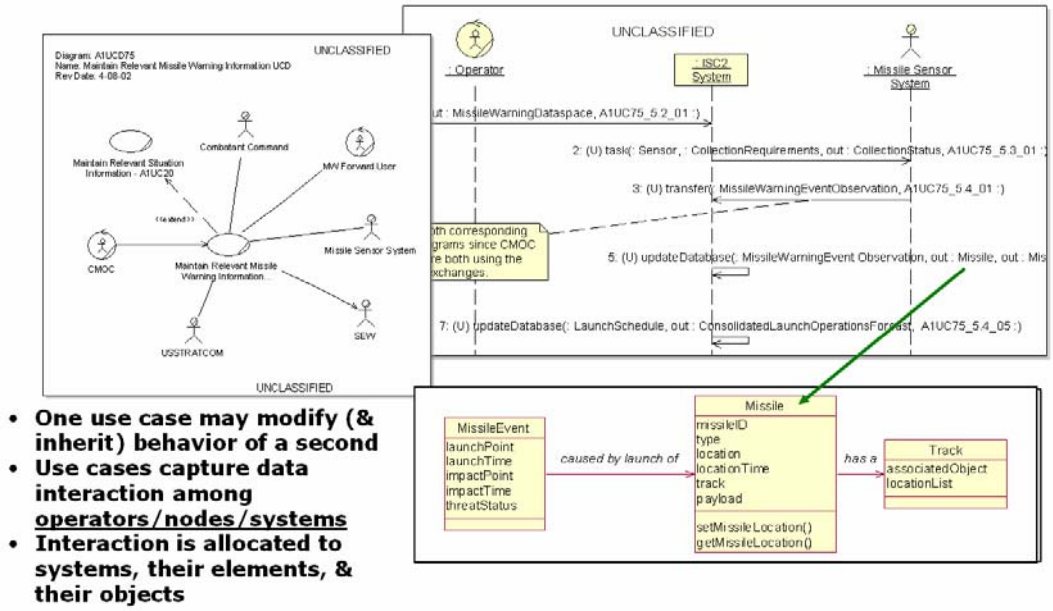


**Figure 2-4: Example Object-Oriented**

The UML describes the system behavior at its surface from the user's perspective by explicitly representing operator and inter-system dialog. The method organizes functionality along generalization-specialization lines, promoting process consistency and product line development. The ROV focused method (following similar principles described by Lean-Six Sigma) pays special attention to component interfaces and system behavior while leaving the design space open for designers, and keeps user behavioral needs foremost. This method lays the foundation for direct object-oriented development activities. In short, structured analysis emphasizes process and functions, while object-oriented analysis emphasizes system behavior using objects.

### 2.3.2 Architecture Products and Levels of Detail

Most graphical products (e.g., OV-2, OV-5, SV-1, and SV-4) permit the modeling of their respective architecture data elements using decomposition (i.e., several diagrams of the same product may be developed for the same architecture, where each diagram shows an increasing level of detail). An example of levels of detail are the various perspectives such as planner, owner, designer, or builder defined by Zachman [Zachman, 1987]. In general, the level of usable

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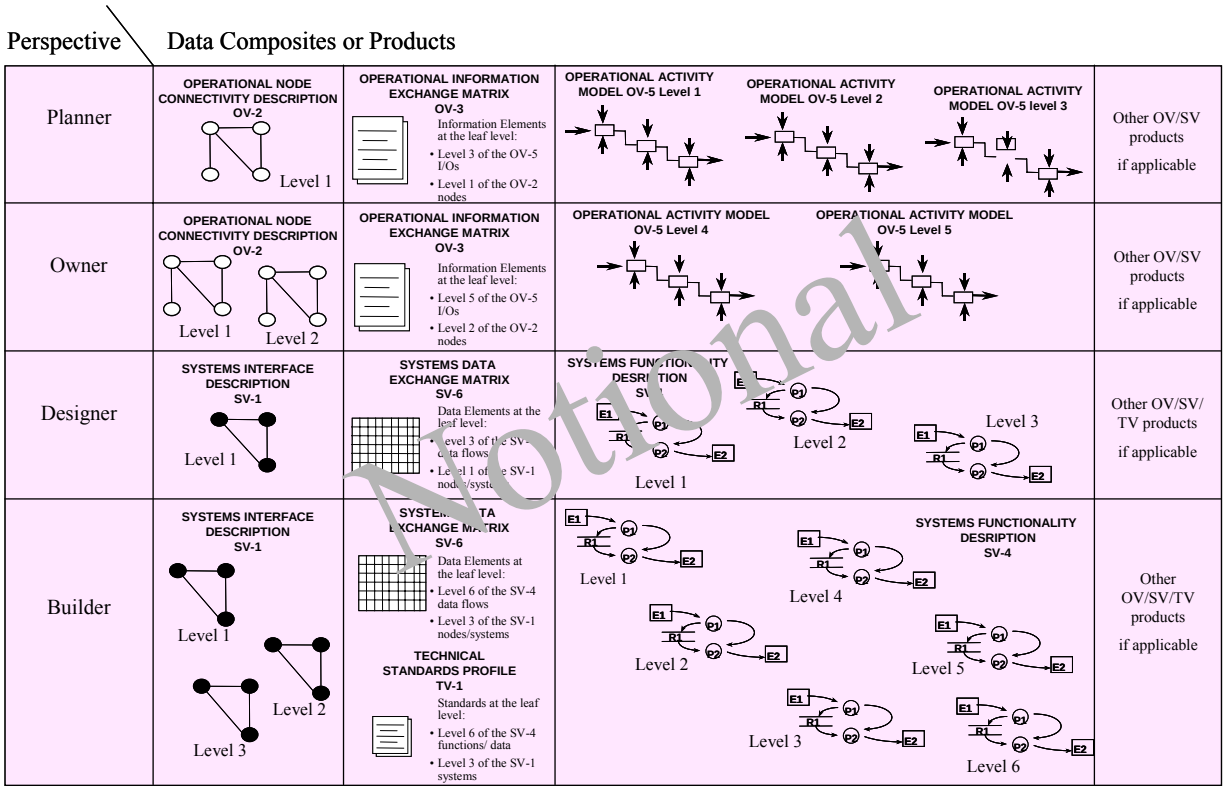
[5] It is important to note that not all UML tools employ effective object-oriented methods. The modeling language itself is not object-oriented, but provides the basis for well-written object-oriented tools. Some tools on the surface appear to be object-oriented due to their apparent UML construct, but employ structured analysis concepts.

[6] Inheritance - a feature whereby a new object can be created from existing objects and, as a consequence of creation, possess the variables and methods of the parent object.

detail increases as the perspective changes from that of the planner, to the owner, to the designer, and to the builder.

Within each perspective, all products developed should remain cohesive with respect to the level of detail. For example, if one diagram of OV-2 operational nodes is developed that shows aggregated organizations only, then it is imperative that the corresponding OV-5 product be developed to show only those operational activities that are meaningful with respect to these operational nodes. Similarly, the information exchanges of OV-3 should remain at a high level of aggregation to represent actual information workflow products that are used at the operational nodes shown in OV-2 (and not their subordinate operational nodes).

A good guide to tracking the level of detail of an architecture is to always ensure that the information is at the level of detail that is meaningful to the intended user of the architecture. A good rule of thumb is to restrict decomposition levels for any one type of diagram within the same perspective to no more than three levels because that is generally sufficient to provide the required level of granularity for a stated objective. **Figure 2-5** illustrates some of the decomposition rules of thumb for various perspectives.




No more than 6 levels of decomposition for each type of product within a perspective
All products within a perspective remain cohesive as to level of detail provided in each

**Figure 2-5: Perspectives and Decomposition Levels**

The products illustrated in Figure 2-5 and the number of decomposition levels shown are not significant but are only examples. The collection of products for each perspective (or level of detail) comprises one model of the architecture. To conduct adequate analyses, an iterative process, where multiple architecture models are developed (one for each perspective), is usually needed.

### 2.3.3 Iterative Development of the Products

Depending on the architecture level needed (e.g., high levels of abstraction that hide design and implementation details) and the intended audience, the Framework products may be developed by applying an iterative method. Iterative development crosses all views. OVs can drive SV and TV changes; SVs can drive OV and TV changes, and so forth. Products iterate across views in the same way that they iterate within one view but across levels of detail.

During this iterative development process, different models are developed at varying levels of abstraction with products that trace from one model to another [Booch, 1999]. That is, at the highest level of abstraction, when only a minimum of Framework products are developed to help describe a new concept of operations, a few products may be developed to produce one model of this architecture (denoted *Model A*).

This first model may consist of only highly abstract/generic sets of operational nodes, operational activities, and so forth. Later, when new details need to be added and the architecture is expanded to show more design detail, a new model (*Model B*, consisting of modified Model A products plus additional products as necessary) must be developed.

The new products that make up Model B will include and trace back to the original group of products (that make up Model A of the architecture). For example, an operational node in an OV-2 product (as part of Model A) may have been used to represent an aggregated organization or command (one that may consist of multiple subordinate operational nodes, but it is deemed unnecessary to show those subordinate nodes at the Model A level). In Model B, the operational node of Model A's product may now be expanded to show the subordinate nodes. No new root-level Framework operational nodes should be introduced at this level that do not trace back to the previous model. For example, if, in the process of model refinement, it is determined that an operational node is part of the architecture, and that this node is not yet a part of any of the aggregated operational nodes of OV-2 included in Model A, then Model A's OV-2 needs to be updated to include the newly identified node. Model B's OV-2 can then include that subordinate node, which will be a decomposition of the Model A node, and will trace back to that node.

### 2.3.4 Product Templates

Where applicable, the templates for the Framework products reference industry standard methodologies and techniques, although there is no requirement to comply with the template's chosen standard. Regardless of the technique used to develop the product, the architecture data elements and their relationships, as defined in the architecture data elements tables, must be accurately reflected, including relationships to architecture data elements in other products. All products should contain explanatory text, even those whose primary presentation is graphical. Where applicable, the templates for the Framework products reference SA or OO standard notation(s).

### 2.3.5 Object-Orientation and the Unified Modeling Language Support

#### 2.3.5.1 Relationship to the Unified Modeling Language

During the last few years UML has emerged as the dominant and most prevalent language for OO modeling irrespective of the development process used. The Object Management Group (OMG) characterizes UML as "The OMG's most-used specification, and the way the world models not only application structure, behavior, and architecture, but also business process and data structure." [OMG, 2007a].

The UML representation is provided in this version of the Framework to assist architects who choose to use OO methodologies. This representation includes a collection of UML diagram types that describe the same information as the Framework products. An OMG activity that kicked off in 2005 is finalizing the specification of a UML profile for DoDAF [OMG, 2007b]. Future versions of the UML profile specification will be coordinated with the DoDAF Working Group.

It should be noted that this document is not a complete and thorough tutorial on the entire UML and the processes for using that language. There are numerous books written on UML and its applications to software and systems engineering, and, in fact, this is a continuing and ongoing research area. Interested readers can consult these other reference books for additional information on UML and application techniques. For further reading material on UML and OO methodologies, see Annex E, References.

#### 2.3.5.2 Comments on a UML Representation Multi-diagram and Multi-model Approach

The Framework UML representation uses UML notation to model both Framework OV and SV architecture products. The UML is fundamentally based on use cases. The UML definition for a use case is a description of system behavior, in terms of sequences of actions. A use case should yield an observable result of value to an actor. A use case contains all flows of events related to producing the "observable result of value," including alternate and exception flows. More formally, a use case defines a set of use-case instances or scenarios. An actor is someone or something outside the system that interacts with the system. Actors aggregate to operational nodes useful to express OV-2, OV-3, and OV-4 information.

The same set of diagram types may be used to model several operational products. The UML diagram for each type of operational product will represent a different aspect of the architecture. For example, a UML class diagram is used to model OV-4 organizational charts, as well as to define a Logical Data Model (OV-7). In the case of OV-4, class diagram notation is utilized to allow the modeling of relationships among organizations (as opposed to relationships among classes of data objects).[7] Classes in the OV-4 diagrams represent organizations, and UML association relationships among these classes represent operational command, control, and organizational relationships among the organizations. Class diagrams used in OV-7, on the other hand, show classes that relate to OV-5 activities and information flows.

For completeness, definitions of the UML terms used in this section have been included in Annex C, under the subheading *Dictionary of UML Terms*. Where a term used in discussing UML has also been used in the Framework document to convey a slightly different meaning, the term is fully qualified within the UML representation sections. For example, the term *component(s)* used in the UML sections refers to any type of system software (as in systems engineering), while the term *component* as referenced in the Framework denotes DoD organizational units. Within the UML section, the term is qualified as *UML Component*.

## 2.4 PRODUCT AND ARCHITECTURE DATA ELEMENT RELATIONSHIPS

There are general relationships that logically interconnect the Framework products from one view to products of another view. The architect needs to be continuously aware of these

[7] An object is an instance of a class.

necessary relationships to produce an architecture that is consistent across the four views and to provide clear traceability and connections from one view to another. **Figure 2-6** illustrates some relationships among the architecture data elements for a subset of the products.

Section 7 of this volume contains a detailed description of these product and architecture data element relationships.

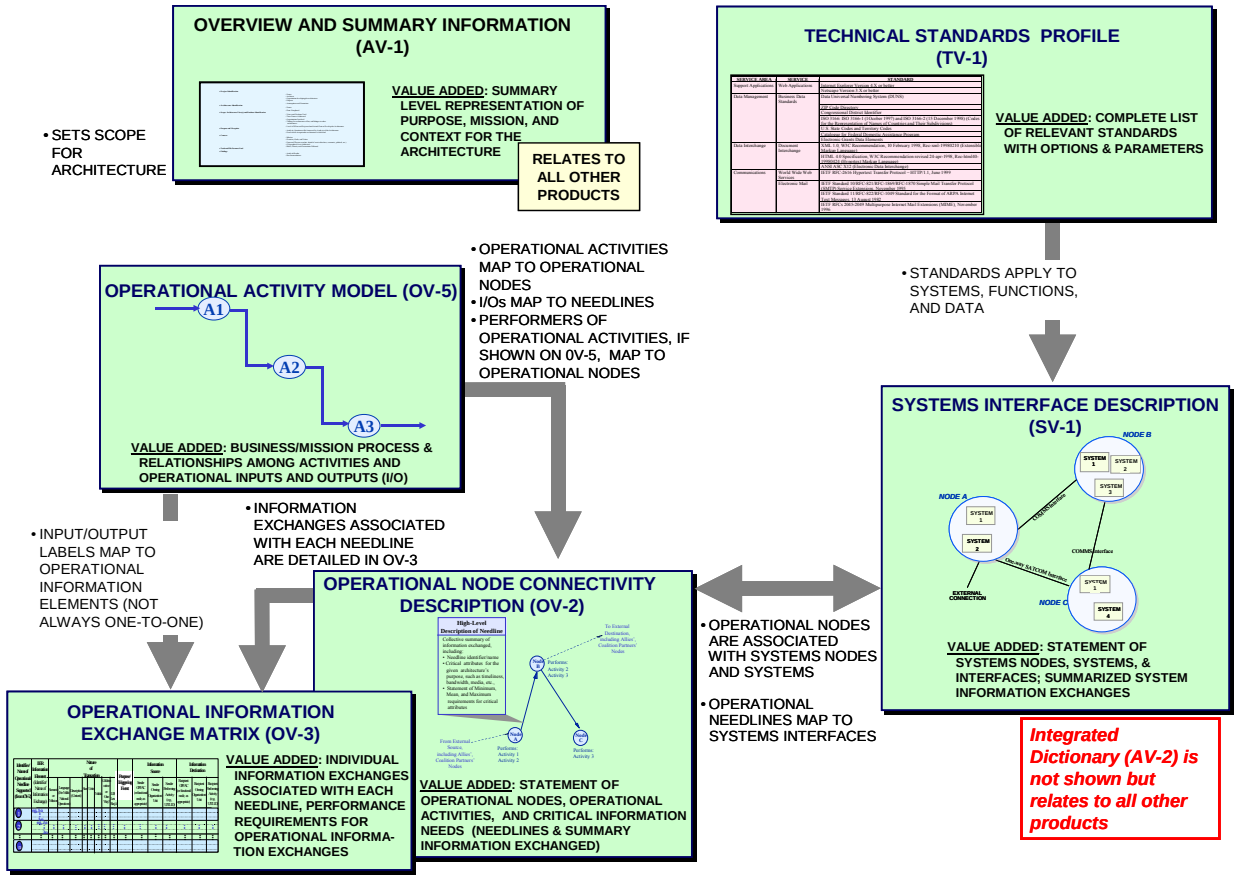



**Figure 2-6: Fundamental Linkages Among the Products and Architecture Data Elements**

## 2.5 NET-CENTRIC GUIDANCE FOR ARCHITECTURE PRODUCTS

As described in Volume I, the DoD is committed to making operations net-centric; that is, enabling ***the ability to share information when it is needed, where it is needed, and with those who need it***. ***Net-centricity*** is an information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. In essence, net-centricity translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace[8]. Accordingly, as the Department's architectures align to support net-centricity and NCO, the DoDAF will undergo appropriate transformation. The DoDAF v1.5 is provided as guidance for architects to begin representing net-centric architectural constructs

[8] Alberts, David S., Garstka, John J., and Stein, Frederick P., Network Centric Warfare: Developing and Leveraging Information Superiority, 2nd Edition (Revised), 1999, CCRP Publication Series

within the DoDAF v1.5 views and products, while remaining backward compatible with DoDAF v1.0 products which may still be sufficient for architectures that have yet to address the NCE.

To identify the specific net-centric constructs that may be represented in the various operational, systems and services, and technical standards views, a set of high-level net-centric concepts were decomposed into specific elements and attributes that enable an architecture product to document how the subject architecture supports net-centricity. For example, ***services*** are a key means to share information and capabilities in the NCE through published ***service interfaces***. In the context of net-centric concepts, a service is a self-contained function in which consumers interact through a well-defined interface. Using this principle, the consumer does not know (or care) "how" the service implements the requested action - only that the service performs "what" is defined by its published interface. As the SV-1 product depicts systems interfaces, the details of how the service interfaces are implemented can be captured in the SV-2 by depicting different views between services.

The application of net-centric concepts (at the attribute level) to the individual architecture products enables:

- The current DoDAF architecture product set to remain well integrated (through mappings between views), while being able to quickly identify net-centric attributes that the architect may describe in a particular view
- Support for the common practice of distributed development of allowing different architects to focus on particular view sets (e.g., OVs, SVs, TVs) with coordination between view sets

While the approach described above is useful for the depiction of net-centric attributes to specific products, it is also important to describe how the various net-centric attributes relate to one another and how they fit together to describe NCO. The following section provides an overarching context within which the attributes were derived and details a thread through net-centric information sharing in a way that highlights the major net-centric attributes that are applied to the DoDAF v1.5 product views.[9]

As mentioned above, a set of high-level net-centric concepts were identified and vetted within the DoD community. These concepts are described below, along with a description of how these concepts decompose into key attributes. These key attributes are discussed in more detail within the net-centric guidance section for each of the OV, SV, TV, and AV products.

**CONCEPT: Populate the Net-Centric Environment**

This concept addresses the data, information, and capabilities that are being made discoverable and accessible on the NCE so that they can be leveraged by others. The information and capabilities provided to the NCE should support discovery and enable access to authorized users (human or machine, known and unanticipated) using a web-based device or platform. While there are many methods and technologies to provide information to the NCE, web-based, open technology standards are preferred. As information and capabilities are provided to the NCE, architects and engineers should ensure that they are done so in a manner that provides the most value, in convenient ways,

[9] Detailed attributes and sub-attributes are described within the guidance sections for each view.

to the broadest set of potential users. In essence, architects and engineers should provide value-added services to the NCE.

The term service has many definitions, depending on the context and intended use. DoDAF v1.5 embraces the IEEE 1003.0 definition of a service, which is "a distinct part of the functionality that is provided by a system on one side of an interface to a system on the other side of an interface." To better align with overarching DoD net-centric strategies, the DoDAF v1.5 extends this definition of service to include those interfaces that allow execution of a business or mission process, or exchange information among both machine and human users via standard interfaces and specifications without regard for the underlying implementation. For example, a service can be an information processing routine that is invoked to assist in a business processing function (e.g., payroll lookup). Or, a service can be one that provides map imagery directly to a human that has access to a web-based device or platform (e.g., a web-enabled PDA). Accordingly, web portals, web sites, and Web Services all fall within the definition of a 'service' as discussed in DoDAF v1.5. Note, while the net-centric guidance provided in the DoDAF v1.5 focuses on web-based services, much of the guidance is applicable to any form of electronic information processing or access service.[10]

Regardless of the type of service that provides information and/or a capability to the NCE, the ***service provider*** (i.e., the entity that actually provides the capability) will need to describe the service in a robust manner that gives both humans and machines enough details to make a decision on when, where, and how to use the service (in addition to other important details such as performance level expectations and information assurance specifics). A ***service specification*** is the set of descriptive metadata that provides a consistent way to describe the use, composition, and implementation of a service to service providers, users, developers, and managers. A ***service specification*** should be provided for each service that is or will be provided to the NCE. The service specification enables services to be documented in a consistent manner, and the DoD-wide ***Service Specification Template (SST)*** should be used to the extent possible for describing each service. Regardless of the precise service specification template employed in the subject architecture, a minimum set of information for each service must be provided in the following categories:

- ***Interface Model Category*** – describes the interface, available operations, any faults that an individual operation may generate, and points to access the service
- ***Information Model Category*** – describes the capability the service provides, the expected input and output data model, and outlines the available metadata for the service
- ***Behavior Model Category*** – Identifies how the service interacts with other services, describes the underlying processing rules of the service, and describes the multiple integration patterns available to users of the service

[10] The Organization for the Advancement of Structured Information Standards (OASIS) SOA (Reference Model for SOA 1.0) provides additional information.

- ***Fault Model Category*** – describes how the service will handle faults and under what conditions a fault may be returned to the consumer
- ***Quality Model Category*** - describes the security requirements of the service, the QoS levels, and any performance considerations for service deployment
- ***Point of Contact Information Category*** – describes the types of contacts associated with a service, which may include developers, managers, or maintenance organizations.
- ***Service Access Point Information Category*** – describes the message format and transmission protocol, Uniform Resource Locator (URL), the operational status and point of contact, and the lifecycle step of the service (e.g., Development, Testing, or Production)

The level of detail contained within a service specification is driven partly by the type of service. ***Human-facing web services*** (e.g., portals, web sites) generally need only be specified in a manner that allows a human to find and understand what the service does, how to access it, and how to understand its outputs. Both human facing services and system facing services are described using the template. However, where the primary user of services is another system, a more detailed specification is required to be machine interpretable. These system consumable services generally will be specified through the service information, service interface, and service implementation categories in the specification template.

**CONCEPT: Utilize the Net-Centric Environment**

This concept addresses what information and capabilities are being leveraged from the NCE. In order to leverage information and capabilities from the NCE, users (both human and machine) will need to first be aware of them. That is, services that provide information and capabilities need to be readily ***discoverable*** by users across the NCE. Accordingly, architectures that provide services must also account for how these services are discoverable to humans and machines.

To leverage information for multiple uses in the NCE, search engines, data catalogs, integrated data environments, and ***document repositories*** may enable human users to search for data or applications of interest. DoDAF v1.5 refers to all of these and similar mechanisms as catalogs. These ***catalogs*** typically enable search through the use of keywords and other more advanced methods. The DoD has established a basic set of elements that must be used to describe the information, applications, and services that are described in these catalogs. Architects should indicate how this information is being ***tagged*** and made searchable. The DoD has established mechanisms (metadata specifications, vocabularies, taxonomies, and ontologies) to enable these catalogs to be consistently searched across the DoD enterprise. Accordingly, participation in the DoD enterprise discovery processes may be represented within the OV-3, OV-5, OV-6c, or OV-7.

As a catalog may be used to enable discovery of data and information products and human facing services, capabilities, offered as services, may be leveraged for multiple uses in the NCE through a service registry. The ***service registry*** is used to capture the service specification information about each machine consumable service. The ***service registry*** is a platform neutral, network-based directory that stores information about services and is

searchable based on the descriptive metadata defined in the service specification. The service registry can aid in governing services, enabling service reuse, managing the lifecycle of services, and providing an authoritative source for service policies.

In the NCE, users can discover information, capabilities, and services through catalogs and registries.[11] The goal of NCO is to leverage the power of this ability to enhance mission execution capability. Accordingly, using the NCE implies a paradigm shift in the way mission and business processes are planned and architected. Leveraging the NCE to accomplish missions imparts new and modified ***constraints*** to work within. Refer to the Net-Centric Environment Joint Functional Concept, v1.0, 7 April 2005, for a complete definition of NCO.

***Operational constraints*** may include dependencies on services external to the architecture, service availability, or identification of supported environments. External services can be a part of the architecture, but those external services are owned by other programs or components. Additional program coordination may be required with development, operation, and maintenance of the external services. ***Programmatic constraints*** include planning for service availability, deprecation of services or replacement of specific system functions with services. As the federation of architectures becomes increasingly important – showing interoperability across the DoD and with other Federal agencies, Coalition, and Allies – identification of constraints of a given architecture can be considered on behalf of a portfolio of capabilities, rather than a system by system basis.

**CONCEPT: Accommodate the Unanticipated User**

This concept emphasizes that NCO intend for users to look to the NCE, rather than being constrained to a predefined source, to find the information and capabilities they need to execute their missions. This supports the ability for NCE users, both known users and ***unanticipated users*** (human and machine), to discover information and capabilities that populate the NCE. While tightly engineered – predefined interfaces between systems will continue to exist in the architecture – the objective in the NCE is to increase the potential for many other systems and users to leverage the same data and capabilities without having to anticipate this use in the development cycle.

To accommodate the unanticipated users, the analysis of architecture products may provide insights as to 1) how capabilities are engineered to support authorized but unanticipated human and machine users, and 2) how information and data are made available to the NCE early in the data lifecycle and that data and information is provided in flexible formats to enable use by varied consumers. To accommodate both known and ***authorized unanticipated users***, architectures should reflect engineering decisions that enable the capability to grow and evolve in a timely and cost effective manner as more users may wish to use it. Engineering decisions may also indicate how process, doctrine, and policy enable known and authorized unanticipated users to access the capability. Information and data should be provided to the NCE at various points in their lifecycle in order to support users who may be able to leverage semi-processed or unprocessed data. This operational construct of ***post before processing***[7] further enables multiple uses of data and information in the NCE beyond their original predefined use.

[11] DoD Net-Centric Data Strategy, May 9, 2003

Likewise, as data and information in the NCE are used throughout the DoD enterprise, these products' use will be varied. To accommodate this, providers of data and information should utilize ***data formats*** that allow users the most flexibility in processing and understanding the information.

**CONCEPT: Promote the Use of Communities of Interest**

This concept emphasizes the significance of ***Communities of Interest (COIs)*** in achieving the jointness required to operate in the NCE by defining ***common vocabularies, taxonomies, data standards, interchange agreements, and specifications*** relevant to the communities architecture. ***COIs*** are collaborative groups of users who exchange information in pursuit of their shared goals, interests, missions, or business processes, and benefit from sharing common architectural data and representations. COIs should be involved in all processes that support the understanding of common architectural data, information, applications, and services and accordingly have an impact on the development of conceptual, logical, and physical data models and associated information exchange structures or schema. COIs should be reflected in the architecture to ensure that capabilities are being developed in a manner that supports ***structural and semantic interoperability*** across program and organizational boundaries.

**CONCEPT: Support Shared Infrastructure**

This concept addresses the use of, and contribution to, the **sharable infrastructure** of the NCE. This includes indicating how enterprise-level capabilities are being leveraged where appropriate and as available. ***Shared infrastructure*** exists to provide the enterprise information environment resources to provider and consumer users to support and facilitate the effective and efficient flow of information between users and the seamless sharing of capabilities amongst users. Shared infrastructure includes capabilities contained within the Enterprise Information Environment portfolio, and includes ***core enterprise services*** (CSEs), computing infrastructure, transport and communications, and information assurance. The use of CESs should be clearly depicted within architectures that make extensive use of services. CESs are defined as a collection of networked capabilities that enable DoD service providers. The CESs provide and manage the underlying capabilities to deliver content and value to end users. Various technical architecture components can illustrate how program, domain, agency, and Mission Area architectures exploit shared infrastructure components, including enterprise service bus components, service registries, or federated enterprise service discovery amongst others. As architectures become increasingly federated to support NCO, the shared infrastructure must be able to scale and perform accordingly. In this manner, the shared infrastructure enables the Department to better manage its portfolio of capabilities in support of NCO.

The net-centric architecture concepts described in this section are applied to the DoDAF operational, systems and services, technical standards, and all-view views that follow in the remainder of Volume II. Each DoDAF product section is augmented to address 1) the updated purpose of the view in the NCE, 2) detailed guidance for tailoring the product to the net-centric concepts, and, as applicable, 3) example net-centric product diagrams. The concepts applied in this version of DoDAF are the first incremental steps in defining various components of net-centric architectures. Future DoDAF efforts will build upon this increment to address 1) application of SOA design patterns to developing DoD architectures, 2) architecture support for

various architecture perspectives (decision maker, developer, portfolio manager, operators), 3) architecture development methodologies, and 4) leveraging of other frameworks.

## 2.6 CADM SUPPORT FOR ARCHITECTURE PRODUCTS[12]

In pre-release CADM v1.5, each instance (including each version or variant used for analysis) of an architecture product is identified and stored as an instance of Document in a CADM-conformant database. Two attributes of Document (architectureProductCategoryCode and architectureProductSubcategoryCode) are used to characterize Document as a specific DoDAF architecture product. The valid values for these attributes are contained in Volume III. CADM v1.5 explicitly allows for the versioning of every object contained in an architecture. This is accomplished through the ObjectVersion entity, which is the supertype for all the other entities in the model. Document is modeled as a subtype of ArchitectureElement.

In some cases, the same Document subtype is used for both an operational and a systems product of the same kind (e.g., OV-5 and SV-4 use essentially the same structures to specify operational activities, processes, and system functionality). Unlike most of the other figures from the CADM for specific architecture products that follow, **Figure 2-7** shows attribute detail, providing descriptive values. All associations are handled in CADM v1.5 through ObjectVersionAssociation. This allows the linkage of the architecture products to their content.

[12] In this section and the other CADM descriptions that follow, bold blue font in the diagram is used for approved entities (and attributes), and blue lines depict approved relationships (already part of the DoD Data Architecture, the data model that structures approved data standards). Other colors are used to identify parts of the CADM that have not yet completed DoD-wide data standardization. Specifically, bold red italic font is used for entities and attributes that are in Candidate status under DoD-wide data standardization.

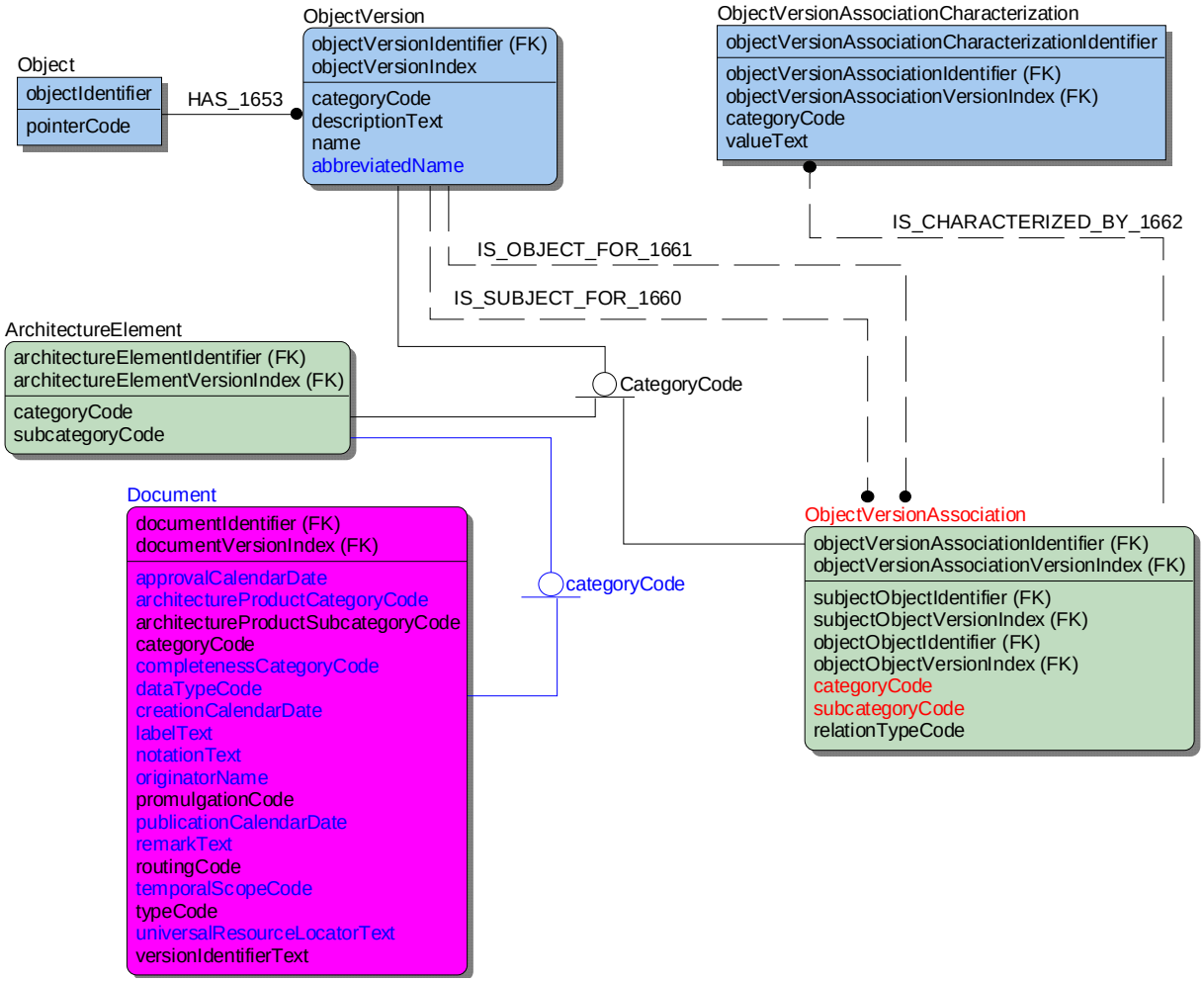



**Figure 2-7: CADM Support for Architecture Products**

**CADM Data Model Diagram Notation.** As illustrated in Figure 2-7, boxes represent entities for which architecture data are collected (representing tables when used for a relational database); they are depicted by open boxes with square corners (independent entities) or rounded corners (dependent entities). The entity name is outside and on top of the open box. The lines of text inside the box denote the attributes of that entity (representing columns in the entity table when used for a relational database). The horizontal line in each box separates the primary key attributes (used to find unique instances of the entity) from the non-key descriptive attributes. The symbol with a circle and line underneath indicates subtyping, for which all the entities connected below are non-overlapping subsets of the entity connected at the top of the symbol. Relationships are represented by dotted (non-identifying) and solid (identifying) relationships in which the child entity (the one nearest the solid dot) has zero, one, or many instances associated to each instance of the parent entity (the other entity connected by the relationship line).

### 2.6.1 Overview and Summary of Common Data Structures – Data Element Definitions

**Common Information Space**

**Object**
**ObjectVersion**
**ObjectVersionAssociation**
**ObjectByReference**
**ObjectByReferenceCharacterization**
**ObjectType**
**ObjectVersionAssociationCharacterization**
**ObjectVersionStructure**
**ObjectVersionStructureAssociation**
**ObjectVersionStructureDetail**
**ObjectItem**

**Table 2-2** defines the data elements related to common data structures.

**Table 2-2 Data Element Definitions for Common Data Structures**

| Data Elements | Attributes | Example Values/Explanation |
|---|---|---|
| **Object** | | |
| | pointerCode | The code that corresponds to the logical name of the leaf entity within the ObjectVersion hierarchy and its subtypes ArchitectureElement, ObjectType, ObjectItem, ObjectByReference, ObjectVersionAssociation. |
| **ObjectVersion** | | |
| | categoryCode | The code that represents a class of ObjectVersion. |
| | descriptionText | The text that characterizes a specific ObjectVersion. Note: This attribute is "inherited" by all the subtypes. |
| | name | The name of a specific ObjectVersion. Note: This attribute is "inherited" by all the subtypes. |
| | abbreviatedName | The name in shortened form of a specific ObjectVersion. Note: This attribute is "inherited" by all the subtypes. |
| **ObjectVersion Association** | | |
| | categoryCode | The code that represents a class of ObjectVersionAssociation. |
| | subcategoryCode | The code that represents the detailed type of relationship between the subject Object and the object Object in a specific ObjectVersionAssociation. |
| | relationTypeCode | The code that characterizes the association of the subject Object with the object Object in a specific ObjectVersionAssociation. |
| **ObjectVersion Association Characterization** | | |
| | categoryCode | The code that represents the applicable attribution of a specific ObjectVersionAssociationCharacterization. |
| | valueText | The text that represents the content assigned to the attribution of a specific ObjectVersionAssociationCharacterization. |
| **ObjectItem** | | |
| | categoryCode | The specific value that represents the class of ObjectItem. |
| | alternateIdentificationText | The unformatted character string assigned to represent an alternate means of identifying an ObjectItem. Note: One of the uses of this attribute is the entry of national unit identification codes or similar codes (e.g., ship codes). |
| **ObjectType** | | |
| | categoryCode | The code that represents the class of ObjectType. |

| Data Elements | Attributes | Example Values/Explanation |
|---|---|---|
| **ArchitectureElement** | | |
| | categoryCode | The code that represents a class of ArchitectureElement. |
| | subcategoryCode | The code that represents a detailed classification of ArchitectureElement. |
| **ObjectByReference** | | |
| | categoryCode | The code that represents a class of ObjectVersion, which is not an explicit member of the ObjectItem, ObjectType, ObjectVersionAssociation or ArchitectureElement hierarchies. |
| **ObjectByReference Characterization** | | |
| | categoryCode | The code that represents the applicable attribution of a specific ObjectByReference. |
| | valueText | The text that represents the content assigned to the attribution of a specific ObjectByReference. |
| **ObjectVersion Structure** | | |
| | name | The name of a specific ObjectVersionStructure. Note: This enables the disambiguation of specific pairs of associations recorded in ObjectVersionAssociation. |
| | categoryCode | The code that represents a class of ObjectVersionStructure. |
| **ObjectVersion StructureAssociation** | | |
| | categoryCode | The code that represents the role of a subject ObjectVersionStructure with respect to a object ObjectVersionStructure. |
| **ObjectVersion StructureDetail** | | |
| | (no data elements) | |

# 3 ALL-VIEWS PRODUCTS

Two products are defined in the All-Views section, Overview and Summary Information (AV-1) and Integrated Dictionary (AV-2).

## 3.1 OVERVIEW AND SUMMARY INFORMATION (AV-1)

### 3.1.1 AV-1 – Product Description

**Product Definition**. The AV-1 provides executive-level summary information in a consistent form that allows quick reference and comparison among architectures. AV-1 includes assumptions, constraints, and limitations that may affect high-level decision processes involving the architecture.

**Product Purpose**. AV-1 contains sufficient textual information to enable a reader to select one architecture from among many to read in more detail. AV-1 serves two additional purposes. In the initial phases of architecture development, it serves as a planning guide. Upon completion of an architecture, AV-1 provides summary textual information concerning the architecture.

**Product Detailed Description**. The AV-1 product comprises a textual executive summary of a given architecture and documents the following descriptions.

***Architecture Project Identification*** identifies the architecture project name, the architect, and the organization developing the architecture. It also includes assumptions and constraints, identifies the approving authority and the completion date, and records the level of effort and costs (projected and actual) required to develop the architecture.

***Scope*** identifies the views and products that have been developed and the temporal nature of the architecture, such as the time frame covered, whether by specific years or by designations such as current, target, transitional, and so forth. Scope also identifies the organizations and COIs that fall within the scope of the architecture. The scope also includes the COIs that are related to the architecture.

***Purpose and Viewpoint*** explains the need for the architecture, what it should demonstrate, the types of analyses (e.g., Activity-Based Costing) that will be applied to it, who is expected to perform the analyses, what decisions are expected to be made on the basis of an analysis, who is expected to make those decisions, and what actions are expected to result. The viewpoint from which the architecture is developed is identified (e.g., planner or decision maker).

***Context*** describes the setting in which the architecture exists. It includes such things as mission, doctrine, relevant goals and vision statements, concepts of operation, scenarios, information assurance context (e.g., types of system data to be protected, such as classified or sensitive but unclassified, and expected information threat environment), other threats and environmental conditions, and geographical areas addressed, where applicable. Context also identifies authoritative sources for the rules, criteria, and conventions that were followed. The tasking for the architecture project and known or anticipated linkages to other architectures are identified.

***Tools and File Formats Used*** identifies the tool suite used to develop the architecture and file names and formats for the architecture and each product.

***Findings*** states the findings and recommendations that have been developed based on the architecture effort. Examples of findings include identification of shortfalls, recommended system implementations, and opportunities for technology insertion.

During the course of developing an architecture, several versions of this product may be produced. An initial version may focus the effort and document its scope, the organizations involved, and so forth. After other products within the architecture's scope have been developed and verified, another version may be produced to document adjustments to the scope and to other architecture aspects that may have been identified as a result of the architecture development. After the architecture has been used for its intended purpose, and the appropriate analysis has been completed, yet another version may be produced to summarize these findings for the high-level decision makers. In this version, the AV-1 product, along with a corresponding graphic in the form of an OV-1 product, serves as the executive summary for the architecture. **Figure 3-1** shows a representative format for the AV-1 product.

- **Architecture Project Identification**
  - Name
  - Architect
  - Organization Developing the Architecture
  - Assumptions and Constraints
  - Approval Authority
  - Date Completed
  - Level of Effort and Projected and Actual Costs to Develop the Architecture
- **Scope: Architecture View(s) and Products Identification**
  - Views and Products Developed
  - Time Frames Addressed
  - Organizations Involved
- **Purpose and Viewpoint**
  - Purpose, Analysis, Questions to be Answered by Analysis of the Architecture
  - From Whose Viewpoint the Architecture is Developed
- **Context**
  - Mission
  - Doctrine, Goals, and Vision
  - Rules, Criteria, and Conventions Followed
  - Tasking for Architecture Project and Linkages to Other Architectures
- **Tools and File Formats Used**
- **Findings**
  - Analysis Results
  - Recommendations

**Figure 3-1: AV-1 - Representative Format**

### 3.1.2 UML Representation

The UML tool(s) used for analysis and design usually allows for the addition of documentation to annotate the model/architecture being designed. There is no specific UML product (diagram) that is equivalent to the AV-1 product. Documentation should be developed for AV-1, which can be input via a documentation field in a UML modeling tool, if desired.

### 3.1.3 Net-Centric Guidance for AV-1

**Augmented Product Purpose**. In the NCE, the AV-1 identifies an architecture's net-centric capabilities and highlights assumptions, constraints, and limitations associated with NCO and which may affect high-level decision processes involving the architecture.

**Net-Centric Product Description**. In the NCE, the AV-1 details the **scope**, **purpose,** and **context** of the architecture, including those net-centric attributes. The AV-1 is iterative, like the

other architecture products, which may result in scope and context changes. Specifically, the purpose of the architecture in the NCE is expanded to include how the architecture populates the NCE, utilizes the NCE, supports the unanticipated user, leverages COIs to promote jointness, and supports shared infrastructure.

As part of the architecture viewpoint, the AV-1 describes whether the architecture depicts a ***Service Provider*** perspective, a ***Service Consumer*** perspective, or both. The Service Provider perspective in the NCE describes the operational role, which contributes information and capabilities to the NCE in support of both the set of anticipated consumers as well as to the larger set of unknown consumers (generally limited to those users in the service, agency, Allied, and coalition partner planning space). The AV-1 should capture any assumptions, constraints, and limitations that may be required to support the unanticipated user, including those affecting deployment, communications performance, and information assurance environments. The Service Consumer perspective in the NCE describes the operational role that relates to the consumption of information and capabilities from sources in the NCE.

The context of the architecture describes the aspects of the mission goals and vision that support NCO. This should include scenarios that address Service Providers and Service Consumers in the NCE, the type of Service Consumers anticipated, and the type of capabilities and information that are supplied to the NCE. Program level architectures should describe how the program will operate within the enterprise to support net-centricity.

The scope of the architecture describes the breadth and depth of the architecture, and includes the operational activities covered by the architecture. Accordingly, the scope of a net-centric architecture describes what information and capabilities are provided to or consumed from the NCE, and emphasizes the information and capabilities 1) being offered to machines through the use of web-based services, and 2) being offered as web-based technologies to human consumers on the NCE. Within the scope, the architecture identifies organizations involved in the subject architecture. The scope of a net-centric architecture builds on this construct and encourages identification of the COIs with which any specific architecture products have been developed, particularly, any vocabularies, data models, data sharing agreements or service interface specifications, applicable Mission Areas, applicable domains, and architecture stakeholders.

Documenting these various aspects of net-centricity in the AV-1 products will aid the following efforts:

- Development of planning guides for net-centric components of the program
- Enable portfolio management to leverage key net-centric capabilities as part of managing the Department's IT investments
- Identify dependencies on information and capabilities provided by the NCE and direct the categorization of the incurred risks from those dependencies
- Identify the information and capabilities provided by the program so that they may be promulgated to other programs

### 3.1.4 CADM Support for AV-1

In CADM v1.5, each architecture is an instance of Architecture. **Figure** 3-2 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for AV-1 in a CADM-conformant database. Each view of an Architecture is specified as a

separate instance of Architecture, and the collection of views is related to the overall instance of Architecture by populating ObjectVersionAssociation. When an instance of Architecture is a specific view (OV, SV, or TV), the attribute ViewCategoryCode in the entity Architecture is set to the appropriate value, and the corresponding data are entered for that instance. The set of System instances addressed in an SV can be tracked by associating the instance Architecture to the pertinent instances of System.[13]

Each architecture product for a specific Architecture is specified as an instance of Document with the appropriate value of the attribute ArchitectureProductTypeCode designating the kind of DoDAF architecture product. All the architecture products for a specific Architecture are recorded by associating the instance of Architecture to the pertinent instances of Document via ObjectVersionAssociation. In addition, any OperationalScenario relevant to a specific Architecture can be linked in the same way (see Volume III for details).

Organizations have several possible roles in a specific Architecture. In CADM v1.5 via ObjectVersionAssociation**,** it is possible to relate instances of Organization to a specific instance of Architecture. Additional semantics, such as where an instance of Organization is the focus of an Architecture, can also be expressed in CADM v1.5.

[13] The technical details are outside the scope of this document. A full description of how CADM v1.5 captures associations is provided in Volume III. Essentially, CADM v1.5 uses ObjectVersionAssociation to link any instance within the ArchitectureElement hierarchy to any other instance within either the same or any other of the CADM v1.5 hierarchies. In those cases where the specific concept is not explicitly modeled it becomes an instance of ObjectByReference in CADM v1.5.

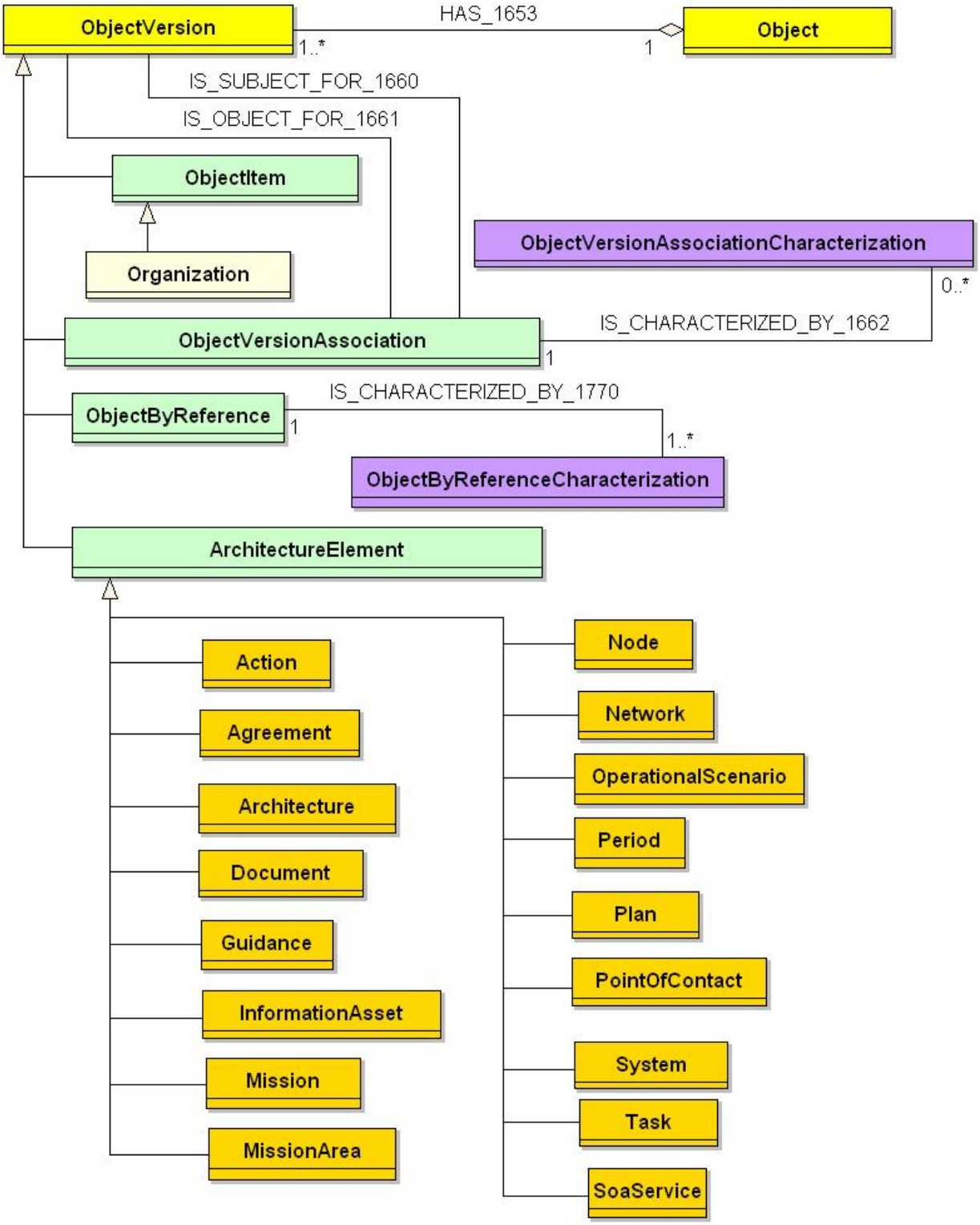



**Figure 3-2: CADM Diagram for AV-1**

The association of reference elements other than System and Organization (noted above) to a specific Architecture is equally possible in CADM v1.5. In particular, the following relations are noted:

- Instances of Task, which can list, for example, the elements of the Universal Joint Task List (UJTL) and other recognized task lists germane to a specific Architecture
- Instances of MissionArea, which can list, for example, the general class to which an operational mission belongs with respect to a specific Architecture
- Instances of Guidance, which can list, for example, the goals and objectives as well as the information exchange requirements germane to a specific Architecture
- Instances of Node, which can list, for example, the nodal elements germane to a specific Architecture
- Instances of Period, which can list the time frame germane to a specific Architecture

Recommendations, constraints, issues, and other types of findings related to an Architecture are also expressible in CADM v1.5. Associations among these are captured as instances of ObjectVersionAssociation. A similar approach allows designating any finding as related to one or more of the following: Doctrine, Training, Leadership, Organization, Materiel, and Warfighter (soldier).

#### 3.1.4.1 AV-1 – Data Element Definitions

**AV-1 Information Space**

| | |
|---|---|
| **Action** | **Node** |
| **Agreement** | **OperationalScenario** |
| **Architecture** | **Organization** |
| **Document** | **Period** |
| **Guidance** | **Plan** |
| **InformationAsset** | **PointOfContact** |
| **Mission** | **SoaService** |
| **MissionArea** | **System** |
| **Network** | **Task** |

**Table 3-1** defines the data elements related to the AV-1 product.

**Table 3-1: Data Element Definitions for AV-1[14]**

| Data Elements | Attributes | Definition |
|---|---|---|
| **Action*** | | |
| | actualEndCalendarDateTime | The calendar date-time of the actual conclusion of an Action. |
| | actualStartCalendarDateTime | The calendar date-time of the actual beginning of an Action. |
| | categoryCode* | The code that represents a class of Action. |
| | priorityCode | The code that represents the precedence of an Action. |
| | statusCode | The code that represents the current state of a specific Action. |
| | verbCode | The code that represents a function to be performed by a specific Action. |

[14] As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

| Data Elements | Attributes | Definition |
|---|---|---|
| **Agreement*** | | |
| | categoryCode* | The code that represents a classification of an Agreement. |
| | durationTypeCode | The code that represents a specific kind of time frame associated with an Agreement. |
| | effectiveCalendarDate | The calendar date when an Agreement becomes effective. |
| | expirationCalendarDate | The calendar date on which an Agreement is no longer in force. |
| | contentText | The text of an Agreement. |
| | typeCode | The code that represents a specific kind of Agreement. |
| | useTypeCode | The code that represents a class of employment of a specific Agreement. |
| | versionIdentifierText | The text that identifies a specific rendition of a specific Agreement. |
| **Architecture*** | | |
| | nameText* | The name of the Architecture being described (e.g., Naval Strike Warfare). |
| | descriptionText* | The narrative that describes the Architecture. |
| | commandLevelCode | The code that represents the highest level of authority depicted by a specific Architecture. |
| | completionCalendarDate | The calendar date on which a specific Architecture was finished. |
| | completionStatus Code | The code that represents the degree to which a specific Architecture has come to its intended end state. |
| | contextText | The text that characterizes the setting for the Architecture. |
| | databaseName | The name of the database maintained for a specific Architecture. |
| | effectiveEndCalendarDate | The calendar date on which a specific Architecture terminates being in effect. |
| | effectiveStartCalendarDate | The calendar date on which a specific Architecture begins to be in effect. |
| | granularityCode | The code that represents the level of detail at which a specific Architecture will be built. |
| | Implementability CharacterizationCode | The code that represents whether a specific Architecture is intended to be implemented. |
| | levelCode | The code the represents the breadth of scope of the Architecture. |
| | objectiveText | The text that characterizes the aim of a specific Architecture. |
| | purposeConstraintText | The text that summarizes the limitations for the goal of a specific Architecture. |
| | purposeText | The text that characterizes the primary use for the Architecture. |
| | registrationIdentifierText | The text that identifies an Architecture assigned by the architect. |
| | releaseCalendarDate | The calendar date on which the Architecture is formally made available. |
| | scopeText | The text that characterizes the extent of applicability for a specific Architecture. |
| | summaryDescriptionText | The text that concisely describes a specific Architecture. |
| | systemArchitecture ApplicabilityStatusCode | The code that represents the state of pertinence of a specific systems Architecture. |
| | temporalScopeCode | The code that represents the kind of time frame addressed by a specific Architecture. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | useTypeCode | The code that represents a kind of expected employment of the Architecture. |
| | viewCategoryCode | The code that represents a specific kind of Architecture depiction. |
| | viewSubcategoryCode | The code that represents a detailed classification of Architecture depiction. |
| | viewpointName | The name of the object that provides the perspective of a specific Architecture. |
| | versionIdentifierText | The text that identifies the rendition for a specific Architecture. |
| | warehouseIdentifierText | The text that associates the Architecture with a collection of products. |
| **Document*** | | |
| | approvalCalendarDate | The calendar date that a Document is approved. |
| | architectureProductCategory Code* | The code that represents the kind of architectural structured specification described by the Document. |
| | architectureProduct SubcategoryCode | The code that represents the kind of architectural structured specification described by the Document. |
| | categoryCode | The code that represents a classification of a Document. |
| | completenessCategoryCode | The code that represents a class of Document as to whether it provides detail from initial starting event to concluding event. |
| | dataTypeCode | The code that represents the kind of electronic form of a specific Document. |
| | creationCalendarDate | The calendar date on which a Document is created. |
| | labelText | The text that provides a descriptive term for a specific Document. |
| | notationText | The text that specifies the syntactical language used in the Document. |
| | originatorName | The name for the originating entity for a specific Document. |
| | promulgationCode | The code that represents the way in which the Document is formally put into effect. |
| | publicationCalendarDate | The calendar date on which a specific Document was made publicly available. |
| | remarkText | The text of comments associated with a Document. |
| | routingCode | The code that denotes the distribution category specified for a Document. |
| | temporalScopeCode | The code that represents the actual or planned time frame addressed by a specific Document. |
| | typeCode | The code that represents a kind of Document. |
| | universalResourceLocator Text | The text that provides a world-wide web universal resource locator (url) access to a specific Document. |
| | versionIdentifierText | The text describing the identifier for a specific release of a Document. |
| **Guidance** | | |
| | authorityText | The text of the authority for promulgating Guidance. |
| | beginCalendarDateTime | The calendar date-time on which Guidance starts. |
| | categoryCode | The code that denotes a specific class of Guidance. |
| | endCalendarDateTime | The calendar date-time on which Guidance concludes. |
| | functionalTypeCode | The code that represents a kind of Guidance by function. |
| | synopsisText | The text that provides a condensed description of an occurrence of Guidance. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | subjectText | The text that describes the topic of a Guidance. |
| **InformationAsset*** | | |
| | acronymText | The text that provides the common abbreviation used to represent a specific InformationAsset. |
| | commentText | The text of commentary on an InformationAsset. |
| | definitionText | The text that unambiguously characterizes an InformationAsset. |
| | reusableCode | The code that represents the reusability of an InformationAsset. |
| | StandardizationAuthority Code | The code that represents the approval authority for the conformity to established criteria of an InformationAsset. |
| | StandardizationStatus CalendarDate | The calendar date of the conformity to established criteria of an InformationAsset. |
| | StandardizationStatusCode | The code that represents the conformity to established criteria of an InformationAsset. |
| | typeCode* | The code that represents a kind of InformationAsset. |
| | versionIdentifierText | The text that identifies a specific rendition of an InformationAsset. |
| **Mission** | | |
| | categoryCode | The code that denotes the class of a Mission. |
| | compositionTypeCode | The code that represents a kind of Mission according to the makeup of the expected participants. |
| | effectiveCalendarDateTime | The calendar date-time for which a Mission is to take effect. |
| | geographicRegionName | The name of the area of focus of a specific Mission. |
| | operationalConceptText | The text that characterizes the operational concept for a specific Mission. |
| | primaryTypeCode | The code that represents a kind of principal Mission. |
| | summaryStatementText | The text that provides an overview of the Mission. |
| | typeCode | The code that denotes a kind of Mission. |
| **MissionArea** | | |
| | jointMissionAreaCode | The code that represents a MissionArea specified by the Joint Staff as a joint mission area. |
| | operationConceptText | The text that characterizes the operational concept for a specific MissionArea. |
| | temporalScopeCode | The code that represents the kind of time frame of the MissionArea. |
| | typeCode | The code that denotes a kind of MissionArea. |
| **Network*** | | |
| | acronymText | The text that provides the common abbreviation used to represent a specific Network. |
| | areaSizeCode* | The code that represents the physical scope of the Network. |
| | controllerTypeName | The name of the controller type for a specific Network. |
| | estimatedUserQuantity | The quantity that represents the estimated number of users of a Network. |
| | implementationTypeCode | The code that represents a kind of Network. |
| | logicalTopologyName | The logical configuration of the connectivity of a Network. |
| | maximumSimultaneousUser Quantity | The quantity that represents the largest number of users that a Network can support at the same time. |
| | maximumThroughputRate | The maximum rate that information bits can be transferred by the Network. |
| **Node*** | | |

| Data Elements | Attributes | Definition |
|---|---|---|
| | c2ServiceDesignatorUser Code | The code that represents a specific user for a specific Node according to the Command Communications Service Designator (CCSD) system. |
| | categoryCode* | The code that represents the class of a specific Node. |
| | limitationsDescriptionText | The text that amplifies the restrictions of a specific Node. |
| | locationText | The text that specifies where the Node may be found. |
| | physicalCode | The code that represents whether the Node represents a real instance. |
| **OperationalScenario** | | |
| | geographicRegionName | The name of the area of focus of a specific OperationalScenario. |
| | summaryText | The text that provides a synopsis of a specific OperationalScenario. |
| **Organization*** | | |
| | abbreviatedName | The name in shortened form for the Organization. |
| | acronymText | The name in abbreviated form derived from initials that represent the Organization. |
| | addressText | The text that summarizes how the Organization can be accessed. |
| | administrativeLossRate | The actual rate of personnel attrition applicable to an Organization. |
| | categoryCode | The code that represents a classification of an Organization. |
| | classificationCode | The code that represents a categorization of an Organization. |
| | durationTypeCode | The code that represents a specific kind of time frame associated with an Organization. |
| | enterpriseTypeCode | The code that denotes the kind of enterprise undertaken by an Organization. |
| | militaryCode | A code which identifies a specific military Organization. |
| | monitoringCommand IdentifierText | The text that identifies the organizational element assigned the responsibility to monitor the Organization. |
| | operationalElementCode | The code that represents whether an instance of Organization is considered to be an OperationalFacility. |
| | primaryActivityCode | The code that represents the principal function of an Organization. |
| | primaryIndustryCategory Code | The code that represents a classification of the principal business area of an Organization. |
| | reportingUnitIdentifierText | The text that identifies the organizational element assigned the responsibility of reporting the Organization. |
| | standardNavyDistributionList IdentifierText | The text that identifies an Organization assigned by the Department of the Navy for use in the Standard Navy Distribution List (SNDL). |
| | symbolIdentifierText | The text that identifies an alternative identification of an Organization. |
| | typeCode | The code that represents a kind of Organization. |
| | unitCommonName | The name normally applied to the Organization. |
| | unitIdentifierText | The text that identifies the assigned unit identification code (UIC) of the Organization. |
| **Period** | | |
| | beginCalendarDateTime | The calendar date-time that a Period starts. |
| | delineationTypeCode | The code that denotes the type of delineation of a Period. |
| | endCalendarDateTime | The calendar date-time that a Period is completed. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | relativeReferenceText | The text that describes the relevant time Period of the content information. |
| | typeCode | The name of a kind of Period. |
| **Plan** | | |
| | commanderIntentText | The text used to provide the commander's intent for a specific Plan. |
| | purposeCode | The code used to provide the commander's intent for a specific Plan. |
| | subjectText | The text that describes the topic of a Plan. |
| | contentText | The text of a Plan. |
| | typeCode | The code that represents a kind of Plan. |
| | versionIdentifierText | The text that identifies the version of a Plan. |
| **PointOfContact** | | |
| | lastName | The family name for a specific PointOfContact. |
| | middleInitialText | The text that provides the letter(s) representing the middle name of a PointOfContact. |
| | officeName | The name of the office designated for the PointOfContact. |
| | officeSymbolText | The text that represents the abbreviated office name for a specific PointOfContact. |
| | positionName | The name of the primary assigned role for a specific PointOfContact in an Organization. |
| | postalZoneIdentifier Text | The text that identifies the area used for postal deliveries for a specific PointOfContact. |
| | secureElectronicMailAddress Text | The text that provides the most electronic mail address for classified networks for a specific PointOfContact.. |
| | titleName | The name that provides the professional title of a specific PointOfContact.. |
| | UnclassifiedElectronicMail AddressText | The text that provides the electronic mail address for unclassified networks for a specific PointOfContact.. |
| | unitedStatesStateAlphaCode | The alphabetic code that represents a united-states-state for a specific PointOfContact. |
| **SoaService** | | |
| | specificationDescriptionText | The describing narrative that contains the SOA Service specification. |
| | typeNameText | The character string that designates the kind of SOA Service. Examples: Discovery Service, Collaboration Service, Messaging Service. |
| **System** | | |
| | acronymText | The text that provides the common abbreviation used to represent a specific system. |
| | alternateName | The name alternatively used to specify a system. |
| | budgetInitiativeNumber IdentifierText | The text that identifies the alpha numeric string that represents the budget initiative number assigned by the Information-Technology Registry to indicate funding source for a specific System. |
| | commentText | The text that amplifies information regarding a specific System. |
| | criticalityCode | The code that represents how essential the operability of a specific System is deemed to be. |
| | descriptionText | The text that characterizes a specific System. |
| | detailText | The text that further describes a specific System. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | executiveAgencyCode | The code that represents the component that sponsored the introduction of this system into DoD's inventory for a specific System. |
| | ManufacturerModification Text | The text that characterizes changes made by the developer for the specified version of the System. |
| | manufacturerName | The name of the developer for this specific version of the System. |
| | modelIdentifierText | The text that identifies the design of a specific system. |
| | nomenclatureName | The name providing the complete entry for the DoD standard military naming system for a specific System. |
| | nominalUsersQuantity | The quantity that represents the number of persons that are planned to be able to operate a specific System at the same time. |
| | purposeText | The text that summarizes the objective of a specific System. |
| | roleCategoryCode | The code that represents a class of use for a specific System. |
| | roleSubcategoryCode | The code that represents a detailed class of System. |
| | softwareInterfaceText | The text that characterizes the software interfaces of a specified version of the System. |
| | sourceName | The name of the originating entity for the System. |
| | statusCode | The code that represents the state of a specified version of the System. |
| | unitCostAmount | The amount of the cost of a single instance of a System. |
| | versionName | The name that identifies a specific rendition of a specific System. |
| **Task** | | |
| | alternateIdentifierText | The text that pertains to the identifier that is alternatively used to represent a specific Task. |
| | alternateIdentifierSource Name | The name of the origin of the alternate identifier of a specific Task. |
| | categoryCode | The code that represents a class of Task. |
| | commandLevelCode | The code that represents the general scope of military operation for a Task. |
| | commentText | The text that provides comments on a specific Task. |
| | derivedReferenceText | The text that provides an audit trail for the origin of requirements for a specific Task. |
| | effectiveCalendarDate | The calendar date upon which the Task comes into effect. |
| | hierarchyNumberName | The name that represents the hierarchical relationship of a specific Task to other Task(s). |
| | hierarchyPrefix IdentifierText | The text that pertains to the identifier commonly used before the hierarchy number to form a reference for a specific Task. |
| | proponentName | The name of the sponsor of a specific task. |
| | referenceSourceText | The text that characterizes the authorized origin for a specific Task. |
| | verbCode | The code that represents a function to be performed by a specific Task. |
| | versionIdentifierText | The text that identifies the rendition of a specific Task |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| Action | is related to | Action |
| Action | is described by | Document |
| Action | references | Guidance |
| Action | has as a participant | Organization |
| Agreement | is related to | Agreement |
| Agreement | is specified using | Document |
| Agreement | implements | Guidance |
| Agreement | references | Architecture |
| Agreement | specifies the service use for | SoaService |
| Agreement | specifies the service level for | SoaService |
| Architecture | is related to | Architecture |
| Architecture | is recorded in | Document |
| Architecture | conforms to | Guidance |
| Architecture | addresses | Mission |
| Architecture | includes | Network |
| Architecture | is described using | Node |
| Architecture | cites | OperationalScenario |
| Architecture | includes | Organization |
| Architecture | cites | System |
| Architecture | supports | Task |
| Document | describes | Action |
| Document | specifies | Agreement |
| Document | provides the conops for | Architecture |
| Document | records | Architecture |
| Document | is related to | Document |
| Document | specifies | Guidance |
| Document | is source for | Mission |
| Document | is the source for | MissionArea |
| Document | describes | Network |
| Document | describes | OperationalScenario |
| Document | references | Organization |
| Document | describes | System |
| Guidance | is referenced by | Action |
| Guidance | is implemented by | Agreement |
| Guidance | is implemented by | Architecture |
| Guidance | is related to | Guidance |
| Guidance | may be specified in | Document |
| Guidance | applies to | OperationalScenario |
| Guidance | governs | Mission |
| Guidance | is referenced by | Organization |
| Guidance | is implemented by | Plan |
| Mission | is addressed in | Architecture |
| Mission | is cited for | MissionArea |
| Mission | is related to | Mission |
| Mission | is governed by | Guidance |
| Mission | applies to | Organization |
| Mission | requires | Task |
| MissionArea | may be cited for | Mission |
| MissionArea | is cited for | Node |
| MissionArea | is supported by | Organization |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| MissionArea | is supported by | System |
| MissionArea | is supported by | Task |
| Network | is related to | Network |
| Network | is described in | Document |
| Network | has as a participant | Node |
| Network | has | Organization |
| Network | operates using | System |
| Node | describes | Architecture |
| Node | represents | Network |
| Node | participates in | Network |
| Node | is related to | Node |
| Node | supports activities in | MissionArea |
| Node | is associated with | Organization |
| Node | is supported by | System |
| Node | performs | Task |
| OperationalRole | is related to | SoaService |
| OperationalScenario | is cited for | Guidance |
| OperationalScenario | is used for | Mission |
| Organization | participates in | Action |
| Organization | coordinates development of | Agreement |
| Organization | has | Architecture |
| Organization | is assigned | Mission |
| Organization | has | Network |
| Organization | is cited for | Node |
| Organization | references | Agreement |
| Organization | is related to | Organization |
| Organization | is referenced by | Document |
| Organization | is referenced by | Guidance |
| Organization | supports | MissionArea |
| Organization | staffs | Plan |
| Organization | has | PointOfContact |
| Organization | is service functionality provider for | SoaService |
| Organization | has association with | System |
| Period | applies to | Architecture |
| Period | describe the occurrence of | Document |
| Period | is related to | Period |
| Period | applies to availability | System |
| Plan | is related to | Plan |
| Plan | is described by | Document |
| Plan | implements | Guidance |
| Plan | is staffed through | Organization |
| PointOfContact | applies to | Architecture |
| PointOfContact | pertains to | Guidance |
| PointOfContact | is related to | PointOfContact |
| PointOfContact | provides data for | System |
| SoaService | is part of | SoaService |
| SoaService | interfaces with | SoaService |
| SoaService | outputs data to | SoaService |
| SoaService | produces data for | SoaService |
| SoaService | sends to and receives data from | SoaService |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| SoaService | is available at | Node |
| SoaService | uses | SoftwareType |
| SoaService | uses | EquipmentType |
| SoaService | has | SoaOperation |
| SoaService | is related to | SystemFunction |
| SoaService | is allocated to | System |
| SoaService | uses | TechnicalInterface |
| SoaService | has profile specified by | SoaServiceSpecification Template |
| SoaSerivice | has | PointOfContact |
| SoaService | complies with | InformationTechnologyStandard |
| System | is cited for | System |
| System | is used to operate | Network |
| System | supports the functions of | Node |
| System | is related to | System |
| System | is described by | Document |
| System | supports | MissionArea |
| System | is associated to | Organization |
| System | is based on data pr by | PointOfContact |
| System | is cited by | Architecture |
| System | is service provider for | SoaService |
| Task | is supported by | Architecture |
| Task | is used to accomplish | Mission |
| Task | is performed by | Node |
| **Task** | is related to | Task |
| **Task** | supports | MissionArea |

## 3.2 INTEGRATED DICTIONARY (AV-2)

### 3.2.1 AV-2 – Product Description

**Product Definition**. The AV-2 contains definitions of terms used in the given architecture. It consists of textual definitions in the form of a glossary, a repository of architecture data, their taxonomies, and their metadata (i.e., data about architecture data), including metadata for tailored products, associated with the architecture products developed. Metadata are the architecture data types, possibly expressed in the form of a physical schema. In this document, architecture data types are referred to as architecture data elements.

**Product Purpose**. AV-2 provides a central repository for a given architecture's data and metadata. AV-2 enables the set of architecture products to stand alone, allowing them to be read and understood with minimal reference to outside resources. AV-2 is an accompanying reference to other products, and its value lies in unambiguous definitions. The key to long-term interoperability can reside in the accuracy and clarity of these definitions.

**Product Detailed Description**. AV-2 defines terms used in an architecture, but it is more than a simple glossary. Many architectural products have implicit or explicit information in the form of a glossary, a repository of architecture data, their taxonomies, and their metadata. Each labeled item (e.g., icon, box, or connecting line) in the graphical representation has a corresponding entry in AV-2. Each item from a textual representation of an architectural product also has a corresponding entry in AV-2. The type of metadata included in AV-2 for each item depends on the type of architectural product from which the item is taken. For example, the metadata for an operational node in AV-2 includes the attributes' *Name, Description, and Level Identifier*. A taxonomy of operational nodes applicable to the architecture may be consulted, and the name used for a specific operational node may be chosen from that taxonomy. The AV-2 entry for the node then consists of the metadata data fields (a name field, a description field, and a level identifier field), a value for each of these fields, and the taxonomy for operational nodes.

Metadata, which refers to the architecture data types, are defined in the data element tables provided for each product in this volume. These tables identify key architecture data types (concepts about which architecture data are recorded), their attributes, and explanation. The tables form the primary requirements for the CADM. The CADM describes the types and relationships of architecture data in a standard (IDEF1X [FIPS 183, 1993]) form for use in relational or other database design and by tool or repository builders. Everything in AV-2 could be stored in a CADM-based repository, just as all Framework architecture products could be stored in a CADM-based architecture modeling tool and/or modeling and repository tool. At a minimum, AV-2 contains the data values for a specific architecture(s), and it is ideally a repository conforming to the CADM.

Architects should use standard terms where possible (i.e., terms from existing, approved dictionaries, glossaries, and lexicons). However, when a given architecture is at a lower level of detail than existing architectures or lexicons, or when new concepts are devised for objective architectures, new terms and/or modified definitions of existing terms may be needed. All definitions that originate in existing dictionaries should provide a reference for the source, in addition to providing the definition itself so that architectures are self-contained.

### 3.2.2 Taxonomies

AV-2 defines the architecture data and their common terms of reference used in creating, maintaining, and using architecture products. The OV, SV, and TV products are interrelated, sometimes very extensively. Because of this inter-relationship among products and across architecture efforts, it is useful to define common terminology with common definitions (referred to as *taxonomies*) in the development of the architecture products. These taxonomies are the building blocks for architecture products. The need for standard taxonomies derives from lessons learned from early DoD architecture development issues, including the independent development of multiple operational architectures that could not be integrated. Integration was impeded because of the use of different terminology to represent the same architecture data. Use of taxonomies to build architecture products has the following benefits over free-text labeling:

- Provides consistency across products
- Provides consistency across architectures
- Facilitates architecture development, validation, maintenance, and re-use
- Traces architecture data to authoritative data sources

The following are critical taxonomies requiring concurrence and standardization for integrated architectures:

- Operational Nodes that represent Organizations, Organization Types, and Occupational Specialties. The taxonomy minimally consists of names, descriptions, and breakdowns into the parts of the organization, organization type, or human role.
- Operational Activities (or Tasks).[15] The taxonomy minimally consists of names, descriptions, and decomposition into the constituent parts that comprise a process activity.
- Information Elements. The taxonomy minimally consists of names of information elements exchanged, descriptions, decomposition into constituent parts and subtypes, and mapping to system data elements exchanged.
- Systems Nodes that represent facilities, platforms, units, and locations. The taxonomy minimally consists of names, descriptions, breakdowns into constituent parts of the node, and categorizations of types of facilities, platforms, units, and locations.
- Systems consisting of family of systems (FoSs), system of systems (SoSs), networks of systems, individual systems, and items (e.g., equipment hardware and software). The taxonomy minimally consists of names, descriptions, and breakdowns into the constituent parts of the system and categorization of types of systems. Typing may also address variations across time and systems node installation.
- System Functions. The taxonomy minimally consists of names, descriptions, and decomposition into the constituent parts that comprise a system function.

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[15] Operational Activities defined and standardized by the Joint Staff are in the form of Mission Essential Tasks [CJCSM 3500.04D, 01 AUGUST 2005]. Operational Activities are also specified (and sometimes standardized) in the form of process activities arising from process modeling. It is sometimes convenient to merge these sets, either as activities or tasks.

- Triggers/Events. The taxonomy minimally consists of names, descriptions, and breakdown into constituent parts of the event or trigger and categorization of types of events or triggers.
- Performance Parameters. The taxonomy minimally consists of names, descriptions, units of measure, and conditions that may be applicable to performance parameters.
- Technical Standards. The taxonomy minimally consists of categories of standards (e.g., DISR's Service Areas).
- Technology Areas. The taxonomy minimally consists of names, descriptions, and categories of technologies into which individual science and technology initiatives and programs can be categorized.

These taxonomies are used to construct various architecture products as shown in **Figure 3-3**. In the table, taxonomy refers to a set of relationships among pairs of instances, often hierarchical. Composition refers to the use of one instance to represent and include as a subset or group of instances. The symbols in the table represent the potential role played by the taxonomy and not by the architecture data elements themselves (e.g., Operational Nodes are important to OV-1, but taxonomies of these nodes are important for products OV-2 through OV-6). The table shows that taxonomies potentially have a strong role to play in AV-2 as well as many of the OV, SV, and TV products.

Note: Not all architecture data in a given taxonomy is useful in every architectural development. However, given the ongoing evolutionary change in organizations, systems, and processes, the value of using established, validated taxonomic structures that can be expanded or contracted as needed becomes obvious. Moreover, the development of new products over time is greatly simplified as understanding of the taxonomies is increased. Standard taxonomies, like DISR Service Categories, become building blocks for more comprehensive, quality architectural products. The DoD Extensible Markup Language (XML) Registry and Clearinghouse and the Net-Centric Implementation Document (NCID) are potential sources for taxonomies.

In some cases, a specific community may have its own operational vocabulary. This local operational vocabulary may use the same terms in radically different ways from other operational communities. (For example, the use of the term *track* refers to very different concepts in the carrier battle group community than in the mine-sweeper community. Yet both of these communities are Navy operational groups and may participate together in littoral warfare task forces.) In these cases, the internal community versions of the architecture products *should* use the vocabulary of the local operational community in order to achieve community cooperation and buy-in. These architecture products should include notes on any unique definitions used and provide a mapping to standard definitions, where possible.

| | | ARCHITECTURE PRODUCTS | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TAXONOMY TYPES | STRUCTURE | AV | | Operational View (OV) | | | | | | | System View (SV) | | | | | | | | | | | TV | |
| | | 1 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 1 | 2 |
| Operational Nodes ***Organizations, Types of Organizations, and Occupational Specialties*** | Taxonomy & Composition | | ● | | ● | ● | ● | ● | ● | | ◉ | | | | | ◉ | | | | | | | |
| Operational Activities and Tasks | Taxonomy & Composition | | ● | | ● | ● | | ● | ● | ● | | | | | ● | ◉ | | | | | ● | | |
| Information Elements ***and mappings to Systems Data Elements*** | Taxonomy & Composition | | ● | | ◉ | ● | | ● | ● | ● | | | | ◉ | | ◉ | | | | ◉ | ● | ◉ | ◉ |
| Systems Nodes ***Facilities, Platforms, Units, and Locations*** | Taxonomy & Composition | | ● | | | | | | | | ● | ● | ◉ | ◉ | | ● | | | | | | | |
| Systems ***Family of Systems, System of Systems, Networks, Applications, Software, and Equipment*** | Taxonomy & Composition | | ● | | | | | | | | ● | ● | ● | ● | ◉ | ● | ● | ● | ● | ● | | ◉ | ◉ |
| System Functions | Composition | | ● | | | | | | | | ◉ | | | ● | ● | ● | ◉ | ◉ | ◉ | ● | | | |
| Triggers / Events | Taxonomy & Composition | | ● | | | ● | | ● | ● | | | | | ● | | ● | | | | ● | | | |
| Performance Parameters | Taxonomy & Composition | | ● | | | | | ● | | | | | | ● | | ● | ● | ● | ● | | | | |
| Technical Standards ***Info Processing, Info Transfer, Data, Security, and Human Factors*** | Taxonomy & Composition | | ● | | | | | | | | ● | ● | | ◉ | | ● | | ● | ● | | ◉ | ● | ● |
| Technology Areas ***Systems and Standards*** | Taxonomy & Composition | | ● | | | | | | | | | | | | | | | | ● | | | | ● |

● = Taxonomy element plays a primary role ◉ = Secondary role blank = Element not part of this product

**Figure 3-3: Taxonomies Used in Products**

### 3.2.3 UML Representation

The UML tool(s) being used for analysis and design usually include a data dictionary facility that generates a data dictionary or glossary of terms from the annotated definitions entered by users as they build Framework products. In addition, the collection of products for a specific architecture as stored in the tool comprises the repository of architecture data and the metadata specification.

### 3.2.4 Net-Centric Guidance for AV-2

**Augmented Product Purpose.** In the NCE, the AV-2 contains descriptions of architecture terms and conventions for their use in the architecture project.

**Net-Centric Product Description.** The AV-2 traditionally serves as a glossary that defines terms used in an architecture. Architecture products are constituted of architecture data elements. Architecture data elements can be used in multiple views, where a data element defined in one view is consistently referenced in other views. The names and definitions of the architecture data elements contribute to the AV-2 Taxonomy of terms. Accordingly, in the NCE, the AV-2 will define net-centric elements and associated metadata, i.e., the source of the definition.

The net-centric AV-2 will capture new terms and definitions across all products used to describe the NCE. Because the OV, SV, and TV products are interrelated, it is important to define common terminology with common definitions, referred to as taxonomies, in the development of the architecture products. The net-centric AV-2 may include the following taxonomy:

- Services consisting of family of services, individual services, and hardware and software items. The taxonomy minimally consists of service name, service specification, and decomposition into the constituent service operations. The taxonomies in the AV-2 will be used to categorize service functionality (system functions taxonomy), information provided by a service (information elements taxonomy), service performance categories (performance attributes taxonomy), service technical standards categories (technical standards taxonomy), service technology area dependencies (technology taxonomy), and service operational node consumers and providers (operational nodes taxonomy). The use of taxonomies standardized within a COI will help disambiguate service discovery.

Documenting these various aspects of net-centricity in the AV-2 products is a key step to enabling the creation of net-centric architectures across the DoD enterprise. As various tools support the net-centric paradigm for architecture development, the AV-2 becomes increasingly important to enable federation of architectures and the use of architecture products to manage capability portfolios.

### 3.2.5 CADM Support for AV-2

AV-2 may consist of a CADM-conformant database or repository, specifically in reference tables like Materiel, MaterielType, Organization, OrganizationType, InformationElement, and ProcessActivity that are developed within an architecture or set of architectures. More than one dictionary can be maintained, but only one is needed for each architecture. Each dictionary is stored as an instance of Document with a category code designating it as a DATA-DICTIONARY-SPECIFICATION.

When an architecture database or repository is not provided or deemed adequate, two additional types of data dictionaries are possible:

- An offline dictionary whose terms are stored in a document. Reference to it is stored in Document with the name of the instance storing the filename and the attribute UniversalResourceLocatorText to store its URL.
- An online dictionary whose terms are included in a CADM-structured database. The identity of the dictionary is stored in DataDictionary (a subtype of InformationAsset); each term can be identified, named, and described via ObjectByReference. The relationship to Document is accomplished via ObjectVersionAssociation; the relation to the pertinent instance of Architecture is also recorded in ObjectVersionAssociation.

**Figure** 3-4 provides a high-level diagram from the CADM showing key entities that are used to store architecture data in the form of glossaries, documents, and data dictionaries for this architecture product in a CADM-conformant database.

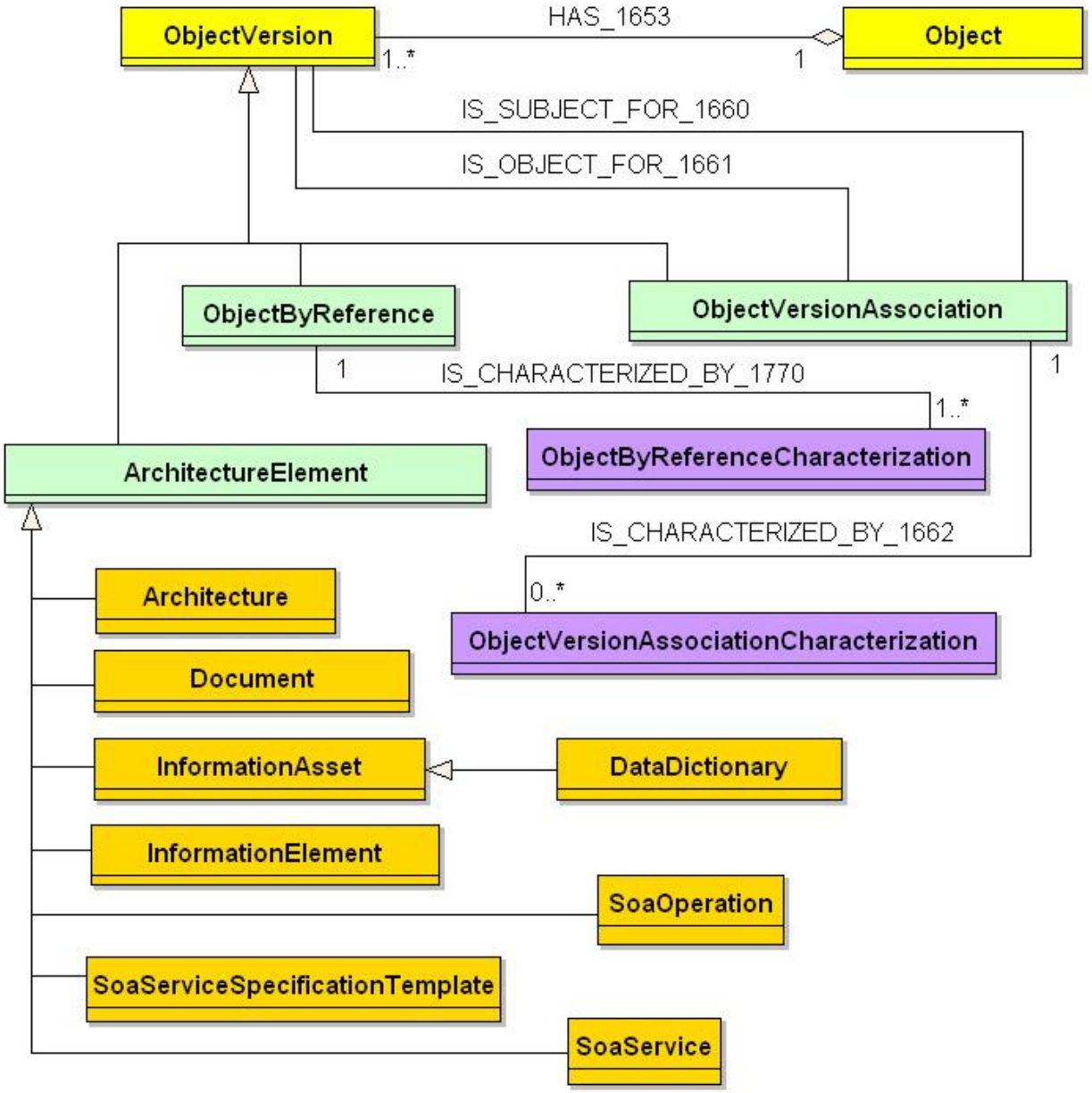


**Figure 3-4: CADM Diagram for AV-2**

Taxonomies relate two instances, often hierarchically (tree diagram); they may be viewed as a set of folders and subfolders. In CADM v1.5, all hierarchical decompositions can be expressed via ObjectVersionAssociation. The following identifies the types of taxonomic decompositions that can be expressed in CADM v1.5 using this approach:

- Operational Nodes:
  - Associations among Organization(s); Associations among OrganizationType(s) for various kinds of operational elements
  - Associations among Node(s) (for specific nodes, each of which could represent an operational unit, a command post, a command post cell, an operational facility, a command element, etc.)

- System and Other Physical Nodes:
  - Associations among Node(s) (for specific nodes, each of which represents a platform, system, etc.)
  - Associations among MilitaryPlatform(s)
  - Associations among Facility(s)
  - Associations among Organization(s) (each organizational unit is assigned a unique ORGANIZATION IDENTIFIER and an ORGANIZATION VERSION INDEX)
  - Associations among Node(s) (when Node denotes specific location)
  - Associations among Feature(s) (when Feature denotes a specific geospatial feature)
- Systems:
  - Associations among SystemType(s) (i.e., among general classes of systems)
  - Associations among System (i.e., among versions of a System)
  - Associations among instances System(s) at a specific Node(s)
- SOA Services:
  - Associations among SoaService(s) (i.e., among a main class of a SOA Service representing a family of services and its components)
  - Associations among SoaService(s) indicating relations other than being a component of a family of services (e.g., replacement, equivalence)
  - Associations showing the decomposition of a SoaService into finer granularity
- Operational (Process) Activities and Tasks:
  - Associations among ProcessActivity(s)
  - Associations among Task(s) (e.g., in UJTL); in the Global Information Grid [GIG] and the Department of the Navy Integrated Architecture Database [DIAD]), each Task corresponds to a unique ProcessActivity and their linkage can be expressed as well
  - Associations among Action(s)
  - Associations among ActivityModel(s) (e.g., for IDEF0 node trees)

In addition, in CADM v1.5, ObjectVersionAssociation allows the linkage of instances of Document to all the entities mentioned above, i.e., Action, Agreement, Capability, Event, Feature, Guidance, InformationAsset, MaterielType, MissionArea, Network, Node, ProcessActivity, System, etc. (See Volume III for a complete description.)

### 3.2.5.1 AV-2 – Data Element Definitions

## AV-2 Information Space

Architecture†
Document†
InformationAsset†
SoaService†

**DataDictionary**
**InformationElement**
**SoaOperation**
**SoaServiceSpecificationTemplate**

†) The descriptions of these elements have been provided in the preceding sections

**Table 3-2 Data Element Definitions for AV-2[16]**

| Data Elements | Attributes | Definition |
|---|---|---|
| **DataDictionary** | | |
| | typeCode | The code that represents a kind of DataDictionary. |
| **InformationElement*** | | |
| | alternateIdentifierText | The text that alternatively identifies a specific InformationElement. |
| | creationCalendarDate | The calendar date on which an InformationElement was created. |
| | definitionText | The text that unambiguously characterizes a specific InformationElement. |
| | revisionCalendarDate | The calendar date on which a specific InformationElement was amended. |
| | scopeText | The text that characterizes the semantic extent of a specific InformationElement. |
| | validationStatusCode | The code that represents the state of sanctioning of an InformationElement. |
| | versionIdentifierText | The text that identifies a rendition of an InformationElement. |
| | informationElement Identifier | The identifier of a specific InformationElement. |
| | informationElement VersionIndex | The identifier of a specific variant of a specific InformationElement. |
| | alternateIdentifierText | The text that alternatively identifies a specific InformationElement. |
| | creationCalendarDate | The calendar date on which an InformationElement was created. |
| | definitionText | The text that unambiguously characterizes a specific InformationElement. |
| | revisionCalendarDate | The calendar date on which a specific InformationElement was amended. |
| | scopeText | The text that characterizes the semantic extent of a specific InformationElement. |
| | validationStatusCode | The code that represents the state of sanctioning of an InformationElement. |
| | versionIdentifierText | The text that identifies a rendition of an InformationElement. |
| **SoaOperation** | | |
| | typeText | The string that specifies the kind of SoaOperation. Examples: Get, Put, Post, Create, Delete. |

16 As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

| Data Elements | Attributes | Definition |
|---|---|---|
| | labelText | The string that describes at the required level of granularity the SoaService. Examples: getOrganizationName(), putOrganizationName(), deleteDatabase(dbName). |
| **SoaService SpecificationTemplate** | | |
| | expectedPerformance Text | The narrative that describes the way in which a specific SoaService is expected to function. |
| | serviceNameText | The string by which a SoaService is known. |
| | serviceVersionText | The string that indicates the specific implementation of a SoaService. |
| | serviceNetworkAddress Text | The string containing the sequence of bytes that represents the portion of the IP address within the network where the SoaService resides. |
| | operationalStageText | The string that indicates the GIG operational or capability provisioning stage. Examples: OPERATIONAL, OPERATIONAL_PILOT, DEVELOPMENT_PILOT, etc. |
| | applicableDataTypesTxt | The URI that points to documentation of complex data types and data structures used in the SoaService operations. |
| | overviewDescriptionText | The descriptive narrative that provides a high level characterization of the SoaService. |
| | applicableWebServices DefinitionLanguageText | The URI that points to a file comprising a bundle of other files including the WSDL and any supporting files for the applicable WSDL. |
| | serviceAccessPointText | The URI that points to the SoaService. |
| | encodingStyleText | The string that names the specific encoding style used by the SoaService. Example: SOAP. |
| | transportProtocolText | The string that names the protocol used for exchanges used by the SoaService. Example: HTTP. |
| | expectedCapacity Quantity | The number of concurrent users that can implement the SoaService. |
| | expectedServiceLatency Quantity | The number of seconds that elapse from the time of service request to the time of service response. |
| | expectedBandwidth Quantity | The nominal bandwidth requirement over all traversed networks measured in bits per second that applies to the specific SoaService. |
| | allowedJitterQuantity | The number of milliseconds that represents the random variation in the timing of a SoaService response. |
| | Authentication MechanismDescription Text | The narrative that describes the security mechanisms that the user is required to use in order to access the SoaService. Example: user logon/password, Valid DoD X.509 Public Key Infrastructure (PKI) certificate. |
| | userAccessModel DescriptionText | The narrative that describes the user access model, criteria and process for registering to use the SoaService. |
| | serviceUseRestrictions DescriptionText | The narrative that describes the restrictions that have been placed on users allowed to access the SoaService. This applies particularly to groups such as HR, medical and legal. |

# 4 OPERATIONAL VIEW PRODUCTS

An OV describes the tasks and activities, operational elements, and information exchanges required to conduct operations. A pure OV is materiel independent. However, operations and their relationships may be influenced by new technologies such as collaboration technology, where process improvements are in practice before policy can reflect the new procedures. There may be some cases, as well, in which it is necessary to document the way processes are performed given the restrictions of current systems, in order to examine ways in which new systems could facilitate streamlining the processes. In such cases, an OV may have materiel constraints and requirements that must be addressed. For this reason, it may be necessary to include some high-level SV architecture data as overlays or augmenting information onto the OV products.

There are seven OV products described in this section:

- High-Level Operational Concept Graphic (OV-1)
- Operational Node Connectivity Description (OV-2)
- Operational Information Exchange Matrix (OV-3)
- Organizational Relationships Chart (OV-4)
- Operational Activity Model (OV-5)
- Operational Rules Model, State Transition Description, and Event-Trace Description (OV-6a, 6b, and 6c)
- Logical Data Model (OV-7)

## 4.1 HIGH-LEVEL OPERATIONAL CONCEPT GRAPHIC (OV-1)

### 4.1.1 OV-1 – Product Description

**Product Definition**. The OV-1 describes a capability and highlights main operational nodes (see OV-2 definition) and interesting or unique aspects of operations. It provides a description of the interactions between the subject architecture and its environment, and between the architecture and external systems. A textual description accompanying the graphic is crucial. Graphics alone are not sufficient for capturing the necessary architecture data.

**Product Purpose**. The purpose of OV-1 is to provide a quick, high-level description of what the architecture is supposed to do, and how it is supposed to do it. This product can be used to orient and focus detailed discussions. Its main utility is as a facilitator of human communication, and it is intended for presentation to high-level decision makers.

**Product Detailed Description**. OV-1 consists of a graphical executive summary for a given architecture with accompanying text. The product identifies the mission/portfolio covered in the architecture and the viewpoint reflected in the architecture. OV-1 should convey, in simple terms, what the architecture is about and an idea of the players and operations involved.

The content of OV-1 depends on the scope and intent of the architecture; in general, it describes the business processes or missions, high-level operations, organizations, and geographical distribution of assets. The product should frame the operational concept (what happens, who does what, in what order, to accomplish what goal) and highlight interactions to the environment and other external capabilities.

During the course of developing an architecture, several versions of this product may be produced. An initial version may be produced to focus the effort and illustrate its scope. After other products within the architecture's scope have been developed and verified, another version of this product may be produced to reflect adjustments to the scope and other architecture details that may have been identified as a result of the architecture development. After the architecture has been used for its intended purpose and the appropriate analysis has been completed, another version may be produced to summarize these findings to present them to high-level decision makers.

OV-1 is the most general of the architecture products and the most flexible in format. Because the format is freeform and variable, no template is shown for this product. However, the product usually consists of one or more graphics (or possibly a movie), as needed, as well as explanatory text. Two graphical examples are shown in **Figure 4-1** and **Figure 4-2**.

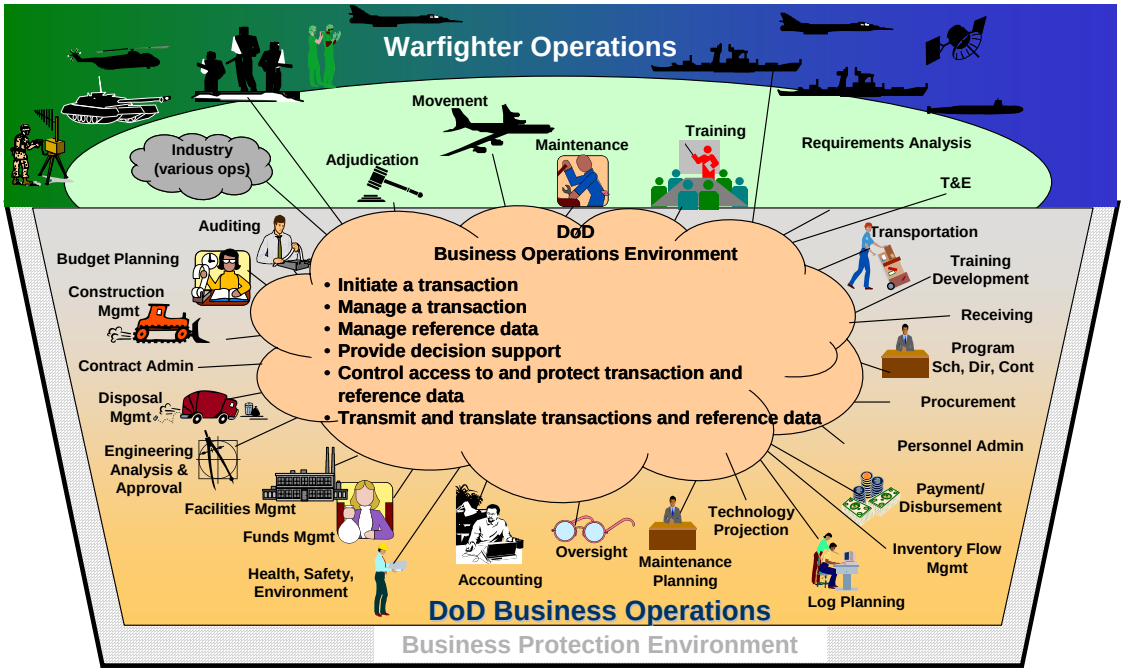


**Figure 4-1: DoD Electronic Commerce Concept of Operations (OV-1)**

Figure 4-1 illustrates the concept of electronic commerce in the DoD, including the relevant business areas and support to the warfighter [DEB, 2000]. Figure 4-2 illustrates an operational concept for strike [ASN(RDA)CHENG, 2002].

**Figure 4-2: Joint Task Force Concept of Operations (OV-1)**

### 4.1.2 UML Representation

It is suggested that OV-1s be constructed in free-format form. If desired, more detailed operational concept diagrams can be constructed using the UML use case diagrams. In this situation, several use case diagrams can be constructed, each focusing on a different architecture mission or operational objective. The use case diagrams are further refined to form OV-5.

### 4.1.3 Net-Centric Guidance for OV-1

**Augmented Product Purpose.** The OV-1 provides a high-level graphical view of the mission and depicts what net-centric capabilities the architecture encompasses, the scope of the subject architecture (including external or enterprise assets required to fulfill the mission), and the net-centric operational roles that support the mission.

**Net-Centric Product Description.** The OV-1 traditionally identifies the mission/domain covered in the architecture. Accordingly, in the NCE, the OV-1 should depict the business processes, organizations, operational roles, and COIs within the scope of the net-centric architecture.

A net-centric OV-1 depicts how the subject architecture uses a fully netted environment in an integrated way to execute the mission. While this product may continue to consist of one or more graphics and explanatory text, a key aspect of the net-centric OV-1 is the depiction of reliable, trusted, visible information and capabilities. In the NCE, the OV-1 could show general capabilities that will be leveraged from the net that may be delivered by multiple organizations rather than a tie to a specific system or organization. Having that "capability layer" shows net-centricity in that anticipated and unanticipated users and providers play a role in the architecture. Specific systems and organizations can be depicted, but showing that they may not be or are not

the only providers and consumers of capability shows a clear understanding of leveraging the net for current and future needs. This can be shown in an OV-1 by depicting a grid or collaborative work environment to capture net-centricity and joint connectivity. It also shows the desire for operational flexibility and scalability. Additionally, the OV-1 may include the depiction and description of both known and ***unanticipated users*** within the high-level graphical depiction of players.

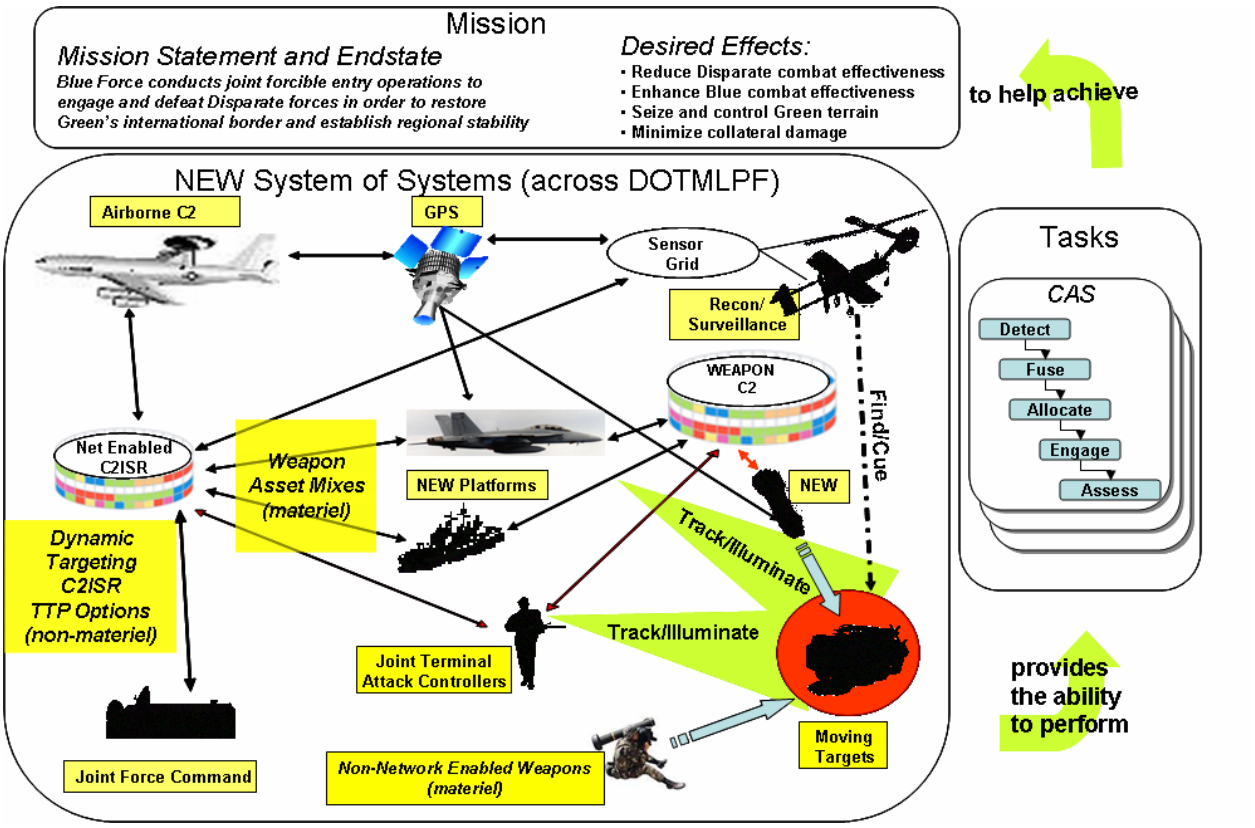


**Figure 4-3: Joint Network Enabled Weapon (NEW) Capability Operational Concept Graphic (OV-1)**

**Figure 4-3** illustrates Capability, Effect, Objective, Endstate, Task, System of Systems, DOTMLPF Resources, and Mission Scenario concepts in a Joint Mission context in the OV-1.

Capturing net-centric aspects in the OV-1 provides a high-level view and understanding of what the architecture is intended to support in the NCE, including the information and capabilities made available to, and also consumed from, the NCE.

### 4.1.4 CADM Support for OV-1

OV-1 is stored as an instance of Document with ArchitectureProductCategoryCode = 6 designating it as a CONCEPT-GRAPHIC. Each graphical element in that diagram can also be represented as a subtype of Document. The set of graphics is represented by a single instance of Document with the associated elements linked to it through ObjectVersionAssociation (see Volume III for details).

Candidates for representation in a CONCEPT-GRAPHIC include the following concepts contained in CADM v1.5:

- Information exchange requirements (IERs) and their underlying needlines and information content
- Data dictionaries, activity models, and other information management objects (stored as instances of InformationAsset)
- Nodes, associations of Nodes to Nodes, and associations to entities such as the following: Organization, OrganizationType, Mission, System, and Task

Associations among Documents can be used to identify various instances of Document related to a specific OV-1; in this fashion, it is possible to link this DoDAF product to capstone requirements documents, concepts of operations, guidance documents, and joint publications.

Tables of organization and equipment can also be recorded in CADM v1.5 through the appropriate linkage of instances of OrganizationType to MaterielType and other OrganizationType(s), and, where required, linked to a given OV-1 to support detailed drill-down (e.g., to show major equipment items).

**Figure** 4-4 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for this architecture product in a CADM-conformant database.

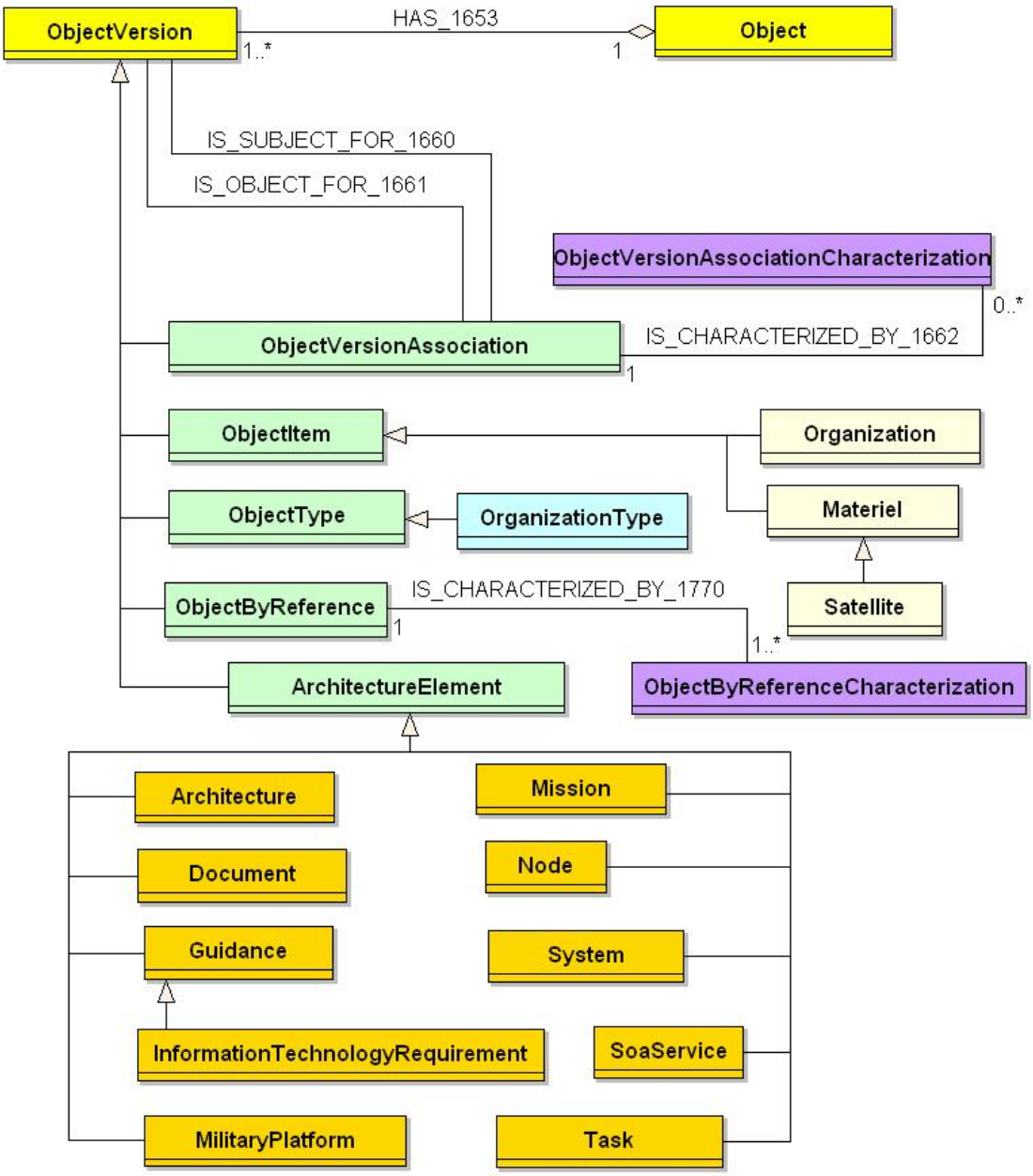


**Figure 4-4: CADM Diagram for OV-1**

#### 4.1.4.1 OV-1 – Data Element Definitions

OV-1 consists of an informal, graphical representation of operations as well as explanatory text. This is a freeform product. However, architecture data elements that appear in an OV-1 are related to others appearing in several OV and SV products.

## OV-1 Information Space

**Architecture**†
**Document**†
**Guidance**†
**Mission**†
**Node**†
**Organization**†
**SoaService**†
**System**†
**Task**†
**InformationTechnologyRequirement**
**Materiel**
**MilitaryPlatform**
**OrganizationType**
**Satellite**

†) The descriptions of these elements have been provided in the preceding sections

**Table 4-1** lists some of these architecture data elements.

**Table 4-1 Data Element Definitions for OV-1**[17]

| Data Elements | Attributes | Definition |
|---|---|---|
| **InformationTechnology Requirement*** | | |
| | alternateIdentifier SourceName* | The name of the originator of the alternate identifier for a specific InformationTechnologyRequirement. |
| | alternateIdentifierText* | The text that alternatively identifies a specific InformationTechnologyRequirement. |
| | blockName | The name that represents a specific collection of instances of InformationTechnologyRequirement intended to be achieved at the same time. |
| | categoryCode* | The code that represents a class of InformationTechnologyRequirement. |
| | interoperabilityLevel Code | The code that represents the class of technical means intended to be used for a specific InformationTechnologyRequirement. |
| | physicalFormatType Code | The code that represents the kind of physical form of a specific InformationTechnologyRequirement. |
| | timelinessCode | The code that represents how quickly information should be transmitted using a specific InformationTechnologyRequirement. |
| | useTypeCode | The code that represents the category of employment of a specific InformationTechnologyRequirement. |
| **Materiel** | | |
| | AcquisitionCalendar Date | The calendar date on which a specific Materiel was obtained. |
| | acquisitionCostAmount | The amount that represents the cost to obtain a specific Materiel. |
| | aliasName | The surrogate name used for a specific Materiel. |
| | alternateIdentifierText | The text that identifies, alternatively, a specific instance of Materiel. |
| | alternateIdentifier SourceName | The name of the origin of the alternate identifier for a specific Materiel. |
| | categoryCode | The code that denotes the class of a specific Materiel. |
| | subcategoryCode | The code that represents a subclass within a class of |

[17] As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

| Data Elements | Attributes | Definition |
|---|---|---|
| | | Materiel |
| | deploymentCode | The code that represents the deployability of a specific Materiel. |
| | deviceConfiguration StatusEffectiveCalendar Date | The calendar date on which the arrangement of components began for a specific Materiel. |
| | deviceFunctionCode | The code that represents the primary capability of a specific Materiel. |
| | deviceUseCode | The code that represents the primary employment of a specific Materiel. |
| | contractor-assigned GovernmentEntity IdentifierText | The text that describes the identifier maintained under the Contractor-Assigned Government Entity (CAGE) program for a specific instance of Materiel. |
| | lotIdentifierText | The text that describes the identifier assigned to represent a specific production of the MaterielType to which the Materiel belongs. |
| | partNumberText | The text that represents the part number for a specific instance of Materiel. |
| | serialNumberText | The text that represents the serial number inscribed on or otherwise associated with a specific Materiel. |
| **MilitaryPlatform** | | |
| | primaryOperationalMode Code | The code that represents the most common way in which a specific MilitaryPlatform performs military tasks. |
| | primaryRoleCode | The code that represents the main means by which a MilitaryPlatform carries out military tasks. |
| | secondaryRoleCode | The code that represents the secondary means by which a MilitaryPlatform carries out military tasks. |
| **OrganizationType** | | |
| | categoryCode | The code that denotes the class of OrganizationType. |
| | functionCode | The code that denotes the role performed by an OrganizationType. |
| | militaryArmCode | The code that represents a class to which a military OrganizationType belongs that is defined as a functional division or grouping of an armed service. |
| | militaryArmQualifier Code | The code that denotes a subgroup of a class to which a military OrganizationType belongs that is defined as a functional division or grouping of an armed service. |
| | orderOfBattleTypeCode | The code that represents the manner in which an OrganizationType is organized for battle. |
| | roleCategoryCode | The code that represents a functional classification for an OrganizationType. |
| | serviceCode | The code that represents a group capable of functioning as a combat, combat support, or combat service support organization to which an OrganizationType belongs. |
| | staffFunctionCode | The code that represents a kind of organizational support provided by a specific OrganizationType. |
| | statusCode | The code that represents the state of an OrganizationType. |
| **Satellite** | | |
| | endCalendarDate | The calendar date on which the functionality for a Satellite is terminated. |
| | expectedLifeQuantity | The quantity of time that the Satellite is expected to be operational. |
| | internationalIdentifier | The text relative to the identifier assigned to a Satellite by |

| Data Elements | Attributes | Definition |
|---|---|---|
| | Text | the United Nations. |
| | launchCalendarDate | The calendar date on which a Satellite is launched. |
| | launchSiteName | The name of the Satellite launch facility. |
| | orbitalPeriodQuantity | The quantity of time required for the Satellite to complete one full orbit. |
| | programName | The name of the program sponsoring a Satellite. |
| | programOfficeIdentifier Text | The text that that describes the identifier, assigned by the program office, that represents a unique Satellite. |
| | operationalStatusCode | The code that denotes the operational readiness of the Satellite. |
| | orbitTypeCode | The code that represents the kind of path of a Satellite from the perspective of the average height above the earth's surface. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| InformationTechnologyRequirement | may be satisfied by | Architecture |
| InformationTechnologyRequirement | is supported by | System |
| InformationTechnologyRequirement | specifies | Task |
| Materiel | is related to | Materiel |
| Materiel | may be represented by | MilitaryPlatform |
| Materiel | is represented by | Node |
| Materiel | participates in | Organization |
| MilitaryPlatform | is related to | MilitaryPlatform |
| MilitaryPlatform | is employed in support of | Mission |
| MilitaryPlatform | is represented by | Node |
| Organization | controls payload for | Satellite |
| Organization | controls platform for | Satellite |
| Organization | participates in | Materiel |
| OrganizationType | is cited by | Architecture |
| OrganizationType | is cited for | Node |
| OrganizationType | is related to | OrganizationType |
| OrganizationType | is referenced in | Document |
| OrganizationType | classifies | Organization |
| OrganizationType | has responsibility for | System |
| Satellite | may serve as a | MilitaryPlatform |
| Satellite | is related to | Satellite |
| System | is responsibility of | OrganizationType |
| System | includes | Satellite |

(All previous relationships for the listed entities that comprise the information space of OV-1 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 4.2 OPERATIONAL NODE CONNECTIVITY DESCRIPTION (OV-2)

### 4.2.1 OV-2 – Product Description

**Product Definition**. The OV-2 graphically depicts the operational nodes (or organizations) with needlines between those nodes that indicate a need to exchange information. The graphic includes internal operational nodes (internal to the architecture) as well as external nodes.

**Product Purpose**. OV-2 is intended to track the need to exchange information from specific operational nodes (that play a key role in the architecture) to others. OV-2 does not depict the connectivity between the nodes.

**Product Detailed Description**. The main features of this product are the operational nodes and the needlines between them that indicate a need to exchange information. The product indicates the key players and the interactions necessary to conduct the corresponding operational activities of OV-5.

***Operational Nodes***. An operational node is an element of the operational architecture that produces, consumes, or processes information. What constitutes an operational node can vary among architectures, including, but not limited to, representing an operational/human role (e.g., Air Operations Commander), an organization (e.g., Office of the Secretary of Defense (OSD)) or organization type, i.e., a logical or functional grouping (e.g., Logistics Node, Intelligence Node), and so on. The operational node will also vary depending on the level of detail addressed by the architecture effort.

***Needlines and Information Exchanges***. A needline documents the requirement to exchange information between nodes. The needline does *not* indicate how the information transfer is implemented. For example, if information produced at node A is simply routed through node B and is used at node C, then node B would not be shown on the OV-2 diagram – the needline would go from node A to node C. OV-2 is not a communications link or communications network diagram. The system implementation (or what systems nodes or systems are used to execute the transfer) is shown in the SV-1. Furthermore, the needline systems equivalent is the interface line depicted in SV-1. The actual implementation of an interface may take more than one form and is documented in a Systems Communications Description (SV-2). Therefore, a single needline shown in the OV may translate into multiple interfaces in SV-1 and multiple physical links in SV-2.

Needlines are represented by arrows (indicating the direction of information flow) and are annotated with a diagram-unique identifier and a phrase that is descriptive of the principal types of information exchanged. It is important to note that the arrows on the diagram represent *needlines* only. This means that each arrow indicates only that there is a need for some kind of information transfer between the two connected nodes.

There is a one-to-many relationship from needlines to information exchanges (e.g., a single needline on OV-2 represents multiple individual information exchanges). The mapping of the information exchanges to the needlines of OV-2 occurs in the OV-3. For example, OV-2 may list Situational Awareness as a descriptive name for a needline between two operational nodes. In this example, the needline represents a number of information exchanges, consisting of various types of reports (information elements), and their attributes (such as periodicity and timeliness)

that are associated with the Situational Awareness needline. The identity of the individual information elements and their attributes are documented in OV-3.

OV-2 should also illustrate needs to exchange information between operational nodes and external nodes (i.e., operational nodes that are not strictly within the scope of the subject architecture but that act as important sources of information required by nodes within the architecture or important destinations for information provided by nodes within the architecture).

***Operational Activities***. The operational activities (from the OV-5) performed by a given node may be listed on the graphic, if space permits. OV-2, in effect, turns OV-5 inside out, focusing first-order on the operational *nodes* and second-order on the activities. OV-5, on the other hand, places first-order attention on operational *activities* and only second-order attention on nodes, which can be shown as annotations on the activities.

***Representation of the product***. For complex architectures, OV-2 may consist of multiple graphics. There are at least two different ways to decompose OV-2. One method involves using multiple levels of abstraction and decomposing the nodes. Another method involves restricting the nodes and needlines on any given graphic to those associated with a subset of operational activities. Both of these methods are valid and can be used together.

OVs usually avoid representing real physical facilities as operational nodes and focus on virtual or logical nodes that can be based on operational (human) roles or missions. Operational nodes are independent of materiel considerations; indeed, they exist to fulfill the missions of the enterprise and to perform its tasks and activities (business processes, procedures, and operational functions). Use of operational nodes supports analysis and design by separating business process modeling and information requirements from the materiel solutions that support them. Similarly, tasks and activities are organized, and COIs are defined to suit the mission and process requirements; the materiel is flexibly and automatically configurable to support the operational processes. However, an OV often has materiel constraints and requirements that must be addressed. Where appropriate, system or physical nodes that constitute the location of an operational node may augment the description of an operational node. These are often taken as recommendations or boundaries for further SV details. **Figure 4-5** provides a template for OV-2.

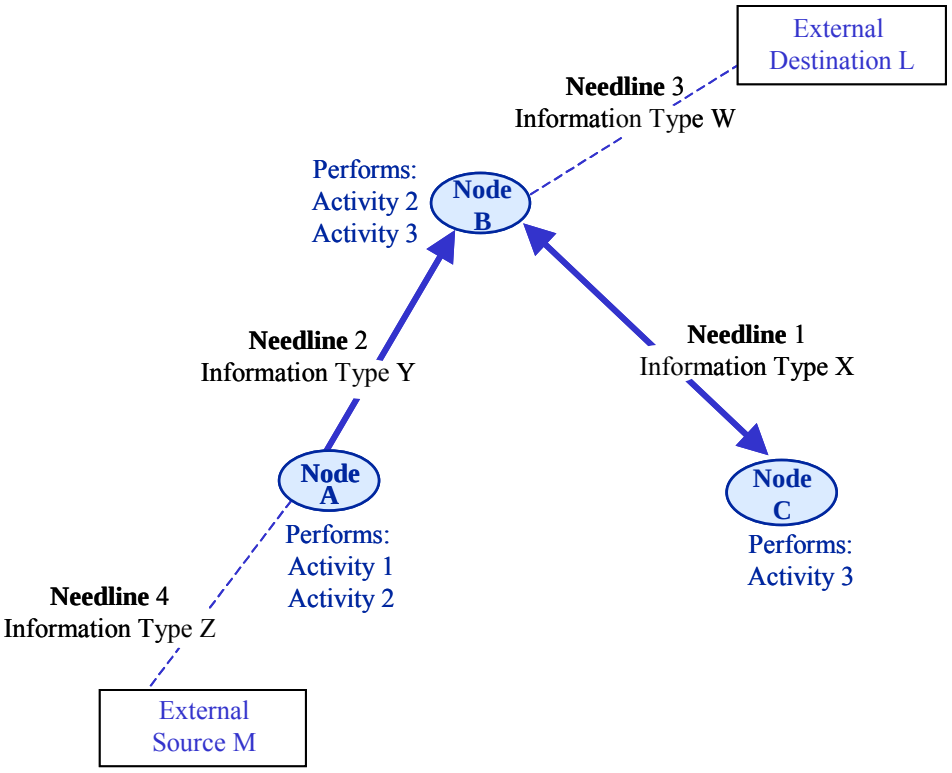


**Figure 4-5: OV-2 Template**

Service provider architectures also use a type of logical node. One purpose of a service provider architecture can be to communicate an external view of the available services to potential subscriber communities. In this situation, the service provider's OV-2 (and OV-3) can use generic representations of the subscriber environments it supports and, potentially, of the service provider facilities as well.

For the service provider, needlines may focus on the characteristics of the service provided or on a generic type of information to be exchanged and not on the exact type or critical attributes of the actual information exchanged. What is represented depends on the type of service being provided. For example, a communications service provider will describe needlines in terms of the type of information to be transferred, with what reliability or priority and security features. A human resources (HR) services provider will describe needlines in terms of the complete set of HR information produced or consumed, but any given subscriber may only deal with a subset of this information. **Figure 4-6** is a notional example of service providers and subscribers.

Subscribers can use information from the service provider's OV-2 to build the portions of their own OV-2 that include use of services from the service provider. The subscribers fill in the blanks or specify the relevant generic portions of the service provider's OV-2.

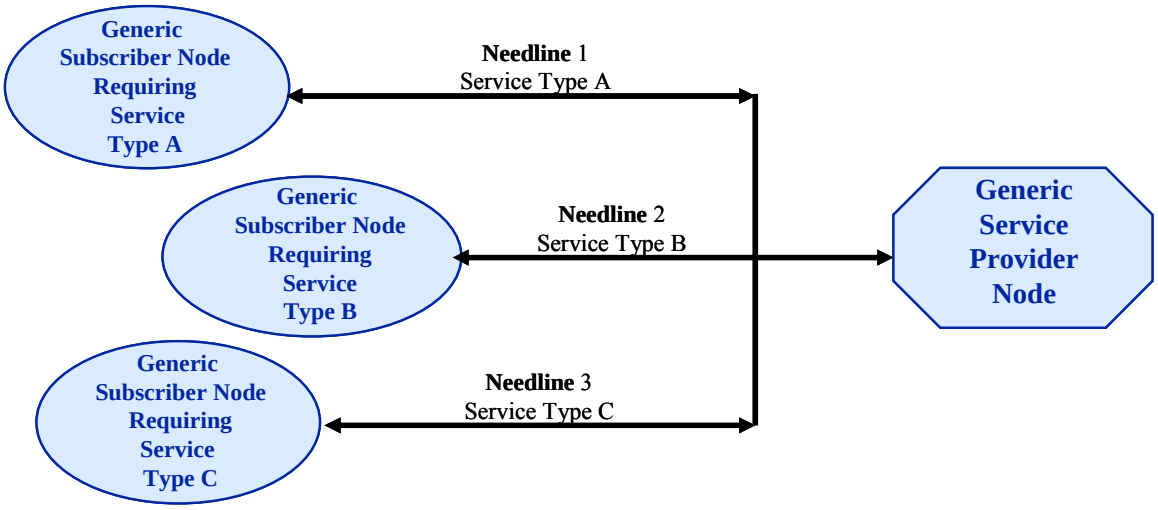


**Figure 4-6: Notional Example of an OV-2 Depicting Service Providers**

### 4.2.2 UML Representation

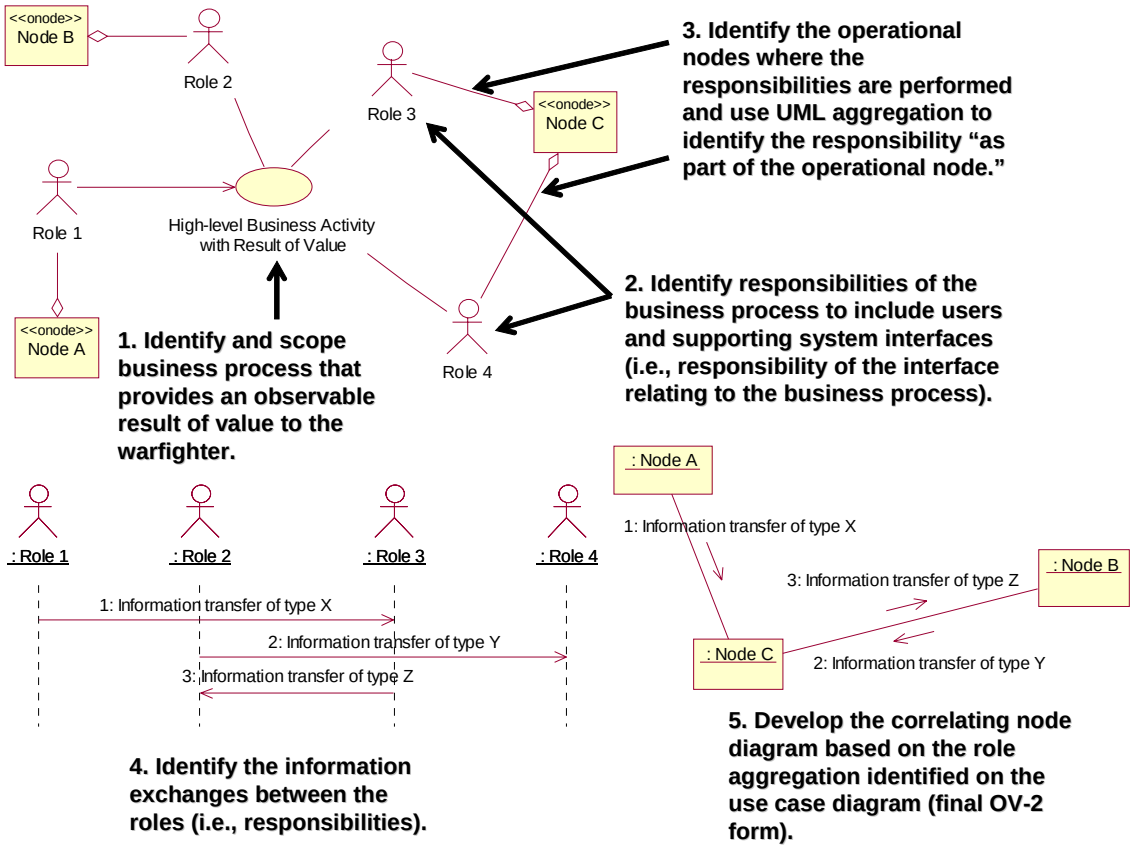


**Figure 4-7: UML OV-2 Template**

Using the UML and object-oriented method is much different from the structured analysis approach to architecture. Prior to developing a UML OV-2, the architect develops the relevant use case (business process) that provides an observable result of value to the warfighter (steps 1, 2, and 3 shown on **Figure 4-7**). Although not usually discussed in commercially prevalent UML books, step 3 provides a proper UML aggregation relationship to evolve the OV-2. Using the

roles identified as essential to the prescribed business process (use case), one can develop the information exchange between the roles (actors) necessary to accomplish the purpose of the use case (i.e., resulting value). Using the information from the aggregation relationship between the role and operational node <<onode>>, one can derive the OV-2 (step 5). Many UML tools offer automated mechanisms to generate the UML collaboration diagram (OV-2) based on the use case diagram (steps 1, 2, and 3) and the sequence diagram shown in step 4. The DoDAF architect should not use actors as operational nodes, because actor responsibilities are useful for future analysis of organizational considerations to evolve the OV-4. The aggregation approach loosely couples the use case from changing organizational adjustments. Although organizations change responsibilities, it is likely the business process is still necessary, and reuse and less maintenance is prevalent. When modeling with the UML, however, the architect will frequently encounter situations where the concept of OV-3 and OV-2 breaks down – this is particularly true when developing net-centric concepts.

### 4.2.3 Net-Centric Guidance for OV-2

**Augmented Product Purpose**. In a net-centric architecture, the OV-2 is used to graphically identify the need to exchange information between operational nodes that are assigned the ***operational role*** of ***Service Functionality Provider***, ***Service Consumer***, and ***Unanticipated User***.

**Net-Centric Product Description.** The OV-2 traditionally indicates the key players and the flow of information necessary to conduct the corresponding operational activities from the OV-5. It does so by describing operational nodes and identifying needlines between them, which depict a need to share information. Accordingly, in the NCE, the OV-2 should identify additional attributes about operational nodes that provide or consume information with external or enterprise sources.

In the NCE, ***Service Functionality Providers*** are sources for capabilities and information and are responsible for ensuring their availability for consumption. Opposite of that, ***Service Consumers*** are customers of capabilities and information and acquire them for use in execution of their missions. Analysis of ***Service Functionality Providers*** and ***Service Consumers*** that appear in a net-centric OV-2 (and the needlines between them) may provide guidance for the following efforts:

- Identifying organizations that have interest in the information being provided or consumed
- In net-centric architectures, the Service Functionality Provider should consider a larger set of users than those known to or required by the architecture. The Unanticipated User represents the dynamic, on-demand requirements of the information age warfighter, and accordingly, the OV-2 should depict that the Unanticipated Users can exploit information and capabilities in the NCE in order to support the changing and unexpected needs of their mission. Although it may be untraditional to represent Unanticipated Users in an architecture, the OV-2 may capture the boundaries, conditions, and constraints of needlines that potential users may encounter when accessing information from providers in an unanticipated way. Both known and unanticipated users are able to rely on the service to perform according to time-sensitive parameters specified in their mission.

There are two critical constructs that can be used in a net-centric OV-2 diagram to illustrate Service Functionality Providers, Service Consumers, and Unanticipated Users along with the need to provide or consume information. The constructs are 1) the operational roles that are applied to operational nodes and 2) needlines that identify the need to exchange information.

The use of operational role applied to operational nodes stresses the responsibility the node plays in interacting with external organizations and human roles. There are three types of operational roles:

- The operational role of Service Functionality Provider helps to illustrate the set of known sources of information and capability. Needlines associated with a Service Functionality Provider role indicate that information is provided by that source. The needlines identify the desire of the service functionality provider to support the needs of service consumers and make educated efforts to provide for Unanticipated Users. The operational role of Service Functionality Provider may be applied to both the operational and external nodes that provide needed information and capability.
- The operational role of Service Consumer helps to illustrate the set of expected users of information and capability. Needlines associated with a Service Consumer role indicate that information is required by that consumer. The operational role of Service Consumer may be applied to both operational and external nodes that require needed functionality.
- The operational role of Unanticipated User helps to identify the potential set of unknown external nodes who may be interested in obtaining information and capabilities. The Unanticipated User operational role will transition to a service consumer role and allows the architecture to roughly categorize the community of unanticipated users of services.

Increased ability to share information is a key component of net-centricity. In the NCE, a provider may not anticipate, or may even underestimate, the potential need for information produced within the scope of the architecture. The net-centric OV-2 enables the paradigm shift for users to look to the NCE to find information rather than to a known provider or source. The OV-2, in combination with the OV-3 supports the need for seamless information sharing between internal and external sources in support of the DoD's mission.

### 4.2.4 CADM Support for OV-2

The DoDAF product OV-2 is stored in CADM v1.5 as an instance of Document with a category code designating it as a NODE-CONNECTIVITY-DESCRIPTION. Each graphical element in that diagram can be represented by an instance of GRAPHIC (via Document with the appropriate value for its attribute, ArchitectureProductCategoryCode). Organizational elements are stored as instances of Organization, OrganizationType, and OperationalRole. Categories (subtypes) of OrganizationType include OperationalFacility and OperationalElement.

The entities Node and Network (which may include subnetworks) store the OV-2 nodal elements. Node(s) can be linked to other instances of Node, as well as to instances of Network in the manner discussed previously, i.e., through ObjectVersionAssociation. In this fashion, CADM v1.5 allows the identification of each Node of each Network, and it may be used to permit one Node to represent an entire Network. This enables drill-downs of an OV-2 that may have multiple

views. Specific Node-to-Node pairs can be expressed in CADM v1.5, as well depending on the level of granularity and detail required, and those pairs can again be used to express the internodal connectivities within a given Network. Finally, through ObjectVersionAssociation, instances of Node can also be linked to a specific Architecture. Quantifiable capability requirements of Node-to-Node pairs may be specified by relating them to CAPABILITY.[18]

Nodes may represent any or all of the following operational elements:[19]

- Organization(s)
- OrganizationType(s)
- OperationalRole(s), which can be characterized, where appropriate, as occupational specialties, or linked to instances of Position, PersonType, or Skill. The OperationalRole can also express net-centric roles such as Service Functionality Provider, Service Consumer, and Unanticipated User.
- ProcessActivity(s)
- Task(s)
- Network(s)
- System(s)
- DataItemType(s) (e.g., a class of information being exchanged)

The following operational requirements may be represented through the appropriate subtypes of InformationTechnologyRequirement:

- Information exchange requirements (IERs)
- Needlines
- Information content of IERs (or potential IERs)
- Requirements for Exchanging Information between Operational Activities

The communication media can be captured via CommunicationMedium and present or future task-related capabilities, Task and Capability. Potentially, an OV-2 can apply to more than one Architecture. When that is the case, CADM v1.5 can express that fact by linking the instances of Architecture to the Document (subtyped as an OV-2).

The ability to link instances of Document to other instances of Document in CADM v1.5 provides a means to relate OV-2s to other architecture products (such as the CONCEPT-DIAGRAM [OV-1], INFORMATION-EXCHANGE-MATRIX [OV-3], ACTIVITY-MODEL-SPECIFICATION [OV-5]), since these are all types of Document. **Figure** 4-8 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for OV-2 in a CADM-conformant database.

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[18] Because the measures being quantified are stored in Capability and because a parallel structure exists in the CADM for System, MaterielType, and other entities, the CADM provides a means to use the same measures to specify what each System, MaterielType, or other object can provide to meet the stated capability requirements.

[19] Not listed here or in the accompanying table and figure are the following entities from the CADM that can additionally be used to characterize what a node represents: CommunicationMedium, ActivityModelInformationElementRole, Facility, InformationAsset, Materiel, and MissionArea.

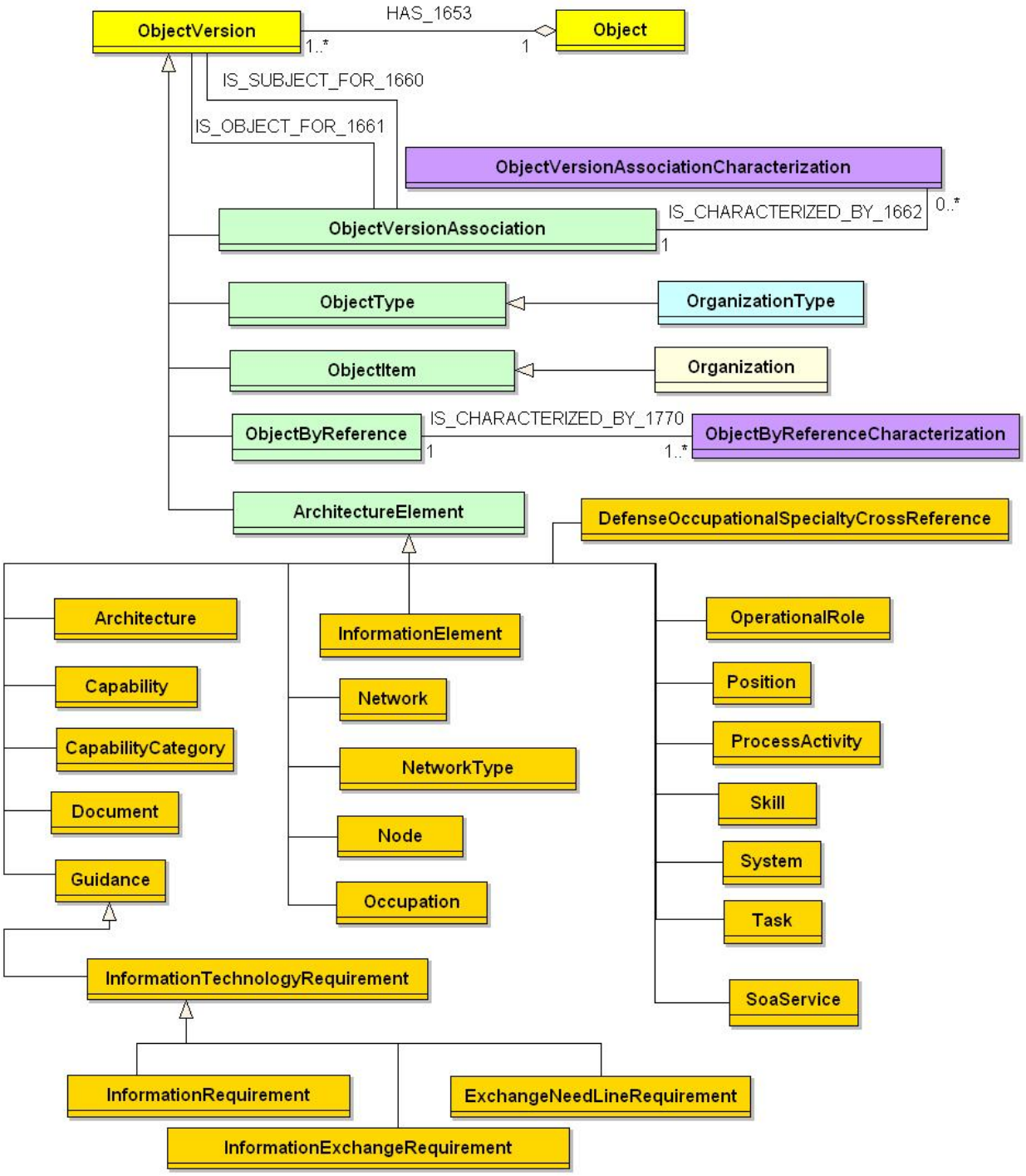


**Figure 4-8: CADM Diagram for OV-2**

#### 4.2.4.1 OV-2 – Data Element Definitions

OV-2 focuses on the operational nodes, the needlines between them, and the types of information associated with the needline. Associated operational activities may also be noted.

## OV-2 Information Space

| | |
|---|---|
| Architecture† | **Capability** |
| Document† | **CapabilityCategory** |
| Guidance† | **DefenseOccupationalSpecialtyCrossReference** |
| InformationElement† | **ExchangeNeedLineRequirement** |
| InformationTechnologyRequirement† | **InformationExchangeRequirement** |
| Network† | **InformationRequirement** |
| Node† | **NetworkType** |
| Organization† | **Occupation** |
| OrganizationType† | **OperationalRole** |
| SoaService† | **Position** |
| System† | **ProcessActivity** |
| Task† | **Skill** |

†) The descriptions of these elements have been provided in the preceding sections.

**Table 4-2** lists some of these architecture data elements.

**Table 4-2: Data Element Definitions for OV-2**[20]

| Data Elements | Attributes | Definition |
|---|---|---|
| **Capability** | | |
| | typeCode | The code that represents a specific Capability. |
| **CapabilityCategory** | | |
| | genericMeasurement Name | The kind of operationalized measurement represented by a specific CapabilityCategory. |
| | measurementAreaName | The name of the high-level organizing framework element that captures aspects of performance common to the input, output, and outcome levels for a specific Capability. |
| | MeasurementCategory Name | The name of the class of characteristic to be measured for a specific Capability. |
| | sourceName | The name of the originator for a specific Capability. |
| **DefenseOccupational SpecialtyCrossReference** | | |
| | commentText | The text that amplifies the applicability of a specific DefenseOccupationalSpecialtyCross Reference. |
| | dodIdentifierText | The text for the identifier provided by DoD 1312.1-1 for a specific DefenseOccupationalSpecialtyCross Reference. |
| | dodPriorIdentifierText | The text for the identifier provided by DoD before March 2001 for a specific DefenseOccupationalSpecialtyCross Reference. |
| | enlistedOfficerCode | The code that represents the category of DefenseOccupationalSpecialtyCross Reference according to whether its application is intended for a commissioned person. |
| | lastChangeActionCode | The code that represents the kind of change that has |

[20] As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

| Data Elements | Attributes | Definition |
|---|---|---|
| | | most recent occurred to a specific DefenseOccupationalSpecialtyCross Reference. |
| | lastChangeCalendarDate | The calendar date on which a change has most recently occurred to a DefenseOccupationalSpecialtyCross Reference. |
| | serviceGroupCode | The code that represents the origin of a specific DefenseOccupationalSpecialtyCross Reference. |
| | specialtyIdentifierText | The text for the identifier assigned by a specific source to characterize the source's DefenseOccupationalSpecialtyCross Reference. |
| | serviceSpecialtyName | The name of a specific DefenseOccupationalSpecialtyCross Reference |
| | serviceStatusCode | The code that represents whether a specific DefenseOccupationalSpecialtyCross Reference is approved for use. |
| **ExchangeNeedline Requirement** | | |
| | automationPriorityCode | The code that represents how operationally important it is for a specific ExchangeNeedlineRequirement to be parsed and processed automatically. |
| | categoryCode | The code that represents a class of ExchangeNeedlineRequirement. |
| | triggerText | The text that characterizes the event that will instigate the information exchange for a specific ExchangeNeedlineRequirement. |
| **InformationExchange Requirement** | | |
| | costOfFailureCode | The code that represents the penalty associated with the failed transmission of the information content between the organization-types by the InformationExchangeRequirement through its relationship to ExchangeNeedlineRequirement. |
| | effectiveCalendarDate | The calendar date on which a specific InformationExchangeRequirement comes into effect. |
| | frequencyHighQuantity | The quantity that represents the highest estimate of the number of times in one period that the InformationExchangeRequirement will be exchanged. |
| | frequencyLowQuantity | The quantity that represents the lowest estimate of the number of times in one period that the InformationExchangeRequirement will be exchanged. |
| | frequencyQuantity | The quantity that represents the number of times in one period that the InformationExchangeRequirement will be exchanged. |
| | frequencyTimePeriod Code | The code that represents the length of time in effect for specifying the rate of InformationExchangeRequirement transmissions. |
| | grade-of-serviceRate | The rate at which information bits are to be transferred for a specific InformationExchangeRequirement. |
| | graphicPageQuantity | The quantity of paginated images for the contents of an InformationExchangeRequirement. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | imageryPixelQuantity | The quantity of pixels expressing the size for the contents of an InformationExchangeRequirement. |
| | imageryPixelDepth Quantity | The quantity that represents the number of bits used to characterize the information for each pixel in an image that is the subject of the InformationExchangeRequirement. |
| | imageryResolution Dimension | The dimension that represents the diagonal length of a resolution cell for the imagery contained in a specific InformationExchangeRequirement. |
| | imageryViewField Dimension | The dimension that represents the radius of the field of view for the imagery contained in a specific InformationExchangeRequirement. |
| | maximumTransitElapsed TimeQuantity | The elapsed-time quantity that represents the extreme upper limit to the permitted time that can elapse from the time sent to the time received for a specific InformationExchangeRequirement. |
| | maximumUsefulElapsed TimeQuantity | The elapsed-time quantity that represents the greatest elapsed time that can take place from the sending of the InformationExchangeRequirement to its use. |
| | methodBroadcastCode | The code that represents whether the manner of the InformationExchangeRequirement will be broadcast. |
| | methodMulticastCode | The code that represents whether the manner of the InformationExchangeRequirement will be multicast. |
| | methodVoice-videoElapsed-timeQuantity | The elapsed-time quantity that represents the elapsed time of a voice-video transmission for the manner of a specific InformationExchangeRequirement. |
| | missionPhaseDescription Text | The text that characterizes the portion of the operational mission activity that the InformationExchangeRequirement is to support. |
| | objectHighCountQuantity | The quantity that represents the highest estimate of the number of objects associated with a specific InformationExchangeRequirement. |
| | objectLowCountQuantity | The quantity that represents the lowest estimate of the number of objects associated with a specific InformationExchangeRequirement. |
| | perishabilityCode | The code that represents the length of useful life of the information being exchanged for a specific InformationExchangeRequirement. |
| | precedenceCode | The code that represents the urgency of a specific InformationExchangeRequirement. |
| | preferenceCode | The code that represents the degree to which the characteristics of a specific InformationExchangeRequirement satisfies the operational requirement. |
| | productDataSizeQuantity | The quantity that represents the average number of bits in the communication product for a specific InformationExchangeRequirement. |
| | productTypeCode | The code that represents the kind of information exchanged between two or more communicating entities for a specific InformationExchangeRequirement. |
| | roleCode | The code that represents the way in which a specific InformationExchangeRequirement functions. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | speedOfServiceCode | The code that represents the time interval from collection to transmission of the information content of a specific InformationExchangeRequirement. |
| | statusCode | (63242/1) (a) The code that represents the state of a specific information-exchange-requirement. |
| | timelinessHighQuantity | The quantity that represents the highest estimate of the proximity of the occurrence of the data to the transmission of that data for a specific InformationExchangeRequirement. |
| | timelinessLowQuantity | The quantity that represents the lowest estimate of the proximity of the occurrence of the data to the transmission of that data for a specific InformationExchangeRequirement. |
| **InformationRequirement** | | |
| | accuracyDescriptionText | The text that summarizes the degree of correctness of a specific InformationRequirement. |
| | automatedProcessing Code | The code that represents how operationally important it is for a specific InformationRequirement to be processed automatically. |
| | contentSizeQuantity | The quantity that represents the computer storage space allocated for the contents of a specific InformationRequirement. |
| | exchangeFrequencyText | The text that characterizes how often a specific InformationRequirement is to be sent. |
| | graphicPageHighQuantity | The quantity that represents the highest number of paginated images for a specific InformationRequirement. |
| | graphicPageLowQuantity | The quantity that represents the lowest number of paginated images for a specific InformationRequirement. |
| | methodVoice-videoHighElapsedTime Quantity | The elapsed-time quantity that represents the longest voice-video transmission for a specific InformationRequirement. |
| | methodVoice-videoLowElapsedTime Quantity | The elapsed-time quantity that represents the shortest voice-video transmission for a specific InformationRequirement. |
| | perishabilityHighElapsed TimeQuantity | The elapsed-time quantity that represents the longest length of useful life of the InformationRequirement. |
| | perishabilityLowElapsed TimeQuantity | The elapsed-time quantity that represents the shortest length of useful life of the InformationRequirement. |
| | subscriptionTypeText | The text that summarizes the kind of control associated with disseminating a specific InformationRequirement. |
| | transactionTypeText | The text that summarizes the intended method of transmission for a specific InformationRequirement. |
| | volumeCode | The code that represents the general size of relevant information that is provided for a specific InformationRequirement. |
| **NetworkType** | | |
| | approvalStatusCode | The code that represents the state of validity for the metadata for a NetworkType. |
| **Occupation** | | |
| | conditionText | The text that describes the circumstances in which a specific Occupation is used. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | performanceStandardText | The text that describes the measured criteria of a specific Occupation. |
| | seriesTypeCode | The code that denotes a specialized line of work associated with a specific Occupation. |
| **OperationalRole** | | |
| | responsibilityText | The text that characterizes the chief obligation of a specific OperationalRole. |
| **Position** | | |
| | durationTypeCode | The code that represents a time frame applicable to a Position. |
| | manningReasonCode | The code that represents the underlying basis for the maintenance of a Position. |
| | mobilizationRequirement Code | The code that denotes whether a Position is required during periods of special preparation for contingency. |
| | peacetimeRequirement Code | The code that denotes whether a Position is required during times other than periods of special preparation for contingency. |
| | scheduleTypeCode | The code that represents a specific kind of work routine applicable to a Position. |
| | travelFrequency RequirementCode | The code that represents the estimated days per month the incumbent of a Position will need to be away from home. |
| | typeCode | The code that represents a specific kind of Position. |
| | workScheduleQuantity | The quantity of work-time commitment established for a Position. |
| **ProcessActivity*** | | |
| | alternateIdentifierText | The text that alternatively identifies a specific ProcessActivity. |
| | categoryCode* | The code that represents the class of a ProcessActivity. |
| | creationCalendarDate | The calendar date on which a ProcessActivity was originated. |
| | dataStoreTypeCode | The code that represents a class of ProcessActivity that is a repository of data. |
| | definitionText | The text that unambiguously characterizes a specific ProcessActivity. |
| | hierarchyDescriptionText | The text that characterizes the relationship of a specific process-activity to other instances of ProcessActivity. |
| | hierarchyName | The name that represents the relationship of a specific process-activity to other instances of ProcessActivity. |
| | scopeText | The text that describes the extent of a ProcessActivity. |
| | sourceDocumentText* | The text of the origination documentation of a ProcessActivity. |
| | validationStatusCode | The code that represents the state of sanctioning of a ProcessActivity. |
| | versionIdentifierText | The text that identifies a rendition of a ProcessActivity. |
| **Skill** | | |
| | conditionText | The text that describes the circumstances of a specific Skill. |
| | performanceStandardText | The text that describes the measured criteria of a specific Skill. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| Capability | is related to | Capability |
| Capability | is cited in | Document |
| Capability | is performed by | Network |
| Capability | is performed by | System |
| CapabilityCategory | is the class of | Capability |
| InformationExchangeRequirement | is specified using | ActivityModelInformationElementRoleler |
| InformationExchangeRequirement | is referenced in | InformationExchangeMatrixElement |
| InformationExchangeRequirement | is restricted by | InformationExchangeRequirementAssurance |
| InformationExchangeRequirement | may have a | InformationExchangeRequirementElement |
| InformationExchangeRequirement | risks | InformationExchangeRequirementFailureImpactDetail |
| InformationExchangeRequirement | is subject to | InformationExchangeRequirementTrigger |
| InformationExchangeRequirement | is used in | OperationalMissionThreadElement |
| InformationExchangeRequirement | cites | DiscoveryMetadata |
| InformationRequirement | is used for | InformationExchangeRequirement |
| NetworkType | describes | Network |
| Occupation | may be cited for | OperationalRole |
| OperationalRole | is represented by | Node |
| OperationalRole | performs | ProcessActivity |
| OperationalRole | is performed by | Organization |
| OperationalRole | is performed by | OrganizationType |
| Position | may be cited for | OperationalRole |
| ProcessActivity | is cited for | Architecture |
| ProcessActivity | is performed at | Node |
| ProcessActivity | is performed by | OperationalRole |
| ProcessActivity | is carried out by | Organization |
| ProcessActivity | is carried out by | OrganizationType |
| ProcessActivity | is related to | ProcessActivity |
| ProcessActivity | is cited in | Document |
| ProcessActivity | corresponds to | Task |
| ProcessActivity | is assigned to | System |
| Skill | may be cited for | OperationalRole |
| Task | is destination need for | InformationExchangeRequirement |
| Task | is source of need for | InformationExchangeRequirement |

(All previous relationships for the listed entities that comprise the information space of OV-2 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 4.3 OPERATIONAL INFORMATION EXCHANGE MATRIX (OV-3)

### 4.3.1 OV-3 – Product Description

**Product Definition**. The OV-3 details information exchanges and identifies "*who* exchanges *what* information, with *whom*, *why* the information is necessary, and *how* the information exchange must occur." [CJCSI 6212.01D, 2006] There is not a one-to-one mapping of OV-3 information exchanges to OV-2 needlines; rather, many individual information exchanges may be associated with one needline.

**Product Purpose**. Information exchanges express the relationship across the three basic architecture data elements of an OV (operational activities, operational nodes, and information flow) with a focus on the specific aspects of the information flow and the information content. Certain aspects of the information exchange can be crucial to the operational mission and should be tracked as attributes in OV-3. For example, if the subject architecture concerns tactical battlefield targeting, then the timeliness of the enemy target information is a significant attribute of the information exchange.

**Product Detailed Description**. OV-3 identifies information elements and relevant attributes of the information exchange, and associates the exchange to the producing and consuming operational nodes and activities and to the needline that the exchange satisfies.

***Information exchange*** is an act of exchanging information between two distinct operational nodes and the characteristics of the act, including the information element that needs to be exchanged and the attributes associated with the information element (e.g., Scope), as well as attributes associated with the exchange (e.g., Transaction Type). A needline represents one or more information exchanges.

***Information element*** is a formalized representation of information subject to an operational process (e.g., the information content that is required to be exchanged between nodes). In contrast, an information exchange is composed of the needline, the information element, and other attributes such as Information Assurance attributes. The specific attributes of the information elements included are dependent on the objectives of the specific architecture effort and include the information scope, accuracy, and language. An information element may be used in one or more information exchanges.

The specific mission/scenario and the related task from the UJTL or Mission Essential Task List (METL) can be noted as an attribute of the information exchange. A mission/scenario may be selected from the Joint Mission Areas. UJTL and METL tasks are related to a specific scenario that requires the information.

The emphasis in this product is on the logical and operational characteristics of the information. It is important to note that OV-3 is not intended to be an exhaustive listing of all the details contained in every information exchange of every operational node associated with the architecture in question nor should the production of such a matrix be considered sufficient to replace an integrated architecture development effort. Rather, this product is intended to capture the most important aspects of selected information exchanges.

A partial format for OV-3 matrix can be found in CJCSI 6212.01D, and that format is required for Information Support Plan (ISP) development. However, additions to the CJCSI 6212.01D matrix to meet program-unique needs should also be allowed. **Figure 4-9** shows a representative format for the OV-3.

| Needline Identifier | Information Exchange Identifier | Information Element Description | | | | | Producer | | Consumer | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Information Element Name and Identifier | Content | Scope | Accuracy | Language | Sending Op Node Name and Identifier | Sending Op Activity Name and Identifier | Receiving Op Node Name and Identifier | Receiving Op Activity Name and Identifier |

| Needline Identifier | Information Exchange Identifier | Nature of Transaction | | | | | Performance Attributes | | Information Assurance | | | | | Security | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mission/Scenario UJTL or METL | Transaction Type | Triggering Event | Interoperability Level Required | Criticality | Periodicity | Timeliness | Access Control | Availability | Confidentiality | Dissemination Control | Integrity | Accountability | Protection (Type Name, Duration, Date) | Classification | Classification Caveat |

**Figure 4-9: Operational Information Exchange Matrix (OV-3) – Template**

In **Figure 4-9**, each information exchange is associated with the needline it helps satisfy. There may be many individual exchanges that collectively satisfy a single needline. Note also that each information element exchanged is related to the leaf operational activity (from the OV-5) that produces or consumes it. However, there may not be a one-to-one correlation between information elements listed in the matrix and the information inputs and outputs that connect activities in a related OV-5. Information inputs and outputs between activities performed at the same node (i.e., not associated with a needline on OV-2) will not show in OV-3. Information inputs and outputs between activities for some levels of operational activity decomposition may be at a higher level of abstraction than the information elements in the matrix. In this case, multiple information exchanges will map to a single operational activity input or output. Similarly, the information inputs and outputs between activities at a low level of activity decomposition may be at a higher level of detail than the information exchanges in the matrix, and multiple information inputs and outputs may map to a single information exchange. Information elements trace to the entities in a OV-7.

### 4.3.2 UML Representation

There is no equivalent diagram to this product in UML. The information exchanges of OV-3 trace to the collaboration or sequence diagram information flows supporting OV-5 and depicted in OV-2 and OV-6c products.

This product is a detailed table that expands on the information associated with OV-2 operational nodes, OV-5 operational activities, and OV-6 elements. If an automated tool is used to create the other products in UML, then the OV-3 expanded definitions can be attached to the applicable elements by using adornments and the documentation facilities possible in the UML tool. As a result, a script may be developed that will automatically generate the matrix.

### 4.3.3 Net-Centric Guidance for OV-3

**Augmented Product Purpose**. In the NCE, the OV-3 captures details that guide the determination of the specific information that will be obtained or provided in a net-centric manner.

**Net-Centric Product Description**. The OV-3 traditionally identifies information elements and relevant attributes of the information exchange associated with a needline between producing and consuming operational nodes in the OV-2. In the NCE, additional information elements and attributes may be included in the matrix to highlight or capture the following:

- The use of an operational profile, which captures COI information, discovery metadata, and the settings and other data associated with security and access control, eases the representation of one-to-many, many-to-many, and many-to-one information exchanges because it associates usage permissions of the information to an individual user or a group of users in the NCE.
- Provide detailed description of the information exchange from external providers.
- Identify the ***intended use*** (internal use only, external only, or open to internal and external use).
- Identify the authorized use for information assurance.

In the NCE, services within a program may consume information without always knowing what the providing service is and/or who the service provider is. The OV-3 may be depicted as two separate products:

- Information Exchange Provided describes and expands on the information associated with OV-2 operational nodes that is made available to the NCE, which includes known as well as those authorized, but beyond the original predefined set of users
- Information Exchange Consumed describes and expands on the information associated with OV-2 operational nodes that are required to be obtained from the NCE, without predetermined knowledge of the producer

In the NCE, analysis of the Service Functionality Providers and Service Consumers (and the needlines between them in a net-centric OV-2) aides in the identification of specific information that is produced or consumed within the architecture. The net-centric OV-3 provides the details of the information exchanged, represented by needlines in the OV-2. The automated information

exchanges and associated characteristics are captured in the SV-6. The net-centric OV-3 provides guidance for the following efforts:

- Determining, analyzing, and selecting external sources of information
- Initiating negotiations of usage permissions, expectations, and performance agreements with external organizations responsible for providing or consuming information

### 4.3.4 CADM Support for OV-3

**Figure** 4-10 provides an overview of the CADM data structures related to each InformationExchangeRequirement and, more generally, to any InformationTechnologyRequirement. Using these entities, detailed characteristics can be stored for each IER cited in OV-3.

OV-3 is stored as an instance of Document with its attribute ArchitectureProductCategoryCode designating it as an INFORMATION-EXCHANGE-MATRIX. In CADM v1.5, each row of OV-3 is built by linking in ObjectVersionAssociation, the pertinent constituents of the matrix, to an instance of ObjectByReference with CategoryCode = INFORMATION-EXCHANGE-MATRIX-ELEMENT. The OV-3 can in this manner point to:[21]

- Instances of CommunicationMedium
- Instances of MaterielType
- Information requirements, exchange needlines, exchange requirements by activity, and IERs via Guidance
- Message standards via Agreement (usually applies only to SV-6)
- Applicable timeframes via Period (usually applies only to SV-6)

[21] This entity has additional attributes used for SV-6 Systems Data Exchange Matrix.

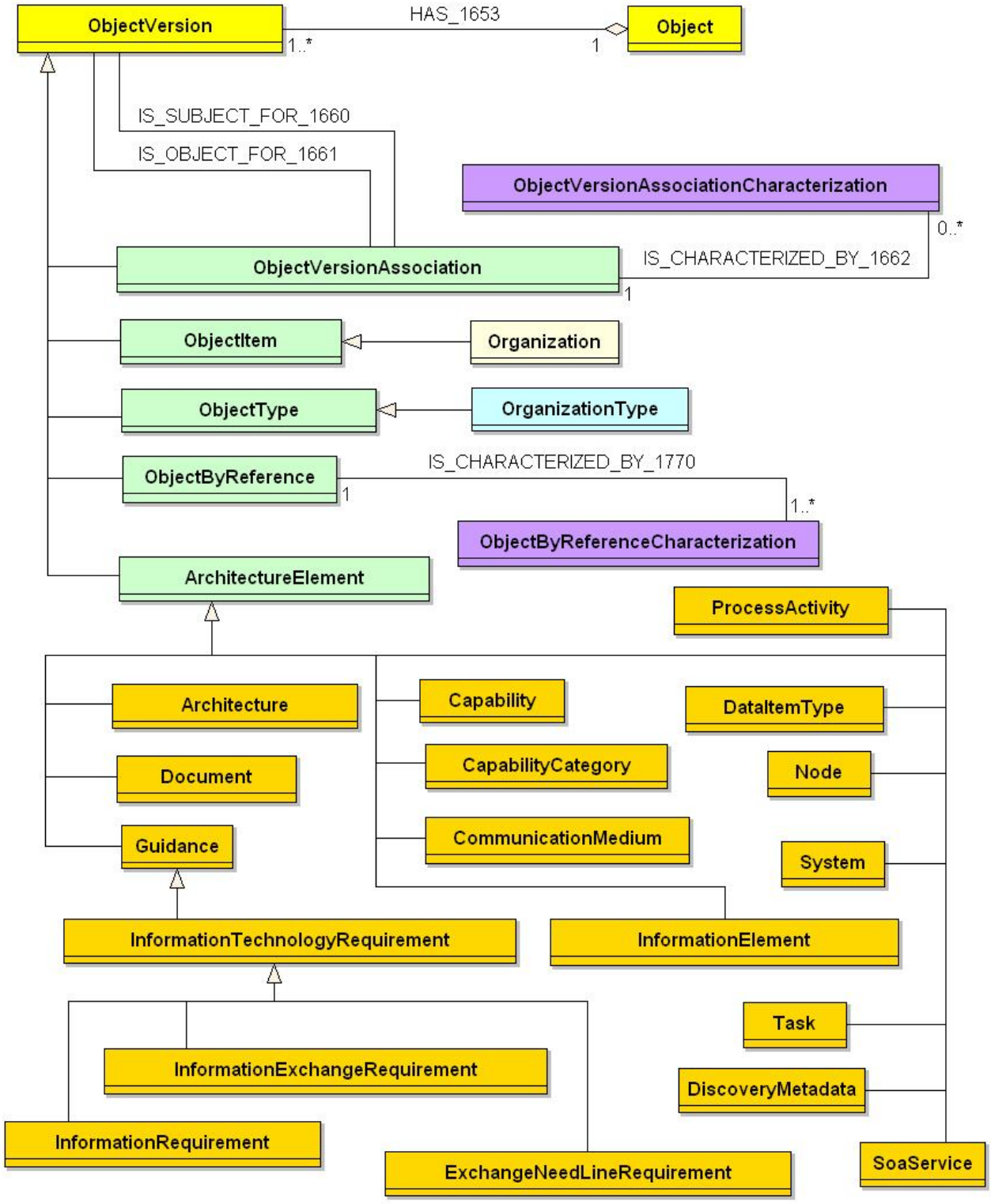


**Figure 4-10: CADM Diagram for OV-3**

Using these references, all the attributes of Guidance, Agreement, and their subtypes can be inserted into OV-3. In addition, these entities can be linked to other entities in CADM v1.5,

allowing the construction of very rich OV-3 content. The following list shows some of the additional data that can be made part of a data-centric OV-3:[22]

- OrganizationType (e.g., OperationalFacility)
- DataItemType
- Organization
- Task
- InformationElement
- SecurityClassification

The following indicate the ways in which the CADM supports draft IER requirements provided by the Office of the Joint Staff J6 to the Architecture Framework Working Group in January 2003:

- Link to OV-2—Number given to each needline in OV-2; supported in CADM v1.5 via Guideline and its subtypes.
- Rationale/UJTL Number—Set of joint mission tasks from the UJTL (CJCM 3500.04B) for each mission area; supported in CADM v1.5 via Task, which can be linked to specific InformationExchangeRequirement(s) with specific roles (e.g., Source Task, Destination Task) in ObjectVersionAssociation.
- Event—Event that triggers the need for the information exchange; supported in CADM v1.5 through textual description via the attribute CausalEventTriggerText in the entity InformationExchangeRequirement; if the trigger is in the form of a doctrinal rule, CADM v1.5 specifies that kind of trigger as an instance of OperationalRule, linking it to the InformationExchangeRequirement.
- Information Characterization—Critical information characteristics that describe what information is being exchanged and how it is to be used; supported in CADM v1.5 through textual description via the attribute SynopsisText in the entity Guidance and linking that instance to InformationExchangeMatrix; where the information is known at a sufficient level of granularity, CADM v1.5 specifies it through the use of the attributes of InformationElement and links the pertinent instances to InformationRequirement.
- Send Node—Sending Node; supported in CADM v1.5 through the relationships that can be established to link instances of OrganizationType with appropriate roles (e.g., sending) to ExchangeNeedlineRequirement; if the role of *send node* is specifically linked to an IER, the sending node may be specified more formally through the entity Node and then linked to InformationExchangeRequirement. (Note: In some architectures, the Sending Node represents an OperationalFacility, which is a subtype of OrganizationType. In network-centric operations, the Sending Node may represent an information network.)

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[22] Not shown in this list are all the other data structures that were modeled explicitly in CADM 1.02/1.03 and which are now instantiatable via ObjectByReference. In addition, please note that references to additional entities are implementation specific and are listed for the Systems Data Exchange Matrix (SV-6).

- Receive Node—Receiving Node; supported in CADM v1.5 through the relationships that can be established to link instances of OrganizationType with appropriate roles (e.g., receiving) to ExchangeNeedlineRequirement; if the role of *receive node* is specifically linked to an IER, the receiving node is specified more formally through the entity Node and then linked to the instance of InformationExchangeRequirement**.** (Note: In some architectures, the Receiving Node represents an OperationalFacility, which is a subtype of OrganizationType. In network-centric operations, the Receiving Node may represent an information network.)
- Critical—Criticality assessment of the information being exchanged in relationship to the mission; supported in CADM v1.5 through ObjectByReference with CategoryCode = INFORMATION-EXCHANGE-REQUIREMENT-ASSURANCE. The attribute InformationCriticalityCode [23] is specified in CADM v1.5 via ObjectByReferenceCharacterization (see Volume III for details). The (DoD-approved) values of this code are the following:
  - 1 = Category 1 Mission Critical (Force C2)—Critical and high-level information (e.g., emergency action message and commander's guidance)
  - 2 = Category 2 Mission Critical (Mission Operations)—Required in support to operations (e.g., joint task force contingency plans and operations plan)
  - 3 = Category 3 Mission Critical (Core Functions)—Ongoing information exchanges (e.g., configuration and guidance information and restricted frequency list)
  - 4 = Mission critical [not otherwise specified]
  - 5 = Mission support—Logistics, transportation, medical (e.g., gallons of petroleum-oil-lubrication scheduled for delivery)
  - 6 = Administrative—Personnel, pay, training, etc. (e.g., change in allotment)
- Format—Description of Data Type; supported in CADM v1.5 through instances of DataItemType linked to InformationExchangeMatrix when the user wishes to specify its own categorization of the types of data; where the format adheres to a standard, CADM v1.5 specifies it via MessageStandard and links it to InformationExchangeMatrix; if the format is specifically related to an information requirement, CADM v1.5 specifies it via the attribute PhysicalFormatTypeCode in the entity InformationRequirement**.**[24]
- Interoperability Level Required—Class of technical means intended to be used for information exchange; supported in CADM v1.5 through the attribute

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[23] The attribute InformationCriticalityCode is formally defined as "The code that represents the seriousness of the benefit that the information exchange element provides to the objective of the action being taken for a specific information exchange requirement assurance." Approved under DoD 8320.1 procedures as Standard Data Element 63248 (INFORMATION-EXCHANGE-REQUIREMENT-ASSURANCE INFORMATION CRITICALITY CODE), Version 1, DoD Data Dictionary System, January 2003.

[24] Approved domain values include: 01 = Audio; 02 = Text; 03 = Graphic (To Include Facsimile); 04 = Imagery Not Otherwise Specified; 05 = Imagery, Still; 06 = Imagery, Stop Motion; 07 = Imagery Full Motion; 08 = Data Not Otherwise Specified; 09 = Data, ASCII; 10 = Data, Bit-Oriented; 11 = Face-To-Face Meeting; 12 = Courier; 13 = Film; 14 = Paper; 15 = Magnetic Tape; 16 = Optical Disk; 17 = Magnetic Disk; 18 = Video (Full-Motion Video With Audio); 19 = Visual Not Otherwise Specified.

InteroperabilityLevelCode in the entity InformationTechnologyRequirement. Approved domain values include the following high-level technical means:

  - 01 = Level 0—Isolated Level (Manual), without sublevel distinction
  - 07 = Level 1—Connected Level (Peer-to-Peer), without sublevel distinction
  - 12 = Level 2—Functional Level (Distributed), without sublevel distinction
  - 16 = Level 3—Domain Level (Integrated), without sublevel distinction
  - 20 = Level 4—Enterprise Level (Universal), without sublevel distinction

- Timeliness—Required maximum time from node to node expressed in seconds; supported in CADM v1.5 through the attribute TimelinessCode in the entity InformationTechnologyRequirement.[25] When actual numerical values are known, CADM v1.5 specifies them through the two attributes FrequencyHighQuantity and FrequencyLowQuantity in the entity InformationTechnologyRequirement.
- Access Control—Mechanism used to ensure that only authorized users can access information; supported in CADM v1.5 through ObjectByReference with CategoryCode = INFORMATION-EXCHANGE-REQUIREMENT-ASSURANCE. The pertinent attribute, AccessControlTypeCode, is defined in CADM v1.5 via ObjectByReferenceCharacterization. The approved domain values include the following:
  - 1 = Not Required—No checks of any kind; anybody can access the information or the information system (e.g., access to most World Wide Web sites)
  - 2 = Profile—Access is controlled by assessing whether the individual seeking access displays the characteristics typically required (e.g., a carload of individuals are granted access to a post because they are in uniform and the car has a sticker)
  - 3 = Password and Identification Document—Individual seeking access must be known and provide a predetermined password (e.g., bank ATMs require both the user's card [ID] and the user to enter a personal identification number [PIN] [password])
  - 4 = SSL (Secure Sockets Layer [Server-Based])
  - 5 = ID Cert/ACL—An identification certificate and presence of the identified entity on a valid access control list (ACL)
  - 6 = Crypto Ignition Key (CIK)—Key required for secure access (e.g., STU III)
  - 7 = Pairwise Key—Source encrypts the information and the destination decrypts the information using symmetric keys
- Protect—Mechanism used to ensure that only authorized users can access information; supported in CADM v1.5 through ObjectByReference with

[25] Approved as Standard Data Element 63267, Version 1, DoD Data Dictionary System, January 2003. Domain values include: 1D = Up to One Day (8 Hour -24 Hours); 1H = Up to One Hour (10 Minutes -1 Hour); 1M = Up to One Month (1 Day -30 Days); 8H = Up to 8 Hours (1 Hour -8 Hours); GM = Greater than One Month; LG = Large (Greater Than 30 Days); M = Moderate (1-10 Seconds); NK = Not Known; NRT = Near-Real-Time (Less Than 1 Second); NS = Not Specified; RT = Real-Time; S = Slow (10 Seconds -10 Minutes).

CategoryCode = INFORMATION-EXCHANGE-REQUIREMENT-ASSURANCE. The pertinent attributes, ProtectionDurationCode, ProtectionElapsedTimeQuantity, and ProtectionSuspenseCalendarDate, are defined in CADM v1.5 via ObjectByReferenceCharacterization. The approved domain values include the following:

– ProtectionDurationCode approved domain values include the following:

a. 1 = None

b. 2 = Encrypted for Transmission Only (EFTO)—After transmission is completed, information protection is not required

c. 3 = Originating Agency's Determination Required (OADR)

d. 4 = Specified until explicit expiration date

e. 5 = Specified as end of mission

f. 6 = Specified as a period of time beginning as of the date and time of transmission and ending after an explicitly provided length of time

- Classification—Classification of the information; supported in CADM v1.5 through instances of SecurityClassification, which can be linked to InformationExchangeRequirement.
- Block Increment—Designated block or increment of the IER is required (usually by separate timeframes); supported in CADM v1.5 through the attribute BlockName in the entity InformationTechnologyRequirement.

#### 4.3.4.1 OV-3 - Data Element Definitions

**OV-3 Information Space**

**Architecture**†
**Capability**†
**CapabilityCategory**†
**Document**†
**ExchangeNeedLineRequirement**†
**Guidance**†
**InformationElement**†
**InformationExchangeRequirement**†
**InformationRequirement**†
**InformationTechnologyRequirement**†
**Node**†
**Organization**†
**OrganizationType**†
**ProcessActivity**†
**SoaService**†
**System**†
**Task**†
**CommunicationMedium**
**DataItemType**
**DiscoveryMetadata**

†) The descriptions of these elements have been provided in the preceding sections

**Table 4-3: Data Element Definitions for OV-3[26]**

| Data Elements | Attributes | Definition |
|---|---|---|
| **CommunicationMedium** | | |
| | categoryCode | The code that represents a class of CommunicationMedium. |
| | typeName | The name of the general class to which a specific CommunicationMedium belongs. |

[26] As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

| Data Elements | Attributes | Definition |
|---|---|---|
| **DataItemType** | | |
| | approvalStatusCode | The code that denotes the state of validity for the data for a DataItemType. |
| | detailCode | The code that represents on a detailed level a DataItemType. source: c4rdp, information-exchange-term code--the code, expressed as 4 characters, that represents the information exchange term. |
| | groupingClassCode | The code that represents a specific grouping of a DataItemType. |
| | typeCode | The code that represents a kind of DataItemType. |
| **DiscoveryMetadata** | | |
| | commentText | The text that explains the specialized character of a specific instance of DiscoveryMetadata. |
| | definitionText | The text that unambiguously characterizes an instance of DiscoveryMetadata. |
| | lastModification CalendarDatetime | The calendar date-time at which a specific instance of DiscoveryMetadata was most recently changed. |
| | obligationLevelText | The name that indicates the degree to which an instance of DiscoveryMetadata is required to be supplied. |
| | primaryCategoryName | The name of the major class to which a specific instance of DiscoveryMetadata belongs. |
| | referencedSourceName | The name that provides a source for a specific instance of DiscoveryMetadata. |
| | setName | The name of the high-level function focus of an instance of DiscoveryMetadata. |
| | subcategoryName | The name of a specific type of DiscoveryMetadata. |

| **Relationships** | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| CommunicationMedium | is used to transport | InformationExchangeRequirement |
| ConceptualDataModel | cites | DiscoveryMetadata |
| DataItemType | uses | InformationRequirement |
| InformationExchangeRequirement | cites | DiscoveryMetadata |
| InformationTechnologyRequirement | cites | CommunicationMedium |
| Node | uses | CommunicationMedium |

(All previous relationships for the listed entities which comprise the information space of OV-3 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter see Volume III.)

## 4.4 ORGANIZATIONAL RELATIONSHIPS CHART (OV-4)

### 4.4.1 OV-4 – Product Description

**Product Definition**. The OV-4 illustrates the command structure or relationships (as opposed to relationships with respect to a business process flow) among human roles, organizations, or organization types that are the key players in an architecture.

**Product Purpose**. This product clarifies the various relationships that can exist between organizations and sub-organizations within the architecture and between internal and external organizations.

**Product Detailed Description**. OV-4 illustrates the relationships among organizations or resources in an architecture. These relationships can include supervisory reporting, command and control relationships, and command-subordinate relationships. Another type of relationship is a coordination relationship between equals, where two organizations coordinate or collaborate without one having a supervisory or command relationship over the other. Others may be defined depending on the purpose of the architecture. Architects should feel free to define any kinds of relationships necessary and important within their architecture to support the goals of the architecture. For example, dynamic teams or task forces (i.e., new operational nodes) may be created in real time with only limited lifespans and assigned missions, and could have needlines assigned to them. The creating node and the created node have a unique relationship that should be documented. This relationship may not be one of lines of command or organizational hierarchies, as these do not necessarily map to the needlines of OV-2. In this product, the dynamic organizations represented by operational nodes in OV-2 have a limited lifespan and a temporary collaboration relationship.

The product illustrates the relationships among organizations or organization types that are the key players in an architecture. These key players correspond to the operational nodes of an OV-2, which contains added detail on how the key players interact together in order to conduct their corresponding operational activities of OV-5.

Human roles whose skills are needed to perform the operational activities or business processes described in the architecture may also be defined in OV-4. The corresponding operational activities should be decomposed to a degree that allows them to be correlated to specific human roles within organizations. In the case of target architectures, human roles that do not reflect a specific supervisory reporting, command and control, or coordination organizational structure may be used in OV-4. In this case, OV-4 may be developed using strictly human roles that are the key players in an architecture.

Organizational relationships are important to depict in an OV (for a current architecture), because they can illustrate fundamental human roles (e.g., who or what type of skill is needed to conduct operational activities) as well as management relationships (e.g., command structure or relationship to other key players). Organizational relationships may influence how the operational nodes in an OV-2 are connected. A template is shown in **Figure 4-11**.

As the template illustrates, boxes can show hierarchies of organizations, and different colors or styles of connecting lines can indicate various types of relationships among the organizations.

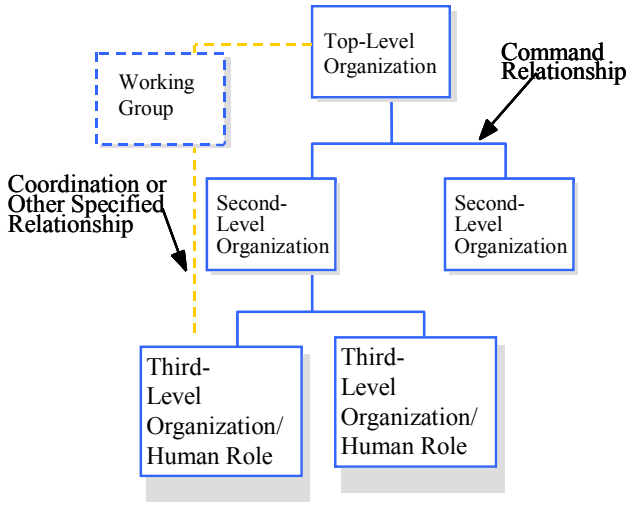


**Figure 4-11: OV-4 – Template**

### 4.4.2 UML Representation

A UML class diagram best represents the OV-4. The DoDAF architect uses operational node stereotyped classes on these diagrams along with their UML association (i.e., bi-directional, unidirectional, aggregation, composition, or generalization). **Figure 4-12** below presents a simple example of a UML OV-4. Some DoDAF UML architects prefer to aggregate operational nodes or play relationships to actors on the use case diagram; alternately, the OV-4 class diagram can accomplish these relationships as well. Most UML tools recognize the association relationship irrespective of their creation point in the model.

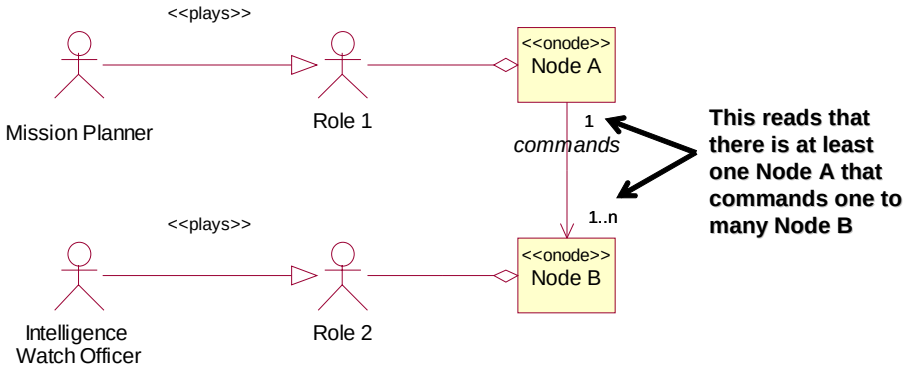


**Figure 4-12: UML OV-4 Sample**

### 4.4.3 Net-Centric Guidance for OV-4

**Augmented Product Purpose**. In a net-centric architecture, the OV-4 depicts the Service Functionality Providers and Service Consumers and provides a description of their associated operational roles in support of net-centric information sharing.

**Net-Centric Detailed Description**. The OV-4 traditionally illustrates the relationships among organizations or resources depicted within an architecture. Accordingly, describing the NCE within an architecture, the OV-4 should define any kinds of relationships necessary to support NCO with respect to populating and using the NCE to achieve the goals of the mission

outlined in the OV-1. In the NCE, the OV-4 identifies the organizations that can be given an operational role of service functionality provider or service consumer on the OV-2.

As programs begin to architect for the NCE, the OV-4 may accommodate organizational relationships that depict the collaborative nature required to execute NCO. The current hierarchical depiction of the OV-4 may be tailored to show how organizations work more jointly to develop capabilities and share information on the GIG.

An OV-4 diagram may be used to depict the organizational relationships of COIs who participate in defining vocabularies, taxonomies, and information exchange agreements in pursuit of shared goals, interests, missions, or business processes. As mentioned in Section 2.5, Net-Centric Guidance for Architecture Products, by identifying the COIs supported by various programs, the architecture may be used to depict information sharing agreements that are used across architectures, and accordingly, enabling more seamless information sharing in the NCE.

The net-centric OV-4 may be used to:

- Represent the structure and governance of users that support data sharing agreements used within the architecture.
- Describe COI structures and highlight how/where organization supports the COI or how the COI's guide/influence the organization in a separate OV-4.
- Depict the COI governance in terms of organizations, programs, and stakeholders who are part of the COI and participate in developing, managing, and adjudicating the COI standards and agreements.

Documenting these relationships in a net-centric relationship will provide an understanding of the relationships among internal and external organizations, classes of users, operational profiles, and operational roles that are key players in the architecture.

### 4.4.4 CADM Support for OV-4

Each OV-4 is represented in CADM v1.5 as an instance of Document with ArchitectureProductCategoryCode = ORGANIZATIONAL-RELATIONSHIP-CHART. The key entities used to specify the architecture data in OV-4 are presented in **Figure** 4-13, a high-level diagram from the CADM showing key entities that are used to store architecture data for OV-4 in a CADM-conformant database.

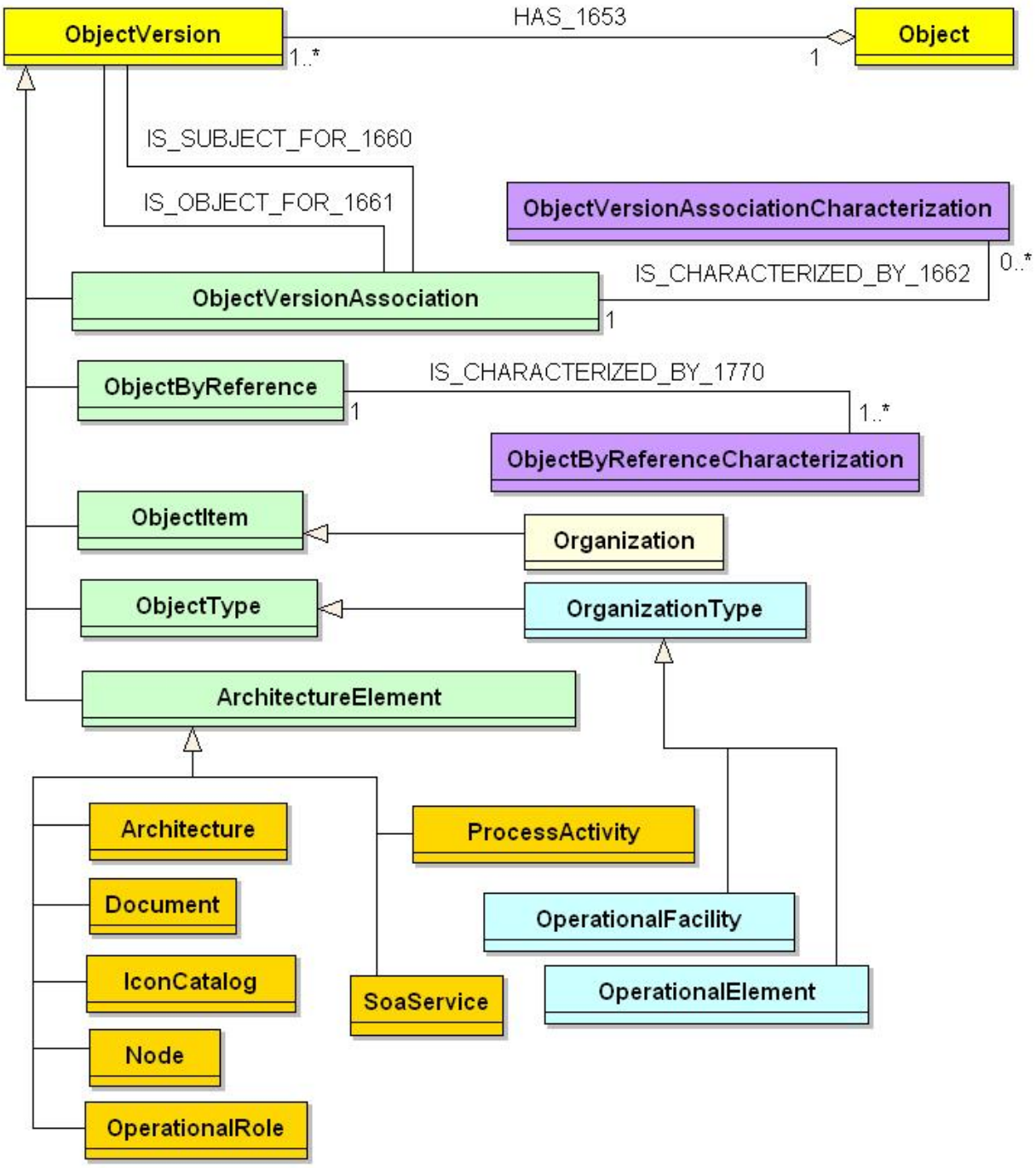


**Figure 4-13: CADM Diagram for OV-4**

In CADM v1.5, the content of an OV-4 is built via Node. An instance of Organization or of OrganizationType can be linked to an instance of Node. Once this is done, hierarchically related pairs of nodes can be expressed via ObjectVersionAssociation and the specific node pairs can be linked to the OV-4 (see Volume III for details). Icons can be specified as instances of IconCatalog and linked to the pertinent instances of either OrganizationType or Organization to enforce, for example, consistent graphical representations of OrganizationType(s) or Organization(s) in an architecture.

#### 4.4.4.1 OV-4 – Data Element Definitions

**OV-4 Information Space**

Architecture†
Document†
Node†
OperationalRole†
Organization†
OrganizationType†
ProcessActivity†
SoaService†
**IconCatalog**
**OperationalElement**
**OperationalFacility**

†) The descriptions of these elements have been provided in the preceding sections

**Table 4-4** describes the architecture data elements for OV-4.

**Table 4-4 Data Element Definitions for OV-4**

| Data Elements | Attributes | Definition |
|---|---|---|
| **IconCatalog** | | |
| | defaultReferenceName | The name of an instance of IconCatalog catalog that is used by the application for internal citations. |
| | iconTypeCode | The code that represents a kind of IconCatalog. |
| | linkArrowstyleTypeCode | The code that represents the kind of arrowhead that will appear on the end(s) of a link type IconCatalog instance. |
| | linkColorIdentification Text | The text that identifies the color to be depicted for a specific link type IconCatalog instance. |
| | linkLinePoint CharacteristicCode | The code that represents the thickness of a link type IconCatalog instance. Default value is "8" (1-point solid line). |
| | linkLinetypeTypeCode | The code that represents the kind of segmentation to be used for a link type IconCatalog instance. Default value is "1." |
| | nodeCategoryCode | The code that represents the kind of IconCatalog that represents a node type IconCatalog instance. |
| | nodeSubcategoryCode | The code that represents a detailed classification of IconCatalog instances that represent a node. |
| **OperationalElement** | | |
| | approvalStatusCode | The code that represents the state of validity for the data for an OperationalElement. |
| | categoryCode | The code that represents a class of OperationalElement. |
| | useTypeCode | The code that represents a kind of OperationalElement by intended employment. |
| **OperationalFacility** | | |
| | alternateIdentifierText | The text that describes the identifier that acts as a substitute for identifying an OperationalFacility. |
| | approvalStatusCode | The code that represents the state of validity for the data for an OperationalFacility. |
| | historicalJustification Text | The text of the rationale for the application of an OperationalFacility. |
| | iterationIdentifierText | The text which describes the identifier that distinguishes the OperationalFacility from any other OperationalFacility with the same echelon and proponent. |
| | justificationText | The text of the rationale for the application of an OperationalFacility. |
| | remarkText | The text representing the comments regarding a specific OperationalFacility. |
| | titleName | The name representing the label to be used for a specific |

| Data Elements | Attributes | Definition |
|---|---|---|
| | | OperationalFacility. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| IconCatalog | is related to | IconCatalog |
| OperationalElement | describes type of | OperationalFacility |

(All previous relationships for the listed entities that comprise the information space of OV-4 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 4.5 OPERATIONAL ACTIVITY MODEL (OV-5)

### 4.5.1 OV-5 – Product Description

**Product Definition**. The OV-5 describes the operations that are normally conducted in the course of achieving a mission or a business capability. It describes capabilities, operational activities (or tasks), input and output (I/O) flows between activities, and I/O flows to/from activities that are outside the scope of the architecture. High-level operational activities should trace to (and are decompositions of) a Business Area, an Internal Line of Business, and/or a Business Sub-Function as published in OMB's Business Reference Model [OMB, 2003].

**Product Purpose**. OV-5 can be used to:

- Clearly delineate lines of responsibility for activities when coupled with OV-2.
- Uncover unnecessary operational activity redundancy.
- Make decisions about streamlining, combining, or omitting activities.
- Define or flag issues, opportunities, or operational activities and their interactions (information flows among the activities) that need to be scrutinized further.
- Provide a necessary foundation for depicting activity sequencing and timing in OV-6a, OV-6b, and OV-6c.
- Identify critical mission threads and operational information exchanges by annotating which activities are critical (i.e., identify the activities in the model that are critical).

**Product Detailed Description**. OV-5 describes capabilities, operational activities (or tasks), I/O flows between activities, and I/O flows to/from activities that are outside the scope of the architecture.

I/Os of operational activities relate to information elements of OV-3 and are further characterized by the information exchange attributes described in OV-3. I/Os that are produced or consumed by leaf operational activities that cross operational node boundaries are carried by needlines of OV-2. Operational activities can be annotated (e.g., via the mechanism arrow in an IDEF0 diagram) with the corresponding operational node from OV-2.

Annotations to the activities may also identify the costs (actual or estimated) associated with performing each activity. The business rules that govern the performance of the activities can also be keyed to each activity. (Business rules are described in OV-6a.) Annotations to OV-5s can further the purposes of the description by adding specific attributes of exchanged information, which can later be used in OV-3.

OV-5 is a key product for describing capabilities and relating capabilities to mission accomplishment. The DoD Dictionary of Military Terms [DoD JP 1-02, 2001] defines a capability as "the ability to execute a specified course of action. (A capability may or may not be accompanied by an intention.)" A capability can be defined by one or more sequences of activities, referred to as operational threads or scenarios. A capability may be further described in terms of the attributes required to accomplish the set of activities (such as the sequence and timing of operational activities or materiel that enable the capability), in order to achieve a given

mission objective. Capability-related attributes may be associated with specific activities or with the information flow between activities, or both. When represented by a set of operational activities, a capability can also be linked to an operational node in an OV-2.

Integrated architectures with Doctrine, Organization, Training, Materiel, Leadership & education, Personnel, and Facilities (DOTMLPF) information provide a structured and organized approach for defining capabilities and understanding the underlying requirements for achieving those capabilities. The full spectrum of DOTMLPF is modeled and related so that analyses and decisions can be supported by describing the sequence and timing of activities; tying them to the operational nodes (representing organizations or human roles); relating them to their supporting systems or system functions; and specifying the actions, events, and related guard conditions or business rules that constrain those activities. Below is a detailed description of how DOTMLPF is tightly weaved into this and related products.

- Doctrine may influence controls or guard conditions in OV-5.
- Organization is represented via the operational nodes of OV-2, which can be shown as mechanisms (or annotations to the activities) in OV-5.
- Training is represented via the operational node that may represent a human role, which, in turn, embodies a certain skill set or knowledge domain required to perform the activities that are, in turn, related to operational activities of OV-5.
- Materiel is tied to the elements in OV-5, where mechanisms may be used to represent systems that support operational activities. Further materiel detail may be related to the activities via SV-5, by relating those activities to the system functions that are executed by systems that automate them (wholly or partially). Each operational thread or scenario (represented by an OV-6c) is associated with a certain capability, since a capability is defined in terms of the activities and their attributes depicted in OV-6c. Consequently, an SV-5 may also be used to relate a capability to the systems that support it, by labeling a set of activities with its associated capability (defined in OV-6c), and by labeling the system functions with the systems that execute them (defined in SV-1, SV-2, and SV-4).
- Leadership may be represented indirectly in OV-5 by first mapping activities to operational nodes via mechanisms and through the relationships of an operational node in OV-2 to organizations, organization types, or leadership human roles in OV-4.
- Personnel may be represented indirectly through the relationships of an operational node in OV-2 to organizations, organization types, or human roles in OV-4.
- Facility is tied to OV-5, because an operational node is directly tied to the systems nodes (facilities) that house the systems, which may be shown as mechanisms that support operational activities.

OV-5 graphic(s) may include a hierarchy chart of the activities covered in the model. A hierarchy chart helps provide an overall picture of the activities involved and a quick reference for navigating the OV-5 I/O flow model.

OV-5 is frequently used in conjunction with a process flow model (such as an IDEF3 model, or a UML sequence diagram) that describes the sequence and other attributes (e.g., timing) of the activities. A process flow model further captures precedence and causality relations between situations and events by providing a structured method for expressing knowledge about how a process or organization works. A process flow model may be annotated with the names of the operational nodes responsible for conducting those activities. A process flow model may be described in OV-6c.

The decomposition levels and the amount of detail shown on OV-5 should be aligned with the operational nodes that are responsible for conducting the operational activities (shown on corresponding OV-2 products). It is important to note the OV-5 is intended to be only as exhaustive as necessary to attain the objectives for the architecture as stated in AV-1. **Figure 4-14** depicts templates for the Operational Activity Hierarchy Chart and one level of a process-flow OV-5.

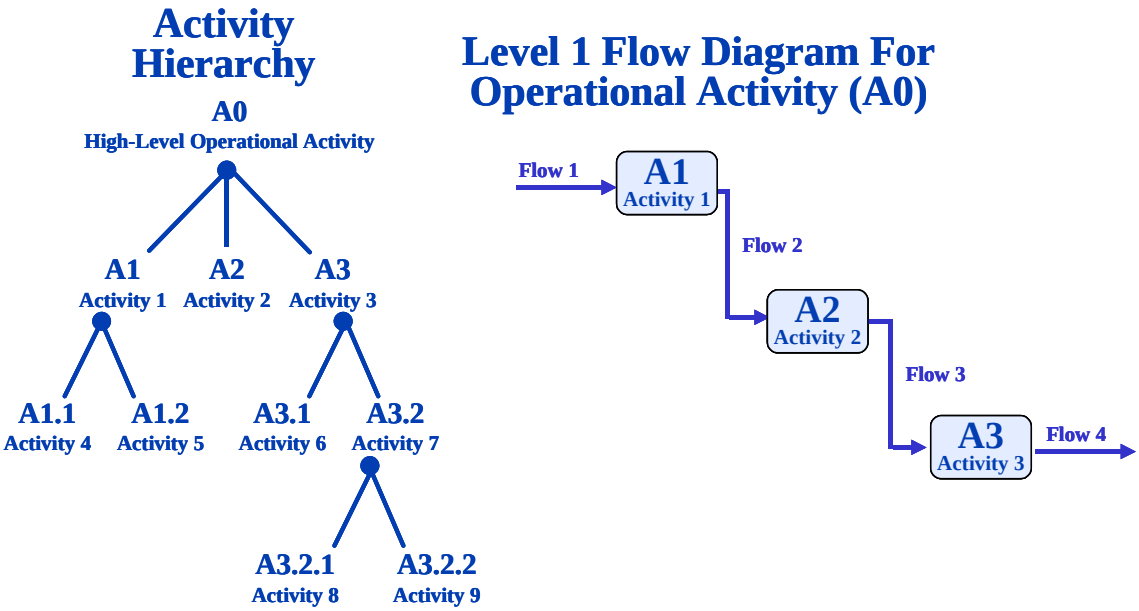


**Figure 4-14: Operational Activity Hierarchy Chart and Operational Activity Diagram (OV-5) – Templates**

**Figure 4-15** is a process-oriented OV-5 template showing how some additional architecture data could be added as annotations to the original template. For example, activities may be annotated with information concerning the operational nodes that conduct them, the materiel that supports them, the cost of conducting the activity, and so forth. (The types of additional architecture data are notional.)

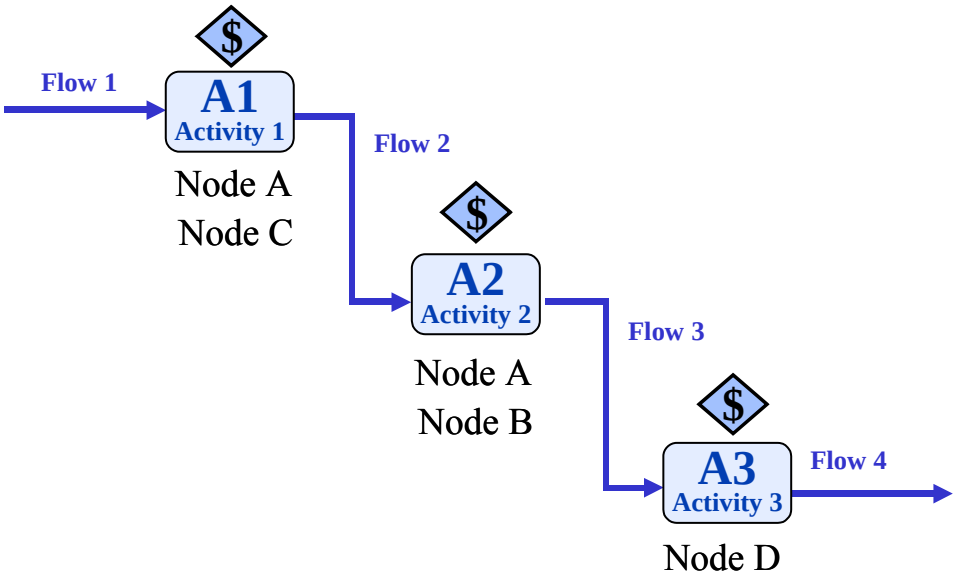


**Figure 4-15: OV-5 – Template with Notional Annotations**

### 4.5.2 UML Representation

The UML version of an OV-5 is much different from the IDEF implementation (**Figure 4-16**). The UML OV-5 presents multiple abstractions, each with more detail. The use case diagram represents OV-5 from a scope perspective. The use case diagram provides a visual means to establish the scope (observable result of value) with the stakeholder and the relevant net-centric interfaces that collaborate with the process. These actor interfaces are potentially operator interfaces or system interfaces – sometimes an actor can represent both depending on the level of abstraction modeled. The activity diagram provides the business rules and flow of control for each instance of the use case. A use case instance is a specific "end-to-end" concrete path through a use case, specific values, and responses; only a single path through one or more possible flows of the use case are given. This concept is important to understand when developing OV-6c, because diagramming instance establishment is important to communicate a specific thread through a use case. Finally, the activities on the activity diagram each have their perspective sequence diagram.

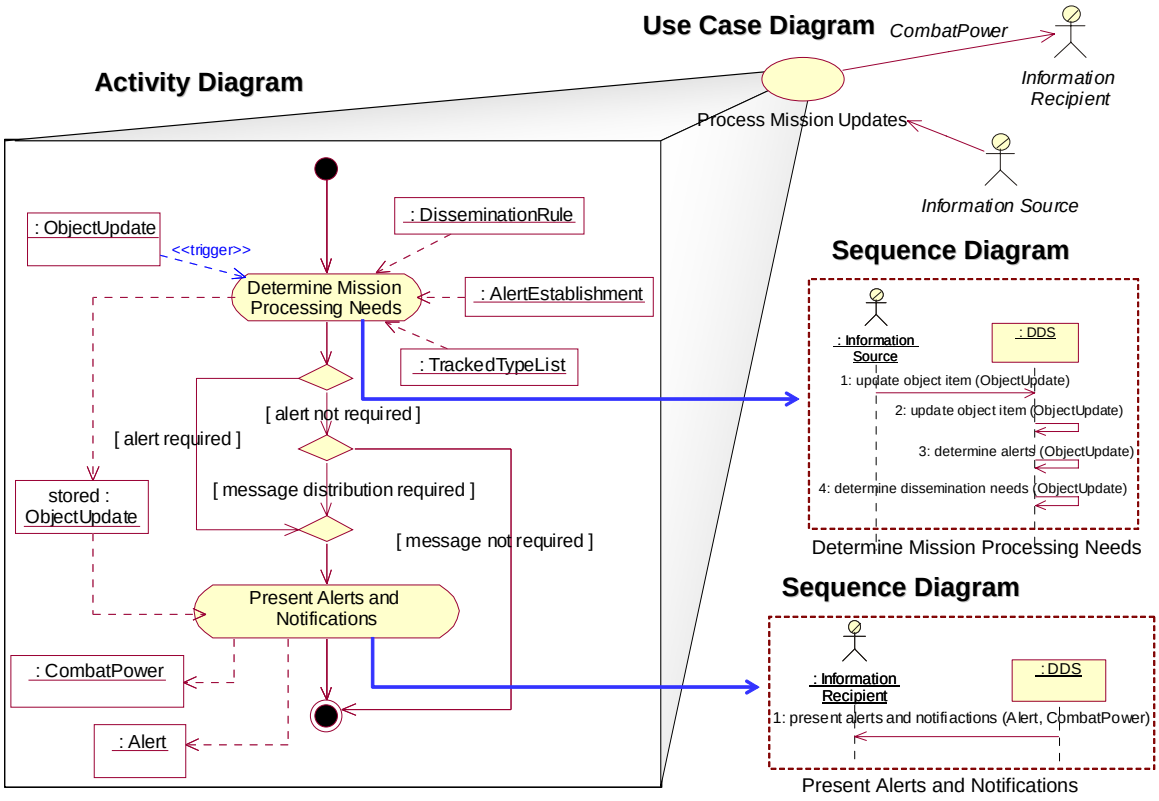


**Figure 4-16: UML Example OV-5**

When modeling UML business use cases (operational view) the architect should render the system as a black box with the overall system name. When this is the modeling approach, the architect should not use swimlanes on activity diagrams. This is an important concept to understand, because the activity is a shared collaboration between the interfaces and the system. Alternately, the DoDAF architect may wish to develop activity models using swimlanes to understand and vet through stakeholders the business process to determine automation opportunities. These "business" activity diagrams are useful in identifying use cases to model system behavior (net-centric service responsibility). Activity diagrams using systems as swimlanes may be useful for system design and implementation. The sequence diagram is the most important view from a net-centric viewpoint, because these diagrams establish service responsibility. Service responsibilities (UML messages on sequence diagrams) identify external and internal interface dependencies of the evolving system. The DoDAF architect places emphasis on the sequence diagram as they provide visibility into patterns of behavior depicted as activities on the activity diagram.

### 4.5.3 Net-Centric Guidance for OV-5

**Augmented Product Purpose**. In the NCE, the OV-5 describes operations, identifies activities, and may capture the inputs and outputs between nodes that enable programs to operate in a net-centric manner.

**Net-Centric Product Description**. The OV-5 traditionally describes capabilities, operational activities (or tasks), and information flows between internal and external activities. Accordingly, in the NCE, the OV-5 should capture the capabilities, activities, and information flows for

posting information and data as soon as possible to encourage discovery and multiple uses as described in the net-centric OV-2. The net-centric OV-5 may highlight multiple inputs and outputs from a particular activity to depict the posting of information in various states of processing (raw, pre-processed, fused, etc). The various states of processing should be readily identified by analyzing key events within the involved processes that change the state of critical information objects.

A central tenet of the NCE is that information and capabilities are obtained from, and contributed to, the netted environment. In operational terms, it is important to identify external sources that may provide information or capabilities within the architecture, so that its mission is more effectively executed. It is also equally as important to make capabilities available to external sources so that they, in turn, may more effectively complete their missions. Accordingly, the net-centric OV-5 places special significance on the I/O flows between activities internal to the architecture and those activities external to the architecture. It highlights both internal activities where information is made available to external activities, and internal activities which result in information being consumed from external activities.

The net-centric OV-5 may be used in the following ways:

- Delineate lines of dependency on external activities when coupled with OV-2.
- Highlight information flows to depict the status of the information's refinement (raw, pre-processed, fused, etc.).
- Provide the critical foundation for depicting Task, Post, Process, and Use (TPPU) activity sequencing and timing in the OV-6a, OV-6b, and OV-6c.
- Identify critical mission threads and operational information exchanges by annotating which activities are critical, i.e., identify the activities in the model that are critical.

The decomposition levels and the amount of detail shown on the OV-5 should be aligned with the operational nodes that are responsible for conducting the operational activities (shown on corresponding OV-2 products). It is important to note that OV-5 is intended to be only as exhaustive as necessary to attain the objectives for the architecture as stated in AV-1.

### 4.5.4 CADM Support for OV-5

Each OV-5 is stored as an instance of Document with its attribute ArchitectureProductCategoryCode = ACTIVITY-MODEL-SPECIFICATION. The structure and content specification of the activity model is stored as an instance of InformationAsset with its attribute TypeCode = ACTIVITY-MODEL.

An OV-5 can, in principle, apply to many architectures. All the Architecture instances to which that instance of Document can be linked, are done via ObjectVersionAssociation.

As depicted in **Figure** 4-17, each activity and subactivity cited in the OV-5 is stored as an instance of ProcessActivity, and its occurrence in the activity model is captured in CADM v1.5 through the corresponding entry in ObjectVersionAssociation. Similarly, the specific hierarchical breakdown of the activities in a given OV-5 is expressed by the appropriate entries in

ObjectVersionAssociation.[27] Note that different activity models can depict *different* hierarchical breakdowns of the same activities; thus, the direct associations among instances of ProcessActivity are *not* used for this purpose. Where applicable, instances of Capability can be linked to the desired instances of ProcessActivity and used to document specific capabilities underlying an operational activity.

The information flows and their component information flows cited in the OV-5 are stored in CADM v1.5 as instances of InformationElement, and their occurrences in the activity model are linked to the OV-5 through ActivityModelInformationElementRole. The decomposition of an InformationElement into its components is specified by relating the instances in ObjectVersionAssociation. (Note that in CADM v1.5, such decompositions are not necessarily dependent on any activity model or operational activity within the OV-5. Therefore, when capturing this type of information for use in more than one OV-5, one should ensure that it is consistent across all of them.)

Each InformationElement may occur in an IDEF0 activity model for a specific activity with four roles: input, control, output, and mechanism. CADM v1.5 specifies this via the entity ActivityModelInformationElementRole. Note that these roles are for the use of the InformationElement in relation to a specific OV-5 and do not depend semantically from the InformationElement itself.[28] The four roles are specified through the attribute CategoryCode in the entity ActivityModelInformationElementRole.

---

[27] In CADM the Node Tree Diagram from IDEF0, which graphically depicts the activity hierarchy in a specific activity model is specified as an instance of Document with its attribute ArchitectureProductTypeCode = NODE-TREE, and its contents specified via associations of Node implemented through ObjectVersionAssociation. By linking each Node in the hierarchical nodal decomposition to a specific instance of ProcessActivity it is possible to capture the content of the Node Tree Diagram.

[28] It is for this reason that the DoD data standard for the entity listing information flows, formerly ICOM, has been changed to be InformationElement. The new name (ActivityModelInformationElementRole) for the entity ACTIVITY-ICOM has also been approved as a change to the DoD data standards.

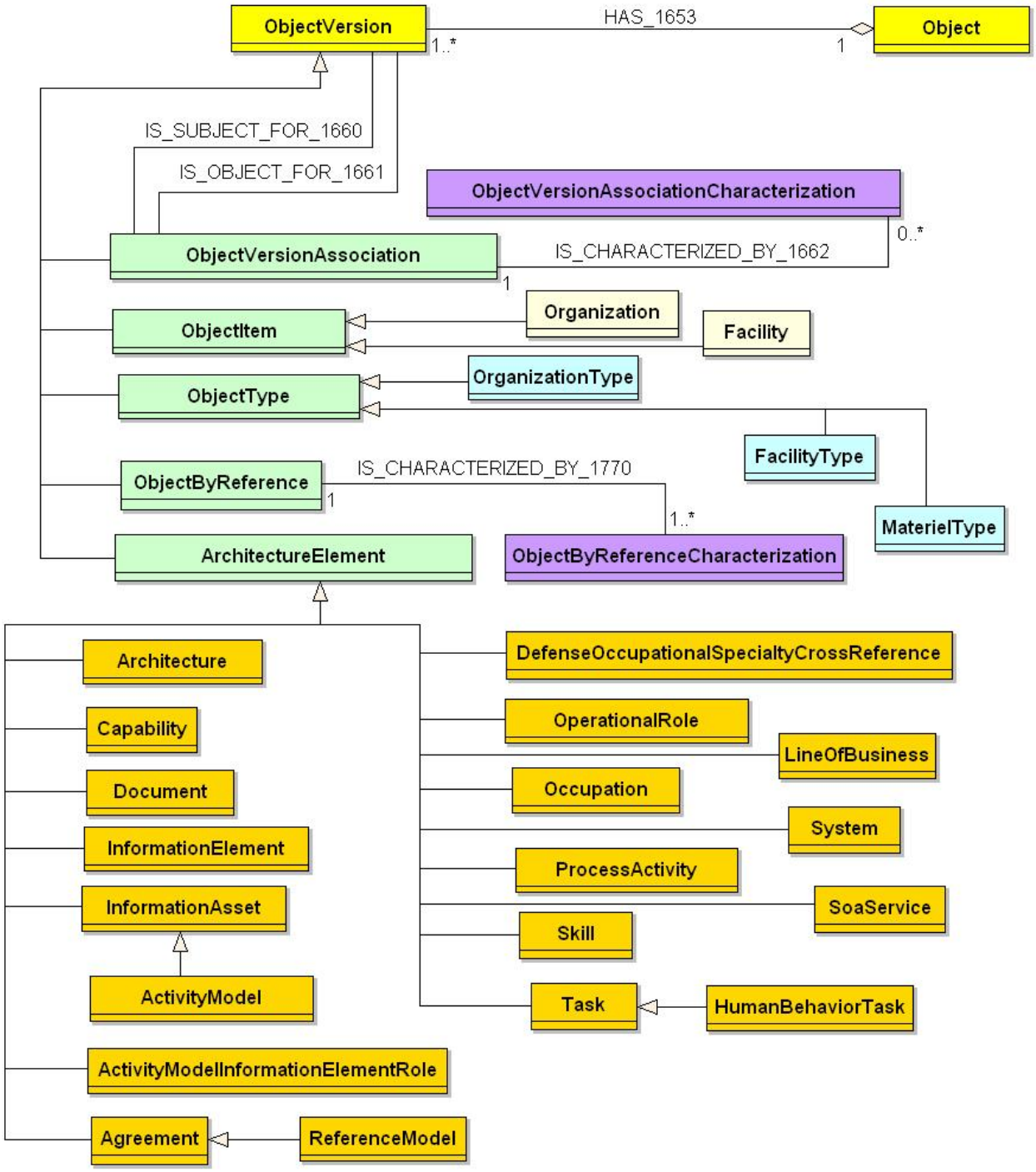


**Figure 4-17: CADM Diagram for OV-5**

Mechanisms can be very important for characterizing how elements of an activity model are, or are to be, supported in carrying out the underlying requirement. In general, mechanisms can include organizations, classes of organizations, systems, classes of materiel, persons with specific skills, and facilities. However, OV-5 focuses on requirements and therefore may intentionally omit references to materiel types, systems, and facilities. The (optional) linkage of those instances that are conceptualized as mechanisms for an OV-5 in CADM can be expressed

by the appropriate entries in ObjectVersionAssociation (see Volume III for details). In CADM v1.5, it is possible to assign instances of the following entities as the mechanisms in an OV-5:

- Organization
- OrganizationType
- OperationalRole
- MaterielType
- System
- Facility
- FacilityType

It is optional to incorporate some or all of the details of an activity model into a CADM-structured database. At a minimum, both InformationElement and ProcessActivity should be populated, so that the information flows and operational activities required for OV-3 and SV-5, respectively, are available for cross reference. Note that in CADM v1.5, system functions are specifically viewed as a subtype of ProcessActivity. This allows the cross reference of instances of system functions to other instances of ProcessActivity (i.e., operational activities or other system functions) through ObjectVersionAssociation. Note also that depending on the level of granularity specified, system functions may map to single SOA services.

A key element of operational requirement traceability is the relation of instances of ProcessActivity to Task instances such as those included in (a) UJTL [CJCSM 3500.04C, 2002], (b) the UJTL extensions for tactical tasks, and (c) the mission essential tasks. In CADM v1.5, this traceability is supported by establishing the appropriate links between ProcessActivity(s) and Task(s) through ObjectVersionAssociation. The same approach is used in CADM v1.5 to relate Document(s) cited for details of an OV-5 (or other subtypes of InformationAsset) to instances of InformationAsset.

#### 4.5.4.1 OV-5 – Data Element Definitions

**OV-5 Information Space**

| | |
|---|---|
| **Agreement**† | **Skill**† |
| **Architecture**† | **SoaService**† |
| **Capability**† | **System**† |
| **DefenseOccupationalSpecialtyCrossReference**† | **Task**† |
| **Document**† | **ActivityModel** |
| **InformationAsset**† | **ActivityModelInformationElementRole** |
| **InformationElement**† | **Facility** |
| **Occupation**† | **FacilityType** |
| **OperationalRole**† | **HumanBehaviorTask** |
| **Organization**† | **LineOfBusiness** |
| **OrganizationType**† | **MaterielType** |
| **ProcessActivity**† | **ReferenceModel** |

†) The descriptions of these elements have been provided in the preceding sections

**Table 4-5** describes the architecture data elements for OV-5.

**Table 4-5: Data Element Definitions for OV-5[29]**

| Data Elements | Attributes | Definition |
|---|---|---|
| **ActivityModel*** | | |
| | authorName* | The name of the architect of an ActivityModel. |
| | calendarDate | The calendar date of an ActivityModel. |
| | developmentStatusText | The text describing an ActivityModel development state. |
| | organizationContextText | The text describing the relationship of an organization with an ActivityModel. |
| | scopeText* | The text that describes the extent of an ActivityModel. |
| | tenseCode | The code that represents the time distinction of an ActivityModel. |
| | typeCode | The code that represents a kind of ActivityModel. |
| | validationStatusCode* | The code that represents the state of sanctioning of an ActivityModel. |
| | viewpointText | The text that describes the point of view of an ActivityModel. |
| **ActivityModel InformationElement Role*** | | |
| | actualOccurrenceQuantity | The existent quantity of an ActivityModelInformationElementRole. |
| | alternateIdentifierText* | The text that alternatively identifies a specific ActivityModelInformationElementRole. |
| | categoryCode | The code that represents a kind of ActivityModelInformationElementRole. |
| | subcategoryCode | The code that represents the detailed class of a specific ActivityModelInformationElementRole. |
| | externalCode* | The code that represents whether a specific ActivityModelInformationElementRole represents an external information flow. |
| | mechanismMeansCode | The code that represents the specific technique of employment for an ActivityModelInformationElementRole. |
| | modificationCalendarDate | The calendar date on which a specific ActivityModelInformationElementRole was last changed. |
| | outputPerformance MeasureIdentifierText | The text that identifies the information-producing performance measure of an ActivityModelInformationElementRole. |
| | outputPerformance MeasureValueIdentifier Text | The text that identifies the quantity of a product produced by a specific ActivityModelInformationElementRole. |
| | unitCostAmount | The amount of a single unit cost of an ActivityModelInformationElementRole. |
| **Facility** | | |
| | alternateIdentification SourceName | The name of the source of the surrogate identifier of a Facility. |
| | alternateIdentifierText | The text that identifies the surrogate identifier for a Facility. |
| | availableElectricalPower Quantity | The quantity that represents the maximum rating of the power panel for the Facility. |
| | constructionBegin | The calendar date the building of a Facility commences. |

[29] As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

| Data Elements | Attributes | Definition |
|---|---|---|
| | CalendarDate | |
| | constructionEnd CalendarDate | The calendar date the building of a Facility ceases. |
| | constructionPermanency CategoryCode | The code that represents a class of expected lifetime of a specific Facility. |
| | electricalServiceCapacity Rate | The rate of the maximum amount of electrical service to a Facility. |
| | elevationAboveSeaLevel Dimension | The dimension elevation from the ground floor of the Facility to mean sea level. |
| | floorQuantity | The quantity of floors in a Facility. |
| | grossArea | The area of the available surface for a specific Facility. |
| | identificationLabelText | The text that identifies the number of a specific Facility. |
| | lengthDimension | The dimension length of a Facility. |
| | peakUsageElectrical PowerQuantity | The quantity that represents the electrical power demanded when all the electrical items are operating in a specific Facility. |
| | telecommunicationDrop Quantity | The quantity that represents the estimated number of user telecommunication access point within a specific Facility. |
| | totalFloorSpaceArea | The total area of floor space in the Facility. |
| | useCategoryCode | The code that represents a kind of Facility. |
| | useSubcategoryCode | The code that represents a kind of Facility. |
| | widthDimension | The dimension width of a Facility. |
| **FacilityType** | | |
| | classCode | The code that represents a class of FacilityType. |
| | useCode | The code that represents a specific type of employment of a FacilityType. |
| **HumanBehaviorTask** | | |
| | activityClassCode | The code that represents the type of action represented by a specific HumanBehaviorTask. |
| | definitionText | The text that states the meaning for a specific HumanBehaviorTask. |
| | hierarchyIdentifierText | The text that identifies the relation of a specific HumanBehaviorTask to other instances of HumanBehaviorTask. |
| | processCode | The code that represents the type of human sensing used for a HumanBehaviorTask. |
| **LineOfBusiness** | | |
| | businessAreaCode | The code that represents a specific kind of services for a specific LineOfBusiness. |
| | typeCode | The code that represents the kind of a specific LineOfBusiness. |
| **MaterielType** | | |
| | alternateIdentifierText | The text that describes the identifier alternatively used to identify a specific MaterielType. |
| | alternateIdentifierSource Name | The name of the originator of the MaterielType alternate identifier. |
| | alternateName | The name alternatively used to designate a specific MaterielType. |
| | approvalStatusCode | The code that represents the state of validity for the data for a MaterielType. |
| | controlNumberType Code | The code that represents a MaterielType control number. |
| | essentialityCode | The code that represents the degree to which the failure of |

| Data Elements | Attributes | Definition |
|---|---|---|
| | | a part affects the ability of the end item MaterielType to perform its intended operation. |
| | estimatedLowestCost Amount | The amount representing the smallest projected price of a specific MaterielType. |
| | federalSupplySchedule IdentifierText | The text that identifies the specific general service agency schedule on which the MaterielType appears. |
| | lineItemNumberIdentifier Text | The text that identifies the alphanumeric string for a specific MaterielType use, as denoted by the line item number (LIN). |
| | nomenclatureName | The name providing the complete entry for the DoD standard military naming system for a specific MaterielType. |
| | productionLeadtime DaysQuantity | The quantity of days that the manufacturer needs to manufacture and deliver a MaterielType. |
| | referenceNumber IdentifierText | The text that identifies the alpha numeric string that relates the MaterielType to the manufacturer's stock identity. |
| | remarkText | The text that provides supplementary information about a MaterielType. |
| | requirementCode | The code that represents whether a specific MaterielType should be referenced in an InformationExchangeRequirement. |
| | softwareCode | The code that represents whether the MaterielType has software characteristics. |
| | stockNumberIdentifier Text | The text that identifies the specific general service agency schedule catalog identifier for which the MaterielType appears. |
| | typeCode | The code that represents a specific kind of MaterielType. |
| **ReferenceModel** | | |
| | levelCode | The code that represents federal enterprise architecture business level of a specific ReferenceModel. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| Document | references | MaterielType |
| Facility | is related to | Facility |
| Facility | relates to | Organization |
| FacilityType | is a type of | Facility |
| InformationElement | is associated with | ActivityModelInformationElementRole |
| LineOfBusiness | applies to | Task |
| MaterielType | is cited for | Architecture |
| MaterielType | represents | System |
| ReferenceModel | defines | LineOfBusiness |
| Task | makes use of | MaterielType |

(All previous relationships for the listed entities that comprise the information space of OV-5 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 4.6 OPERATIONAL RULES MODEL, STATE TRANSITION DESCRIPTION, AND EVENT-TRACE DESCRIPTION (OV-6A, 6B, AND 6C)

### 4.6.1 Overview of OV-6a, OV-6b, OV-6c

OV products discussed in previous sections model the static structure of the architecture elements and their relationships. Many of the critical characteristics of an architecture are only discovered when the dynamic behavior of these elements is modeled to incorporate sequencing and timing aspects of the architecture.

The dynamic behavior referred to here concerns the timing and sequencing of events that capture operational behavior of a business process or mission thread. Thus, this behavior is related to the activities of OV-5. Behavior modeling and documentation is essential to a successful architecture description, because it is how the architecture behaves that is crucial in many situations. Knowledge of the operational nodes, activities, and information exchanges is crucial, but knowing when, for example, a response should be expected after sending message X to node Y can also be crucial to achieving successful operations.

Several modeling techniques may be used to refine and extend the architecture's OV to adequately describe the dynamic behavior and timing performance characteristics of an architecture, such as LDL [Naqvi, 1989], Harel Statecharts [Harel, 1987 a, b], petri-nets [Kristensen, 1998], IDEF3 diagrams [IDEF3, 1995], and UML statechart and sequence diagrams [OMG, 2001]. OV-6 includes three such models. They are:

- Operational Rules Model (OV-6a)
- Operational State Transition Description (OV-6b)
- Operational Event-Trace Description (OV-6c)

OV-6 products portray some of the same architecture data elements, but each also portrays some unique architecture data elements. OV-6b and OV-6c may be used separately or together, as necessary, to describe critical timing and sequencing behavior in the OV. Both types of products are used by a wide variety of different business process methodologies as well as Object-Oriented methodologies. OV-6b and OV-6c describe operational activity or business-process responses to sequences of events. Events may also be referred to as inputs, transactions, or triggers. Events can be internally or externally generated and can include such things as the receipt of a message, a timer going off, or conditional tests being satisfied. When an event occurs, the action to be taken may be subject to a rule or set of rules (conditions) as described in OV-6a.

### 4.6.2 CADM Support for OV-6

**Figure** 4-18 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for sequences and threads, which underlie OV-6a, OV-6b, and OV-6c. The CADM uses the entity Action and the associations of instances of Action to Action to support all the temporal and functional relationships among pairs of (operational and other) Action instances, as shown in Figure 4-18. Temporal attributes permit arbitrary sequencing of Action instances, as well as specifying timing offsets needed for planning concepts (e.g., a fire plan) such as relative timing from an H-Hour or a D-Day.

Threads of activities for sequences of IERs, threads for sequences of process activities, and threads for sequences of process activities embedded in a single activity model can also be

expressed using CADM v1.5 structures. These and related entities are also shown in Figure 4-18. Capability can be linked to instances of ProcessActivity, and of InformationTechnologyRequirement to express specific capabilities for threads of IERs and sequences of operational activities.

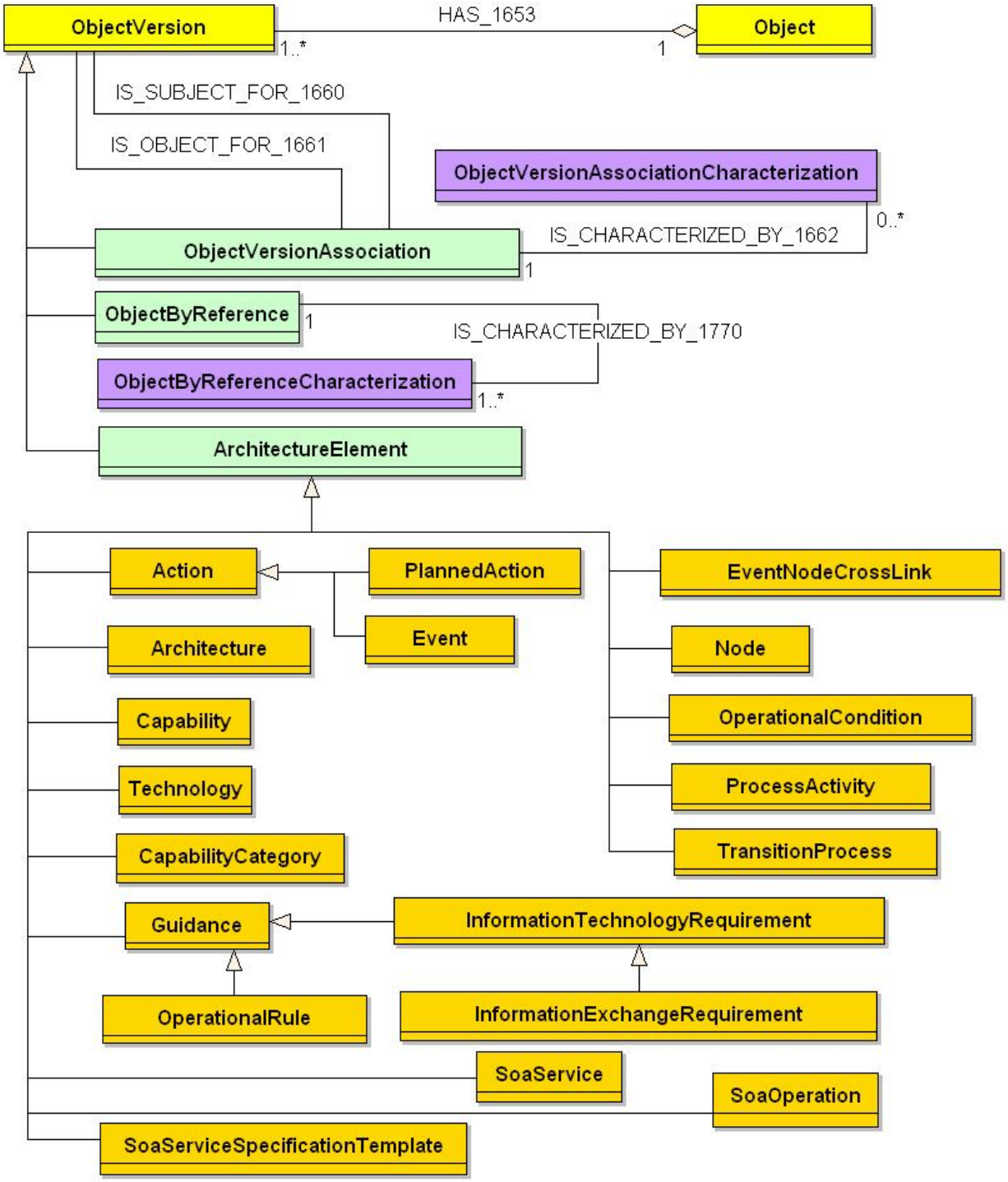


**Figure 4-18: CADM Diagram for OV-6**

### 4.6.3 Operational Rules Model (OV-6a)

**Product Definition**. The OV-6a specifies operational or business rules that are constraints on an enterprise, a mission, operation, business, or an architecture. While other OV products (e.g., OV-1, OV-2, and OV-5) describe the structure of a business—what the business can do—for the most part, they do not describe what the business *must* do, or what it *cannot* do.

At the mission level, OV-6a may consist of doctrine, guidance, rules of engagement, and so forth. At the operation level, rules may include such things as a military Operational Plan (OPLAN). At lower levels, OV-6a describes the rules under which the architecture or its nodes behave under specified conditions. Such rules can be expressed in a textual form, for example, "If (these conditions) exist, and (this event) occurs, then (perform these actions)."

**Product Purpose**. At a top level, rules should at least embody the concepts of operations defined in OV-1, and should provide guidelines for the development and definition of more detailed rules and behavioral definitions that will occur later in the architecture definition process.

**Product Detailed Description**. *Rules are statements that define or constrain some aspect of the mission, or the architecture.* It is intended to assert operational structure or to control or influence the mission thread. As the product name implies, the rules captured in OV-6a are operational (i.e., mission-oriented), not systems-oriented. These rules can include such guidance as the conditions under which operational control passes from one entity to another, or the conditions under which a human role is authorized to proceed with a specific activity.

OV-6a can be associated with the appropriate activities in OV-5. For example, a rule might prescribe the specific set of inputs required to produce a given output. OV-6a can also be used to extend the capture of business requirements by constraining the structure and validity of OV-7 elements.

Detailed rules can become quite complex, and the structuring of the rules themselves can often be challenging. OV-6a extends the representation of business requirements and concept of operations by capturing, in the form of operational rules expressed in a formal language, both action assertions and derivations. Examples of formal languages include structured English, LDL [Naqvi, 1989], and the Object Constraint Language (OCL) [Warmer, 1999]. Action assertions are constraints on the results that actions produce, such as if-then and integrity constraints. Derivations are algorithmically derived facts based on other terms, facts, derivations, and/or action assertions.

Operational rules can be grouped into the following categories:

- Structural Assertions: These rules concern mission or business domain terms and facts that are usually captured by the entities and relationships of Entity-Relationship models. They reflect static aspects of business rules that may also be captured in the OV-7.
    - Terms: Entities
    - Facts: Association between two or more terms (i.e., relationship)

- Action Assertions: These rules concern some dynamic aspects of the business and specify constraints on the results that actions produce. There are three types of action assertions:
    - Condition: This is a guard or if portion of an if-then statement. If the condition is true, it may signal the need to enforce or test additional action assertions.
    - Integrity Constraint: These must always be true (e.g., a declarative statement).
    - Authorization: This restricts certain actions to certain human roles or users.
- Derivations: These rules concern algorithms used to compute a derivable fact from other terms, facts, derivations, or action assertions.

OV-6a can concentrate on the more dynamic Action Assertions and Derivations rules, because the Structural Assertion rules are usually captured in OV-7. Operational rules are:

- Independent of the modeling paradigm used
- Declarative (non-procedural)
- Atomic (indivisible yet inclusive)
- Expressed in a formal language such as:
    - Decision trees and tables
    - Structured English
    - Mathematical logic
- Distinct, independent constructs
- Mission/business-oriented

Each architecture may select the formal language in which to record its OV-6a. The formal language selected should be referenced and well documented.

**Figure 4-19** illustrates an example Action Assertion that might be part of OV-6a. The example is given in a form of structured English.

A base fact could be:
"Battle Damage Assessment consists of three activities: Conduct Battle Damage, Conduct Munitions Effects Assessment, and Recommend Restrike"

Derived facts could be:
"Recommend Restrike activity cannot be completed before a Battle Damage Assessment Report has been completed."
"Recommend Restrike activity cannot be completed before a Munitions Effects Assessment Report has been completed."

A derivation used to derive this derived fact above would be:
A Restrike Recommendation is based on facts contained in Battle Damage Assessment Reports, and Munitions Effects Assessment Reports

**Figure 4-19: OV-6a – Action Assertion Example**

### 4.6.4 UML Representation

There is no equivalent diagram in UML. OV-6a is a text-oriented product. It comprises business rules that apply to operational activities and entities of the Logical Model written in structured English. OV-6a extends the capture of business requirements and concept of operations for the use cases and activities of OV-5. If one considers Operational Rules to be equivalent to complex, nested If-Then-Else and CASE statements, then these statements can be unambiguously derived from UML statechart diagrams. Guard conditions can be specified for state transitions. Consequently, OV-6a may be generated via the use of adornments, and the inclusion of pre- and post-conditions on the use cases of OV-5 (or guard conditions in statechart diagrams). Operational Rules should trace to the constraint relationships identified in OV-5 and to the statechart diagrams for the relevant object classes, if they have been defined. There is no UML diagram to be produced, but the AV-2 will contain these rules and constraints, if they are incorporated into the model as pre- and post-conditions or other adornments in the UML diagrams, where applicable.

### 4.6.5 Net-Centric Guidance for OV-6a

**Augmented Product Purpose.** In the NCE, the OV-6a is used to capture constraints and operational policies that affect program-level architectures operating in a net-centric enterprise.

**Net-Centric Product Description.** The OV-6a traditionally captures business rules and provides guidelines for the development and definition of more detailed rules and behavioral definitions that will occur later in the architecture definition process or that provide amplifying information for those rules and behavioral definitions. Accordingly, in the NCE, the OV-6a should capture the rules and policies that apply to providing and consuming information (OV-2, OV-3, OV-5, and/or OV-7) and capabilities in the NCE (including how policies in OV-6a constrain services and/or service operations in SV-4). Included may be rules and policies for:

- Tagging, posting, and processing information to the NCE (SV-6 and 11)
- Selecting, monitoring, and managing the interactions between consumers and providers (OV-6b and/or 6c)
- Maintaining any shared infrastructure between providers and consumers (SV-2)
- Ensuring that only authorized consumers have access to the provided information (OV-3) and capabilities (OV-2, OV-5, and SV-5)

At a highest level, rules should embody the concepts of operations defined in OV-1. In the NCE, the providers and consumers must communicate and interact with each other as information is passed and capabilities are used, therefore, additional constraints may apply to the management of the information and capabilities exchanged between them. Rules may include the following:

- Requirements and specifications on the acceptable boundaries for reliability, visibility, accessibility, availability, and performance of information and capabilities (SV-7)
- Rules for identifying, prioritizing, selecting, enabling, and disabling different external sources of information and capabilities (OV-2, OV-3, and OV-7 and/or SV-6 and 11)

- Rules for identifying, prioritizing, selecting, enabling, and disabling different external consumers' information and capabilities (OV-3)
- Guidance for dealing with problems and failures if information and capabilities cannot be provided or consumed

In the NCE, the infrastructure required for providing and consuming information and capabilities may be shared between providers and consumers. Rules and policies should be defined for allocating, provisioning, managing, and maintaining the required infrastructure. The net-centric OV-6a may facilitate the following efforts:

- Prioritization and allocation of resources and infrastructure
- Coordination of anticipated maintenance, upgrades, evolution paths, and their implementation schedules (SV-8, TV-2)

It is important to identify ***information assurance*** constraints (OV-3, SV-6, TV-1 and 2) and policies in the NCE in order that information and capabilities are able to be delivered to authorized users based on ***access controls, authorization, and authentication.***

The OV-6a may capture additional IA rules for programs operating in the NCE. Authoritative policies that guard or enable access to net-centric services and capabilities may also be captured in the OV-6a.

### 4.6.6 CADM Support for OV-6a

**Figure** 4-20 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for OV-6a in a CADM-conformant database. Each OV-6a is represented as an instance of Document with its attribute ArchitectureProductTypeCode = RULE-MODEL. This allows the expression of Name, Timeframe, and so on for that architecture product.

The CADM specification for OV-6a also allows the user to describe structural assertions, action assertions with their respective conditions, as well as the applicable integrity constraints, authorizations, and derivations via the instantiation of OperationalRule (a subtype of Guidance) and the use of its attribute LogicalConditionText. Individual rules can be expressed explicitly, where appropriate, as relationships via the entities ConceptualDataModel, or ActivityModel. Where the rules pertain to procedural applications of technologies, they can also be stated in formal or informal terms, as appropriate, as instances of TechnicalGuideline. Where the rules pertain to needs or demands for the acquisition, storage, manipulation, management, movement, control, switching, interchange, transmission, or reception of data, they can be expressed via the entity InformationTechnologyRequirement, and other instances of Guidance. In CADM v1.5, the attribute TypeCode in OperationalRule can be set to either ACTION-ASSERTION-RULE, STRUCTURAL-ASSERTION-RULE, or DATABASE-RULE to refine the semantics of the rules in question. These rules can be related to each other and to various architecture products through ObjectVersionAssociation. This enables, for example, the linkage of a specific OV-6a to instances of OperationalRole.

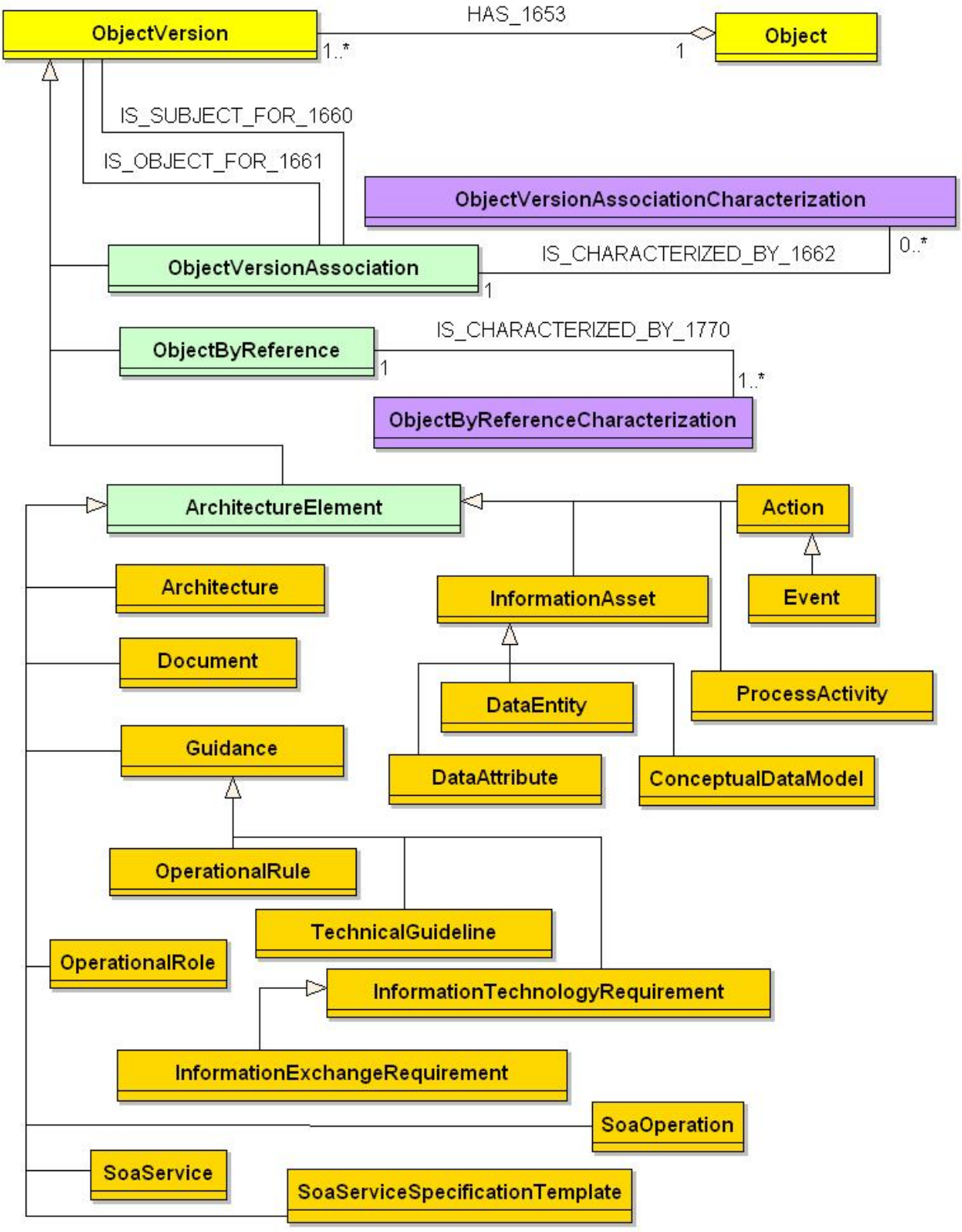


**Figure 4-20: CADM Diagram for OV-6a**

#### 4.6.6.1 OV6a – Data Element Definitions

AV-2 should capture information about the rules specified in OV-6a. For example, the dictionary should have information on the type of rule (i.e., Structural Assertion, Action Assertion, or Derivation), the text for the rule, and the relationship between the rules and other architecture product data elements, such as activities from OV-5 or entities from OV-7. **Table 4-6** describes the architecture data elements for OV-6a.

**OV-6a Information Space**

Action†
Architecture†
Document†
Guidance†
InformationAsset†
InformationExchangeRequirement†
InformationTechnologyRequirement†
OperationalRole†
ProcessActivity†
SoaOperation†
SoaService†
SoaServiceSpecificationTemplate†
**ConceptualDataModel**
**DataAttribute**
**DataEntity**
**Event**
**OperationalRule**
**TechnicalGuideline**

†) The descriptions of these elements have been provided in the preceding sections

**Table 4-6: Data Element Definitions for OV-6a**

| Data Elements | Attributes | Definition |
|---|---|---|
| **ConceptualDataModel** | | |
| | creatorIdentifierText | The text that identifies the agent responsible for creating a specific ConceptualDataModel. |
| | Development MethodologyName | The name of the procedure used to develop a ConceptualDataModel. |
| | developmentStatus IdentifierText | The text that identifies the state of development of a ConceptualDataModel. |
| | developmentToolName | The name of the mechanism used to develop a ConceptualDataModel. |
| | notationStyleName | The name of the memorandum manner used in a ConceptualDataModel. |
| | purposeText | The text of the intention of a ConceptualDataModel. |
| | refinementLevelCode | The code that represents the level of refinement of a ConceptualDataModel. |
| | revisionEffective CalendarDate | The effective date of an amendment to a ConceptualDataModel. |
| | scopeText | The text of the boundaries of a ConceptualDataModel. |
| | statusEffectiveCalendar Date | The effective date of the state of a ConceptualDataModel. |
| | tenseCode | The code that represents the time distinction of a ConceptualDataModel. |
| | tenseEffectiveCalendar Date | The effective date of the time distinction of a ConceptualDataModel. |
| **DataAttribute** | | |
| | characteristicName | The name of a property of a DataAttribute. |
| | referenceSource IdentifierText | The text that identifies the basis for creation of a DataAttribute. |
| | revisionCalendarDate | The amendment date of a DataAttribute. |
| | statusCategoryCode | The code that represents the classification of a DataAttribute. |

| Data Elements | Attributes | Definition |
|---|---|---|
| | timelinessCode | The code that represents the frequency update of a DataAttribute. |
| | validationProcedureText | The text that describes the verification methodology of a DataAttribute. |
| | xmlLongTagName | The name of the marker defined for use in xml associated with a specific DataAttribute. |
| | xmlShortTagName | The shortened form of the name of the marker defined for use in xml associated with a specific DataAttribute. |
| **DataEntity** | | |
| | dependencyCode | The code that represents whether a specific DataEntity depends on any other DataEntity for its primary key. |
| | revisionCalendarDate | The amendment date of a DataEntity. |
| | scopeText | The text of the extent of a DataEntity. |
| | statusCategoryCode | The code that represents a classification of a DataEntity. |
| | xmlLongTagName | The name of the marker defined for use in xml associated with a specific DataEntity. |
| | xmlRecordDelimiter LongTagName | The name of the marker defined for use in xml to identify the beginning and end of a record associated with a specific DataEntity. |
| | xmlRecordDelimiter ShortTagName | The name in abbreviated form of the marker defined for use in xml to identify the beginning and end of a record associated with a specific DataEntity. |
| | xmlShortTagName | The shortened form of the name of the marker defined for use in xml associated with a specific DataEntity. |
| **Event** | | |
| | beginCalendarDateTime | The calendar date-time on which an Event starts. |
| | endCalendarDateTime | The calendar date-time on which an Event concludes. |
| | observationTypeCode | The code that represents the kind of observation associated with a specific Event. |
| | typeCode | The code that represents a kind of Event. |
| | categoryCode | The code that represents a class of Event. |
| **OperationalRule** | | |
| | databaseCategoryCode | The code that represents a class of data-cascading requirement for a specific OperationalRule. |
| | categoryCode | The code that represents a class of OperationalRule. |
| | formalLanguageName | The name of the semantics use to express a specific OperationalRule. |
| | formalLanguageSource Name | The name of the authoritative specification for the semantics used in a specific OperationalRule. |
| | logicalConditionText | The text that defines a clause upon which the truth of an OperationalRule depends. |
| **TechnicalGuideline** | | |
| | categoryCode | The code that represents a class of TechnicalGuideline. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| Action | may produce | Event |
| ConceptualDataModel | cites | DiscoveryMetadata |
| DataAttribute | is related to | DataAttribute |
| DataAttribute | is included in | DataEntity |
| DataEntity | is described by | DataAttribute |
| DataEntity | is used in the design of | DataAttribute |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| DataEntity | is related to | DataEntity |
| Event | is related to | Event |
| Event | is cited in | Document |
| Event | may be the trigger for | InformationExchangeRequirement |
| OperationalRule | limits | Action |
| SoaService | has | SoaOperation |

(All previous relationships for the listed entities that comprise the information space of OV-6a should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

### 4.6.7 Operational State Transition Description (OV-6b)

**Product Definition**. The OV-6b is a graphical method of describing how an operational node or activity responds to various events by changing its state. The diagram represents the sets of events to which the architecture will respond (by taking an action to move to a new state) as a function of its current state. Each transition specifies an event and an action.

**Product Purpose**. The explicit sequencing of activities in response to external and internal events is not fully expressed in OV-5. An OV-6b can be used to describe the explicit sequencing of the operational activities. Alternatively, OV-6b can be used to reflect the explicit sequencing of actions internal to a single operational activity or the sequencing of operational activities with respect to a specific operational node.

**Product Detailed Description**. OV-6b is based on the statechart diagram. A state machine is defined as "a specification that describes all possible behaviors of some dynamic model element. Behavior is modeled as a traversal of a graph of state nodes interconnected by one or more joined transition arcs that are triggered by the dispatching of a series of event instances. During this traversal, the state machine executes a series of actions associated with various elements of the state machine." [OMG, 2003]

The product relates states, events, and actions. A state and its associated action(s) specify the response of an operational activity to events. When an event occurs, the next state may vary depending on the current state (and its associated action), the event, and the rule set or guard conditions. A change of state is called a transition. Each transition specifies the response based on a specific event and the current state. Actions may be associated with a given state or with the transition between states.

Statechart diagrams can be unambiguously converted to structured textual rules that specify timing aspects of operational events and the responses to these events, with no loss of meaning. However, the graphical form of the state diagrams can often allow quick analysis of the completeness of the rule set, and the detection of dead ends or missing conditions. These errors, if not detected early during the operational analysis phase, can often lead to serious behavioral errors in fielded systems or to expensive correction efforts.

**Figure 4-21** provides a template for a simple OV-6b. The black dot and incoming arrow point to initial states (usually one per diagram), while terminal states are identified by an outgoing arrow pointing to a black dot with a circle around it. States are indicated by rounded corner box icons and labeled by name or number and, optionally, any actions associated with that state. Transitions between states are indicated by one-way arrows labeled with an event/action

notation that indicates an event-action pair, and which semantically translates to: when an event occurs, the corresponding action is executed. This notation identifies the event that causes the transition and the ensuing action (if any) associated with the transition.

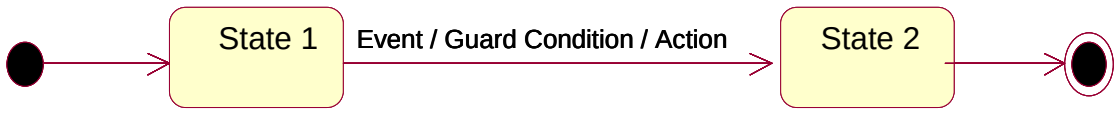


**Figure 4-21: OV-6b – High-Level Template**

Another dynamic behavior modeling technique is Colored PetriNet (CPN) [Kristensen, 1998]. A CPN can be used as an executable operational architectural model or a business workflow model. CPN executable models provide a description of the activity event sequencing (concurrent or consecutive) and can be used to dynamically simulate an OV-5. With a CPN simulation engine or a discrete event workflow simulation engine, parallel event processing and decision support can be achieved.

The most important reason for using both modeling and simulation tools is to show complex, dynamic organizational interactions that cannot be identified or properly understood using static models. Simulation provides insight into how processes in an enterprise add to the overall cost of a mission thread or scenario and can make it possible to animate, analyze, and validate these complex relationships. This information can then be used to create new alternatives or it can be used to compare multiple alternatives until an optimal solution is found. Most importantly, simulation takes information that traditionally was collected in static reports, and makes this information dynamic.

Dynamic analysis is able to assess time-dependent process behavior and shared time-dependent resources, discover ways to efficiently allocate human and system resources to perform those processes, check overall performance, identify bottlenecks and human resource overloads caused by insufficient resources or faulty information flows, and discover and eliminate duplication of effort. Measures of Effectiveness (MOE) relative to mission objectives being evaluated and Measures of Operational Outcomes (MOO) relative to how operational requirements contribute to end results can be determined.

In addition to examining behavior over time, one can also assess an overall dynamic mission cost over time in terms of human and system/network resource dollar costs and their processes dollar costs. Analysis of dollar costs in executable architectures is a first step in an architecture-based investment strategy, where we eventually need to align architectures to funding decisions to ensure that investment decisions are directly linked to mission objectives and their outcomes. **Figure 4-22** illustrates the anatomy of one such dynamic model.

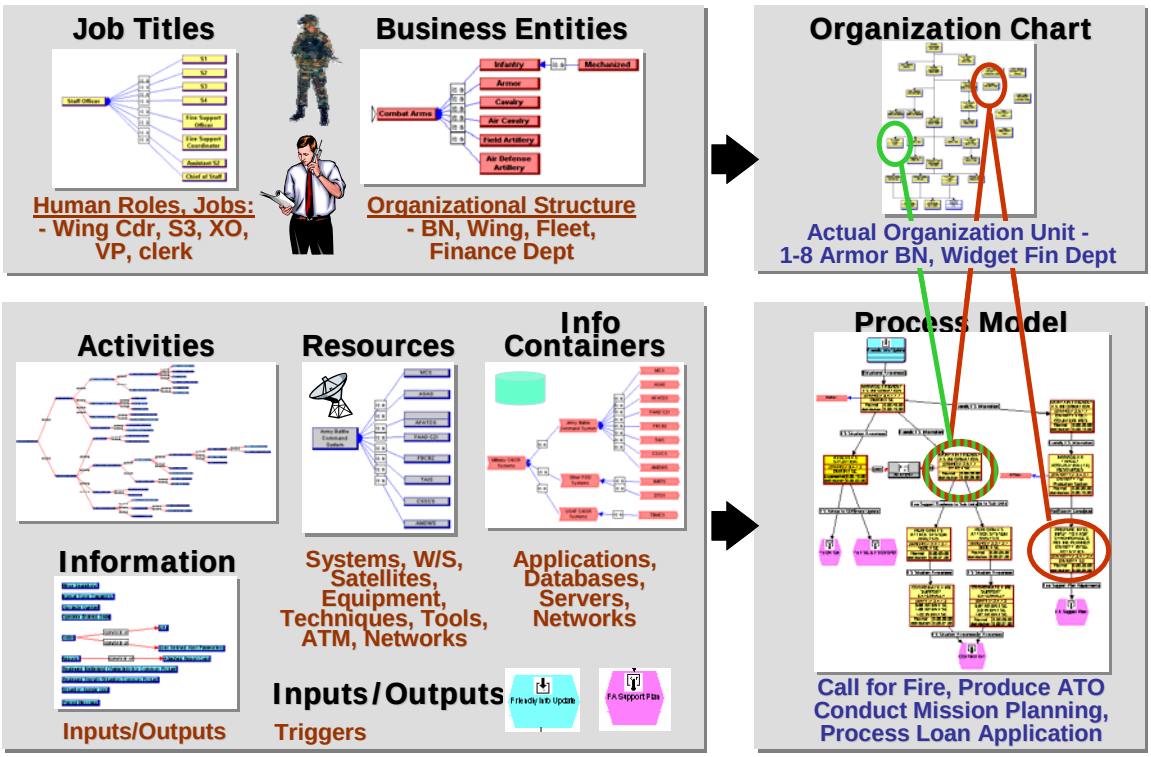


**Figure 4-22: Anatomy of an Executable Operational Architecture**

State transitions in executable operational architectural models provide for descriptions of conditions that control the behavior of process events in responding to inputs and in producing outputs. A state specifies the response of a process to events. The response may vary depending on the current state and the rule set or conditions. Distribution settings determine process time executions. Examples of distribution strategies include: constant values, event list, constant interval spacing, normal distribution, exponential distribution, and so forth. Priority determines the processing strategy if two inputs reach a process at the same time. Higher priority inputs are usually processed before lower priority inputs.

Processes receiving multiple inputs need to define how to respond. Examples of responses include: process each input in the order of arrival independent of each other, process only when all inputs are available, or process as soon as any input is detected. Processes producing multiple outputs can include probabilities (totaling 100 percent), under which each output would be produced.

Histograms are examples of generated timing descriptions. They are graphic representations of processes, human and system resources, and their used capacity over time during a simulation run. These histograms are used to perform dynamic impact analysis of the behavior of the executable architecture. **Figure 4-23** is an example showing the results of a simulation run of human resource capacity.

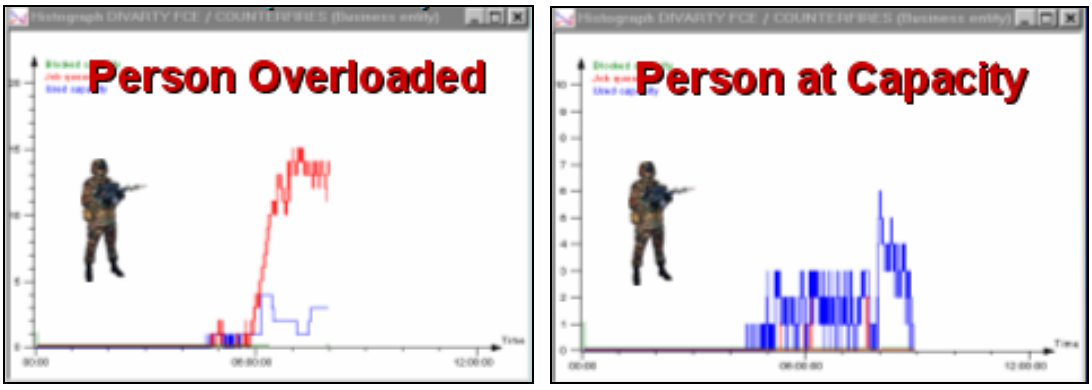


**Figure 4-23: Sample Histograms Showing Results of a Simulation Run**

### 4.6.8 UML Representation

OV-6b may be produced in UML using statechart diagrams that contain simple states and composite states. They also contain transitions, which are described in terms of triggers or events (generated as a result of an action) and guard conditions associated with the events, and an action or sequence of actions that are executed as a result of the event taking place. Statechart diagrams specify the reaction of an object to stimuli as a function of its internal state. Guard conditions of a statechart diagram map to the pre-conditions of an OV-5 use case. Activities in an activity diagram (OV-5) should correlate to states of the relevant object classes (operational nodes) and match to the statechart diagram states for the same object classes, where a state is defined in UML 1.4 as "A condition or situation during the life of an object during which it satisfies some condition, performs some activity, or waits for some event." Transitions on the activity diagrams should correlate to the transitions on the state diagrams. In essence, an activity diagram for multiple operational nodes (or objects using swimlanes) should be mappable to a set of statechart diagrams for those operational nodes, and to a set of sequence diagrams (where each sequence diagram correlates to a specific use case scenario). Events or triggers associated with the transitions on the state diagrams correlate to the triggering events documented in OV-3 and are the same events shown on the sequence diagrams of OV-6c.

### 4.6.9 Net-Centric Guidance for OV-6b

**Augmented Product Purpose.** In a net-centric architecture, the OV-6b is used to describe the set of state transitions for ***providers*** and ***consumers*** in the NCE in response to the ***posting of information*** to the NCE or ***retrieving of information*** from the NCE.

**Product Detailed Description.** The traditional OV-6b relates states, events, and actions associated to transitions between states. Accordingly, in the NCE, the OV-6b should capture states, events, and actions of ***providers*** and ***consumers*** accessing information and capabilities from the NCE. To further enable multiple uses of data and information in the NCE beyond their original predefined use, data asset providers should ***post before processing.***[30] The net-centric OV-6b identifies when information assets are in an initially useful state, and where information assets are made available and posted to the NCE, except when limited by policy, regulation, or security. The time and process implications of post before processing are reflected as operational changes to the business and mission processes in the OV-6 architecture products.

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30 DoD Net-Centric Data Strategy, May 9, 2003

### 4.6.10 CADM Support for OV-6b

**Figure** 4-24 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for OV-6b in a CADM-conformant database. Each OV-6b is represented as an instance of Document, with its attribute ArchitectureProductTypeCode = STATE-TRANSITION-DESCRIPTION. This permits recording the Name, Timeframe, and so forth for this DoDAF product.

The CADM specification for OV-6b also allows the user to describe all the relevant components of a state transition diagram by the proper instantiation of ProcessEvent, TransitionProcess, and ProcessStateVertex. Additional characterization is supported through the use of ObjectByReference (see Volume III for details).

In addition to the entities mentioned above, the CADM v1.5 structures, ProcessActivity, Action, and Event, can be employed to capture the information content of an OV-6b. In this manner, it is possible to relate TransitionProcess to Action as well as types of events called out in UML: SIGNAL-EVENT, CALL-EVENT, TIME-EVENT, and CHANGE-EVENT. In CADM, it is also possible to link an OV-6b to a specific System (including a specific component), a SoftwareItem, or to a Task.

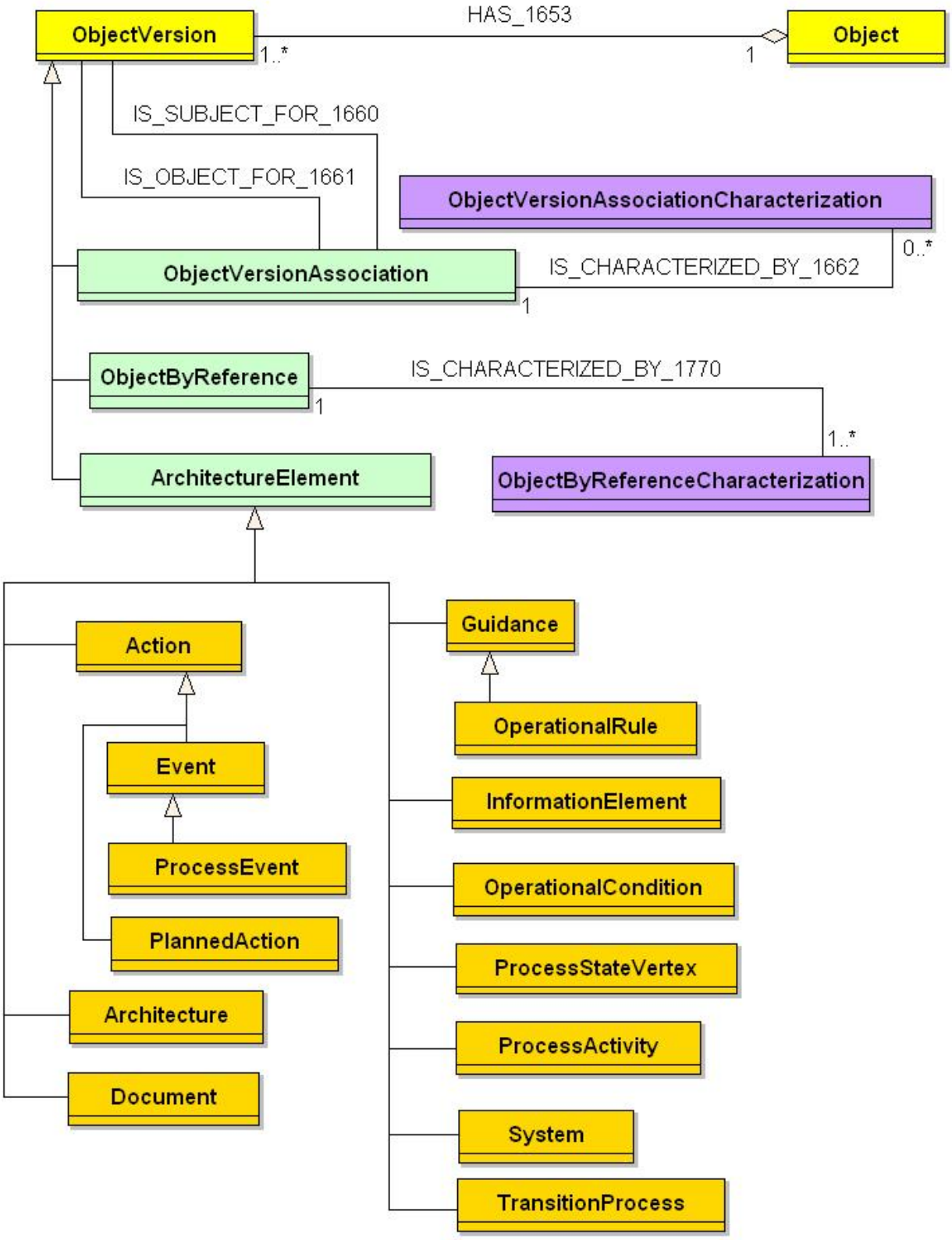


**Figure 4-24: CADM Diagram for OV-6b**

#### 4.6.10.1 OV-6b – Data Element Definitions

OV-6b describes the detailed time sequencing of activities or work flow in the business process, depicting how the current state of a process or activity changes in response to external and internal events. **Table 4-7** describes the architecture data elements for OV-6b.

**OV-6b Information Space**

Action†
Architecture†
Document†
Event†
Guidance†
InformationElement†
OperationalRule†
ProcessActivity†
System†
**OperationalCondition**
**PlannedAction**
**ProcessEvent**
**ProcessStateVertex**
**TransitionProcess**

†) The descriptions of these elements have been provided in the preceding sections

**Table 4-7: Data Element Definitions for OV-6b**

| Data Elements | Attributes | Definition |
|---|---|---|
| **OperationalCondition** | | |
| | formalSpecificationText | The text that summarizes a specific OperationalCondition. |
| | hierarchyName | The name that designates the relationship of a specific OperationalCondition to other OperationalCondition. |
| | valueText | The text that describes the quantity associated with a specific OperationalCondition. |
| **PlannedAction** | | |
| | categoryCode | The code that represents a class of PlannedAction. |
| | plannedEndCalendar Datetime | The calendar date and time of the expected conclusion of a PlannedAction. |
| | plannedStartCalendar Datetime | The calendar date and time of the expected beginning of a PlannedAction. |
| | purposeDescriptionText | The text that summarizes the objective of a specific PlannedAction. |
| **ProcessEvent** | | |
| | booleanExpressionText | The text that represents the logical statement whose truth indicates when a ProcessEvent occurs. |
| | categoryCode | The code that represents a class of ProcessEvent. |
| | elapsed-timeQuantity | The elapsed-time quantity that represents a time deadline for a ProcessEvent. |
| | operationDescription Text | The text that characterizes the operation whose invocation is requested in a specific ProcessEvent. |
| **ProcessStateVertex** | | |
| | categoryCode | The code that represents a class of ProcessStateVertex. |
| | concurrencyCode | The code that represents the specification of decomposition semantics for a specific ProcessState. |
| | subcategoryCode | The code that represents a detailed class of ProcessStateVertex. |
| **TransitionProcess** | | |
| | labelName | The name that represents a specific TransitionProcess in a diagram. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| Event | may be a | ProcessEvent |
| InformationElement | is the subject of | TransitionProcess |
| OperationalCondition | is related to | OperationalCondition |
| OperationalCondition | may be a guard for | OperationalRule |
| OperationalRule | is guard condition for | TransitionProcess |
| ProcessEvent | triggers | TransitionProcess |
| ProcessStateVertex | is source for | TransitionProcess |
| ProcessStateVertex | is target for | TransitionProcess |

(All previous relationships for the listed entities that comprise the information space of OV-6b should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

### 4.6.11 Operational Event-Trace Description (OV-6c)

**Product Definition**. The OV-6c provides a time-ordered examination of the information exchanges between participating operational nodes as a result of a particular scenario. Each event-trace diagram should have an accompanying description that defines the particular scenario or situation.

**Product Purpose**. OV-6c is valuable for moving to the next level of detail from the initial operational concepts. The product helps define node interactions and operational threads. The OV-6c can also help ensure that each participating operational node has the necessary information it needs at the right time in order to perform its assigned operational activity.

**Product Detailed Description**. OV-6c allows the tracing of actions in a scenario or critical sequence of events. OV-6c can be used by itself or in conjunction with OV-6b to describe the dynamic behavior of business processes or a mission/operational thread. An operational thread is defined as a set of operational activities, with sequence and timing attributes of the activities, and includes the information needed to accomplish the activities. A particular operational thread may be used to depict a capability. In this manner, a capability is defined in terms of the attributes required to accomplish a given mission objective by modeling the set of activities and their attributes. The sequence of activities forms the basis for defining and understanding the many factors that impact the capability.

Integrated architectures with DOTMLPF information provide a structured and organized approach for defining capabilities and understanding the underlying requirements for achieving those capabilities. By describing the sequence and timing of activities, tying them to the operational nodes (representing organizations or human roles), relating them to their supporting systems or system functions, and specifying the actions, events, and related guard conditions or business rules that constrain those activities, the full spectrum of DOTMLPF is modeled and related, so that analyses and decisions can be supported. Below is a detailed description of how DOTMLPF is tightly woven into this and related products.

- Doctrine is represented as guard conditions, which are associated with events, which, in turn, map to controls in OV-5.
- Organization is represented via the lifelines or swimlanes, which map to operational nodes of OV-2, which, in turn, map to organizations, organization types, or human roles of OV-4, and mechanisms in OV-5.

- Training is represented via the lifeline or swimlane, since the operational node (shown on the diagram as a lifeline or swimlane) may represent a human role, which, in turn, embodies a certain skill set or knowledge domain required to perform the actions (which are, in turn, related to operational activities of OV-5).
- Materiel is tied to the elements in OV-6c, because this product is tightly coupled with OV-5, where mechanisms may be used to represent systems that support operational activities. Materiel is tied to the elements in OV-6c, because this product is tightly coupled with OV-3, where the information exchanges are tied to operational activities. Further materiel detail may be related to the activities via SV-5, by relating those activities to the system functions that are executed by systems that automate them (wholly or partially). Each operational thread or scenario (represented by an OV-6c) is associated with a certain capability, since a capability is defined in terms of the activities and their attributes depicted in OV-6c. Consequently, an SV-5 may also be used to relate a capability to the systems that support it, by labeling a set of activities with their associated capability (defined in OV-6c), and by labeling the system functions with the systems that execute them (defined in SV-1, SV-2, and SV-4).
- Leadership may be represented either directly via the lifeline or swimlane or indirectly through the relationships of an operational node (shown as a lifeline or swimlane on the diagram) in OV-2 to organizations, organization types, or leadership human roles in OV-4.
- Personnel may be represented directly via the lifeline or swimlane, or indirectly through the relationships of an operational node (shown as a lifeline or swimlane on the diagram) in OV-2 to organizations, organization types, or human roles in OV-4.
- Facility is tied to the elements in OV-6c, because the lifeline or swimlane representing an operational node is directly tied to the systems node (facilities) that house the systems, which may be shown as mechanisms that support operational activities.

The Framework does not endorse a specific event-trace modeling methodology. Two such types of models include UML sequence diagrams [OMG, 2003] and IDEF3 [IDEF3, 1995]. The OV-6c product may be developed using any modeling notation that supports the layout of timing and sequence of activities along with the information exchanges that occur between operational nodes for a given scenario. Different scenarios should be depicted by separate diagrams. **Figure 4-25** provides a template for an OV-6c using a UML diagram. The items across the top of the diagram are operational nodes, usually organizations, organizations types, or human roles, which take action based on certain types of events. Each operational node has a lifeline associated with it that runs vertically. Specific points in time can be labeled on the lifelines, running down the left-hand side of the diagram. One-way arrows between the node lifelines represent events, and the points at which they intersect the lifelines represent the times at which the nodes become aware of the events. Events represent information passed from one lifeline to another and actions associated with the event. Labels indicating timing constraints or providing descriptions can be shown in the margin or near the event arrow that they label. The direction of the events represents the flow of control from one node to another.

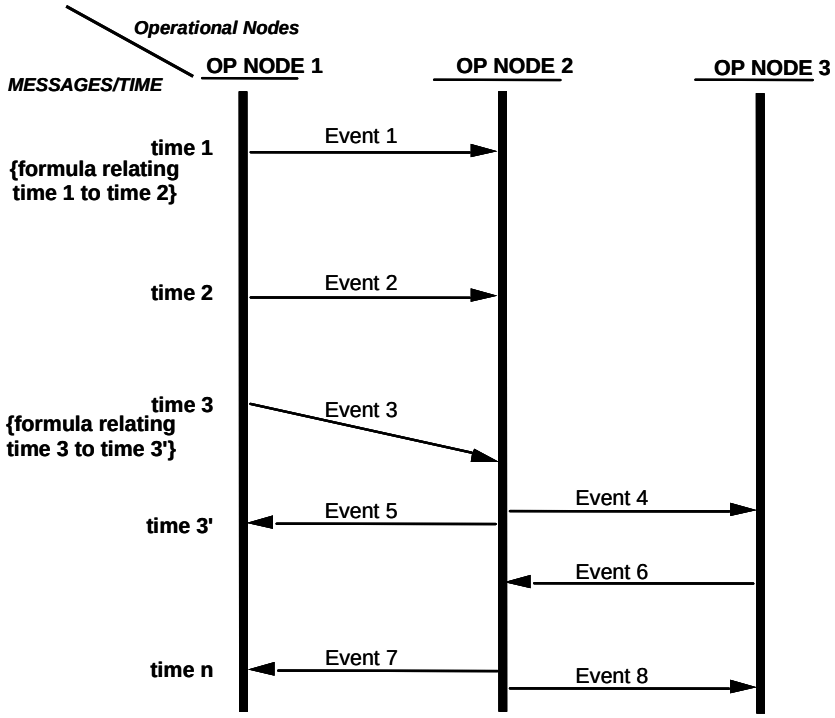


**Figure 4-25: OV-6c – UML-type Template**

**Figure 4-26** shows an example of an OV-6c using IDEF3 notation. Boxes convey a Unit of Behavior (UOB), which is a step in the process and ties to an Operational Activity in OV-5 via an IDEF0 Reference Property. A swimlane represents a horizontal or vertical division of the diagram for showing what operational nodes perform what processes UOBs, and links show control flow between UOBs (not information flow). IDEF3 link types include temporal (sequence, precedence) and logical (guard conditions or business rules).

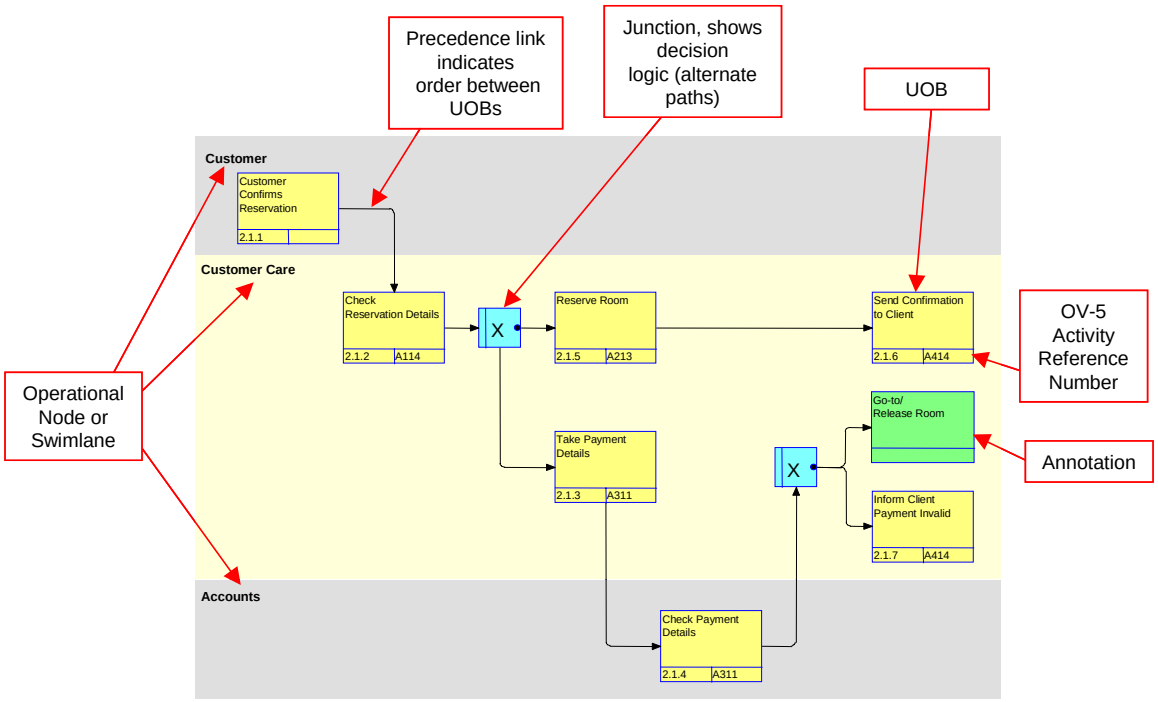


**Figure 4-26: OV-6c – IDEF3 Example**

### 4.6.12 UML Representation

Using the UML, the activity diagram best captures OV-6c information (**Figure 4-27**). Many DoDAF architects may believe that the sequence diagram best captures OV-6c; however, as discussed in the UML Representation OV-5 section, UML use cases are "instantiateable." Because they instantiate, a use case can render many possible sequences of events.

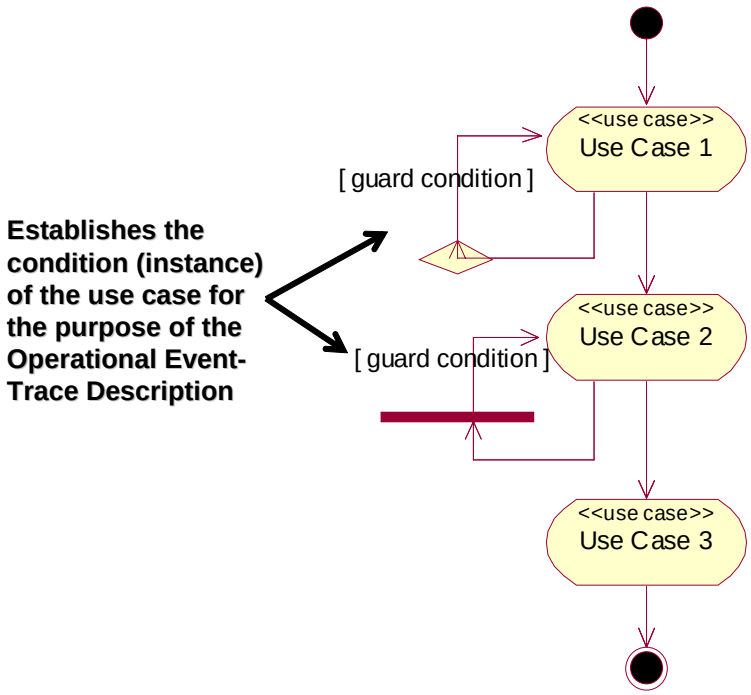


**Figure 4-27: UML Representation of an Operational Event-Trace (OV-6c)**

For example (see Figure 4-16, UML Example OV-5), if the guard condition were "message distribution required," then the sequence *Present Alerts and Notifications* executes after *Determine Mission Processing Needs* is complete. Therefore, the use case would instantiate to include the sequence for both *Determine Mission Processing Updates* and *Present Alerts and Notifications*. Otherwise, the use case would instantiate to include *Determine Mission Processing Needs* sequence only. Although the architect could create a sequence diagram for OV-6c, for complex architectures, they would quickly become a maintenance problem as the use cases mature over time. For example, if the architect decides to modify the sequence diagram of the use case, the sequence diagram of the OV-6c would require modification as well and there might be more than one OV-6c. Using this approach, the architect modifies the sequence diagrams of the use case and the OV-6c is still intact unless a guard condition of the use case changes that, then affects the related OV-6c depiction. This approach is object-oriented in that it takes advantage of the multiple abstraction mechanisms the UML offers. Using the activity view of the OV-6c, it is possible in some tools to automatically generate a complete sequence diagram depicting a more traditional OV-6c. This approach is acceptable, because the architect does not need to manually resolve changes.

### 4.6.13 Net-Centric Guidance for OV-6c

**Augmented Product Purpose.** In the NCE, the OV-6c ensures that the information and capabilities required by operational nodes, specifically with the operational role of Service Functionality Provider and Service Consumer, are available in a time ordered sequence to perform NCO. The Unanticipated User must be accounted for, but cannot be time-phased.

**Product Detailed Description.** The OV-6c traditionally describes operational activities, along with sequence, timing attributes, and information needed to accomplish them. Accordingly, the net-centric OV-6c is used to capture the time ordered sequencing of information and capabilities exchanged between operational nodes with operational roles of ***Service Functionality Provider***, ***Service Consumer,*** and ***Unanticipated User*** that appear in the net-centric OV-5. These exchanges are the inputs and outputs of activities performed in the NCE, and the sequencing highlights when and how often information and data are posted to the NCE or retrieved from external sources.

In the NCE, the OV-6c may depict the following:

- Exchanges between the Service Functionality Providers and Service Consumers, the Service Consumers and external Service Functionality Providers, and between the Service Functionality Providers and Unanticipated Users
- Sequences that describe the timeline for the availability of information for any of its refinement states (raw, pre-processed, fused, etc.)
- Handling, methodologies, and the Enterprise Information Environment (EIE) infrastructure components that support the operational concepts of post before processing[31]

[31] DoD Net-Centric Data Strategy, May 9, 2003

- Illustration of one-to-many, many-to-one, and many-to-many exchanges between Service Functionality Providers and Service Consumers found in the net-centric OV-3.

The net-centric OV-6c describes the business and mission processes that need to be executed to achieve NCO. The ability to discover, access, and understand information and capabilities from the NCE, where and when they are needed, is supported by the OV-6c and can be decomposed to the level of specificity required for the subject architecture.

### 4.6.14 CADM Support for OV-6c

**Figure** 4-28 provides a high-level diagram from the CADM v1.5 showing key entities that are used to store architecture data for OV-6c in a CADM-conformant database. Each OV-6c is represented as an instance of Document with its attribute ArchitectureProductTypeCode = EVENT-TRACE-DESCRIPTION. This permits recording the Name, Timeframe, and so forth for this DoDAF product.

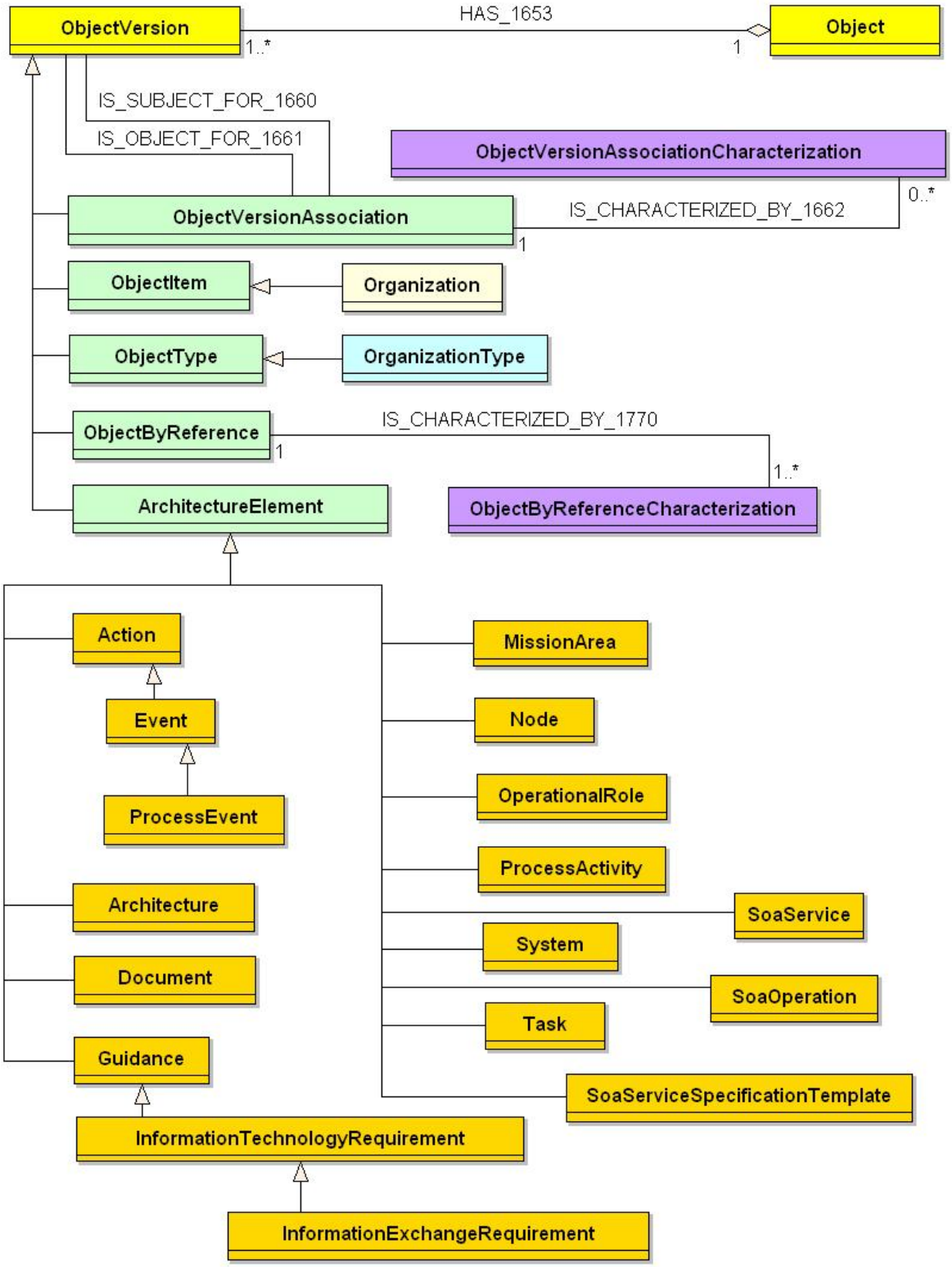


**Figure 4-28: CADM Diagram for OV-6c**

In CADM v1.5, it is possible to state (relative) timelines (or lifelines) for instances of Node. Each such Node can be explicitly associated with a MissionArea, Organization, OrganizationType, ProcessActivity[32], System, and Task. One can also relate two Node instances differing with regard to their timelines. The definition of such relations can be treated as independent architectural statements and reused from one scenario to another. For these temporal relations, one can specify their start at explicit or implicit (computed) absolute or relative times. Relative times can be specified in terms of the start or end of another temporal relation (using a method analogous to one defined for temporally related Action instances). A specific OV-6c can be associated to an OperationalScenario. As noted in the general description of OV-6 products (above), CADM v1.5 supports the linkage of OV-6c to capabilities.

#### 4.6.14.1 OV-6c – Data Element Definitions

**OV-6c Information Space**

- Action†
- Architecture†
- Document†
- Event†
- Guidance†
- InformationExchangeRequirement†
- InformationTechnologyRequirement†
- MissionArea†
- Node
- OperationalRole†
- Organization†
- OrganizationType†
- ProcessActivity†
- ProcessEvent†
- SoaOperation†
- SoaService†
- SoaServiceSpecificationTemplate†
- System†
- Task†

†) The descriptions of these elements have been provided in the preceding sections

[32] In CADM v1.5 the linkage between Node and ProcessActivity is used in the OV-6c to represent the lifeline associated with one or more operational activities. When ProcessActivity is specialized as a system function this same entity is used in SV-10c to represent the lifeline associated with one or more system functions.

## 4.7 LOGICAL DATA MODEL (OV-7)

### 4.7.1 OV-7 – Product Description

**Product Definition**. The OV-7 describes the structure of an architecture domain's system data types and the structural business process rules (defined in the architecture's OV) that govern the system data. It provides a definition of architecture domain data types, their attributes or characteristics, and their interrelationships.

**Product Purpose**. OV-7, including the domain's system data types or entity definitions, is a key element in supporting interoperability between architectures, since these definitions may be used by other organizations to determine system data compatibility. Often, different organizations may use the same entity name to mean very different kinds of system data with different internal structure. This situation will pose significant interoperability risks, as the system data models may appear to be compatible, each having a *Target Track* data entity but having different and incompatible interpretations of what *Target Track* means.

An OV-7 may be necessary for interoperability when shared system data syntax and semantics form the basis for greater degrees of information systems interoperability, or when a shared database is the basis for integration and interoperability among business processes and, at a lower level, among systems.

**Product Detailed Description**. OV-7 defines the architecture domain's system data types (or entities) and the relationships among the system data types. For example, if the domain is missile defense, some possible system data types may be *trajectory* and *target* with a relationship that associates a target with a certain trajectory. On the other hand, architecture data types for the DoDAF (i.e., DoDAF-defined architecture data elements, AV-2 data types, and CADM entities) are things like an *operational node* or *operational activity*. OV-7 defines each kind of system data type associated with the architecture domain, mission, or business as its own entity, with its associated attributes and relationships. These entity definitions correlate to OV-3 information elements and OV-5 inputs, outputs, and controls.

Although they are both called data models, OV-7 should not be confused with the CADM. OV-7 is an architecture product and describes information about a specific architecture domain. The CADM is not an architecture product. The CADM is a database design for a repository of DoDAF products and architecture data. CADM-based repositories can store architecture products, including Logical Data Models, from any DoDAF-based architecture project. Thus, the CADM addresses a structure for storing architecture data (e.g., instances of operational nodes and operational activities), while a Logical Data Model for missile defense, for example, might define architecture domain entities and relationships such as missile tracks and points of impact.

The purpose of a given architecture helps to determine the level of detail needed in this product. A formal data model (e.g., the Integrated Definition for Data Modeling [IDEF1X]) [FIPS 184, 1993] that is detailed down to the level of architecture domain system data, their attributes, and their relationships is required for some purposes, such as when validation of completeness and consistency is required for shared data resources. However, for other purposes, a higher-level conceptual data model of the domain of interest will suffice, such as a subject area model or an entity-relation model without attributes. The term *logical data model* is used here in this context, regardless of the level of detail the model exhibits.

The architecture data elements for OV-7 include descriptions of entity, attribute, and relationship types. Attributes can be associated with entities and with relationships, depending on the purposes of the architecture.

**Figure 4-29** provides a template for OV-7 (with attributes). The format is intentionally generic to avoid implying a specific methodology.

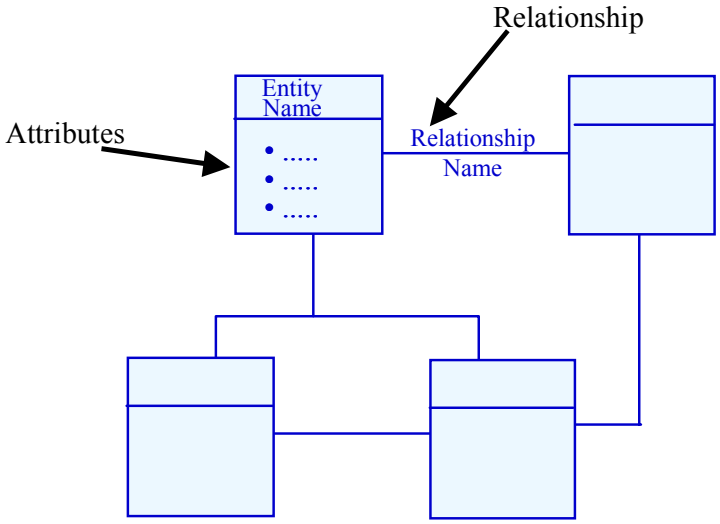


**Figure 4-29: OV-7 – Template**

### 4.7.2 UML Representation

OV-7 may be modeled in UML using a class diagram. See **Figure 4-30**. Class diagrams offer all the UML elements needed to produce entity-relationship diagrams. Class diagrams consist of classes, interfaces, collaborations, dependency, generalization, association, and realization relationships. The attributes of these classes can be expanded to include associations and cardinality [Booch, 1999]. Classes that appear in an OV-7 class diagram correlate to OV-3 information elements and OV-5 inputs, outputs, and controls. The OV-7 class diagram is a separate diagram from the class diagrams that may be developed for other products (e.g., OV-4).

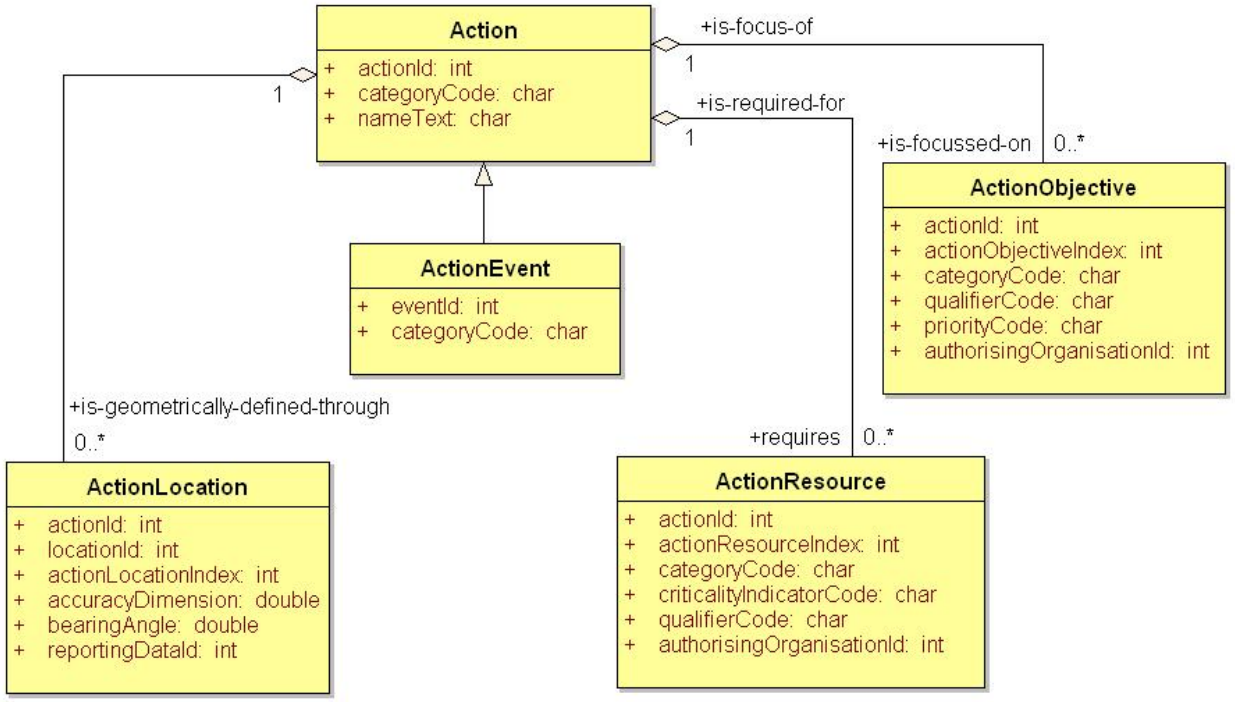


**Figure 4-30: UML Class Diagram for OV-7 – Template**

### 4.7.3 Net-Centric Guidance for OV-7

**Augmented Product Purpose.** In the NCE, the OV-7 describes the structure of data types (information elements) for information being made available or being consumed by the OV-5 activities and provides the organization and composition of metadata that can be used to characterize the information exchanged in the NCE.

**Net-Centric Product Description**. The OV-7 traditionally defines the architecture domain's system data types (or entities) and the relationships among the system data types. The net-centric OV-7 provides the same, but with an emphasis on two concerns: 1) describing data types for information being exchanged between nodes, and 2) using standards or commonly understood COI guidance for domain vocabularies, taxonomies, and upper-level ontologies. net-centricity relies on the use of commonly understood vocabularies and meanings to facilitate better information sharing in the NCE. A net-centric OV-7 supports data understandability in the NCE by defining the data and its relationships agreed to by a collaborative COI. These agreements may be documented in more detail in the SV-11 as a specific information agreement or schema for use in the NCE.

In the NCE, information and capabilities (provided as services) should be tagged so that they are easily discoverable in the NCE. Accordingly, a specific use of the OV-7 product to support net-centricity may be the documentation of the organization and composition of metadata structures for ***discovery***. This may include the descriptive information and capabilities being offered as specified by DoD Discovery Metadata Specification (DDMS)[33] and any COI extensions specific to the architecture, or the required and optional metadata that supports the

[33] "Department of Defense Discovery Metadata Specification", Version 1.3. 29 July 2005

description of services (i.e., the SST) with which the architecture complies with. The OV-7 metadata may be used to provide the structural constraints for XML data structures described in Data Catalogs (local or enterprise). As information and capability assets are tagged and provided in appropriate repositories (DoD Metadata Registry, ***data catalogs***, or service registries), ***Service Consumers*** and ***Unanticipated Users*** can more easily search for and discover these assets to execute their missions more effectively and efficiently. Like the domain vocabularies documented in the OV-7 product, the metadata structures should be agreed upon by COIs or standards organizations so that they are commonly understood.

### 4.7.4 CADM Support for OV-7

**Figure 4-31** provides a high-level diagram from the CADM showing key entities that are used to store architecture data for OV-7 in a CADM-conformant database.

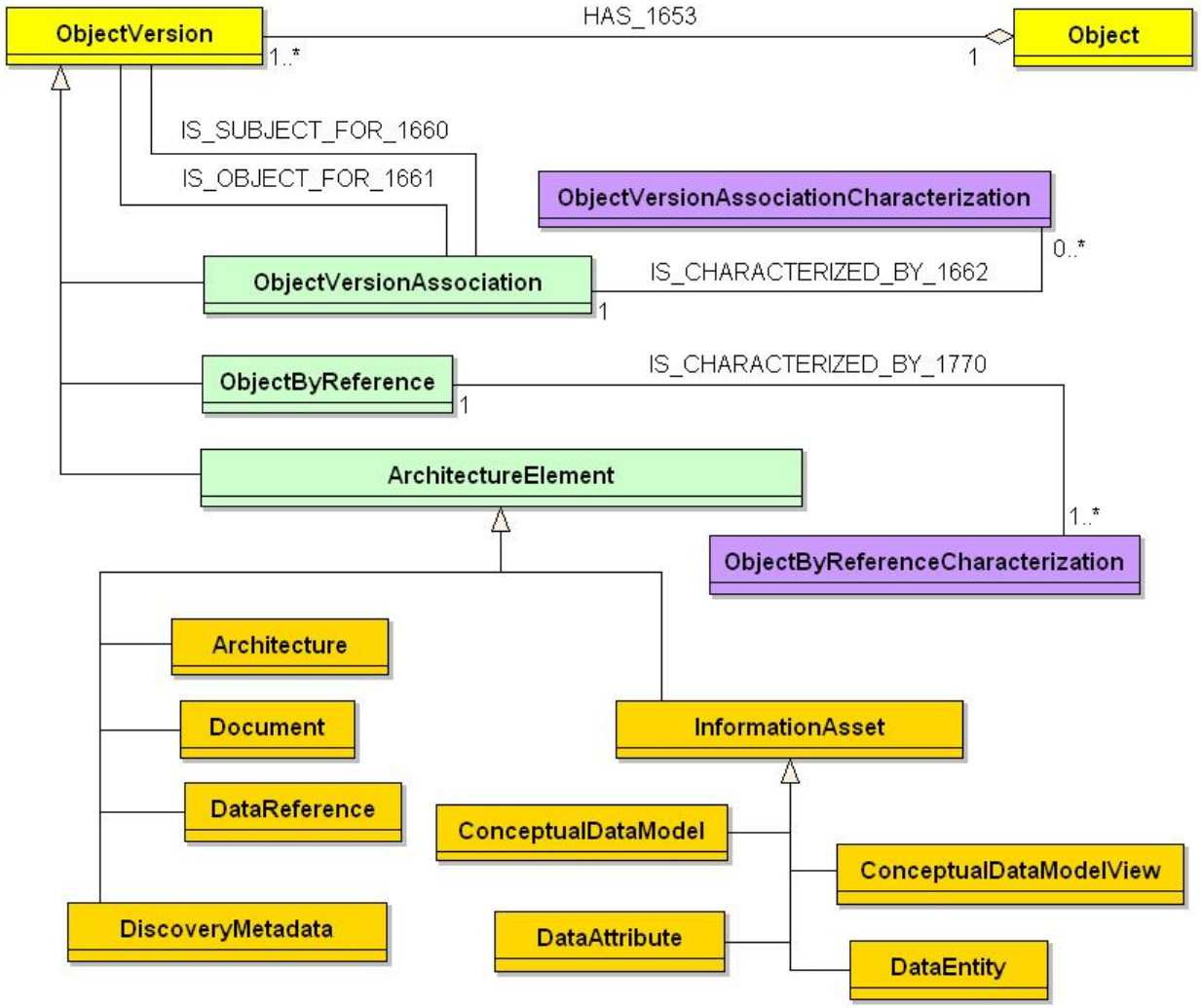


**Figure 4-31: CADM Diagram for OV-7**

Each OV-7 is represented as an instance Document with its attribute ArchitectureProductCategoryCode = LOGICAL-DATA-MODEL. OV-7 cites a specific instance of ConceptualDataModel (a subtype of InformationAsset). The OV-7 use of the ConceptualDataModel supports the relevant set of DoD data standards from the Information Management View of the

DoD Data Architecture (DDA) data model. The key entities in this specification include DataEntity, DataAttribute, and the data domains (all subtypes of InformationAsset). Additional specification of the OV-7 is supported in CADM v1.5 through ObjectByReference, with CategoryCode values equal to DATA-ENTITY-RELATIONSHIP, CATEGORY-RELATIONSHIP, DATA-DOMAIN-LIST, and DATA-DOMAIN-LIST-VALUE respectively. Each DataEntity can be directly related to an ActivityModelInformationElementRole to establish a link between data models and activity models.

#### 4.7.4.1 OV-7 – Data Element Definitions

**OV-7 Information Space**

Architecture†
ConceptualDataModel†
DataAttribute†
DataEntity†
DiscoveryMetadata†
Document†
InformationAsset†
**ConceptualDataModelView**
**DataReference**

†) The descriptions of these elements have been provided in the preceding sections

**Table 4-8** describes the architecture data elements for OV-7.

**Table 4-8: Data Element Definitions for OV-7**

| Data Elements | Attributes | Definition |
|---|---|---|
| **ConceptualDataModelView** | | |
| | creatorIdentifierText | The text that identifies the agent responsible for creating a specific ConceptualDataModelView. |
| | dataStandardizationIdentifierText | The text of a specific ConceptualDataModelView that identifies the tracking of data standards. |
| | scopeText | The text of the boundaries of a ConceptualDataModelView. |
| **DataReference** | | |
| | approvalStatusCode | The code that represents the state of validity of a specific DataReference instance. |
| | firstSubordinateInstanceIdentifierText | The text for the first additional table identifier for the instance of the physical table managed for a specific DataReference. |
| | instanceIdentifierText | The text for the primary table identifier of the instance of the physical table managed for a specific DataReference. |
| | secondSubordinateInstanceIdentifierText | The text for the second additional table identifier of the instance of the physical table managed for a specific DataReference. |
| | tableName | The name of the physical table managed for a specific DataReference. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| ConceptualDataModel | is represented in | ConceptualDataModelView |
| DataEntity | is displayed in | ConceptualDataModelView |

(All previous relationships for the listed entities that comprise the information space of OV-7 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

# 5 SYSTEMS AND SERVICES VIEW PRODUCTS

The SV is a set of graphical and textual products that describe systems and services and interconnections providing for, or supporting, DoD functions. SV products focus on specific physical systems with specific physical (geographical) locations. The relationship between architecture data elements across the SV to the OV can be exemplified as systems are procured and fielded to support organizations and their operations.

There are eleven SV products:

- Systems/Services Interface Description (SV-1)
- Systems/Services Communications Description (SV-2)
- Systems-Systems, Services-Systems, Services-Services Matrices (SV-3)
- Systems/Services Functionality Description (SV-4a and SV-4b)
- Operational Activity to Systems Function, Operational Activity to Systems and Services Traceability Matrices (SV-5a, SV-5b, SV-5c)
- Systems/Services Data Exchange Matrix (SV-6)
- Systems/Services Performance Parameters Matrix (SV-7)
- Systems/Services Evolution Description (SV-8)
- Systems/Services Technology Forecasts (SV-9)
- Systems/Services Rules Model, State Transition Description, and Event-Trace Description (SV-10a, 10b, and 10c)
- Physical Schema (SV-11)

## 5.1 SYSTEMS AND SERVICES INTERFACE DESCRIPTION (SV-1)

### 5.1.1 SV-1 – Product Description

**Product Definition**. The SV-1 depicts systems nodes and the systems resident at these nodes to support organizations/human roles represented by operational nodes of the OV-2. SV-1 also identifies the interfaces between systems and systems nodes.

**Product Purpose**. SV-1 identifies systems nodes and systems that support operational nodes. Interfaces that cross organizational boundaries (key interfaces) can also be identified in this product. Some systems can have numerous interfaces. Initial versions of this product may only show key interfaces. Detailed versions may also be developed, as needed, for use in system acquisition, as part of requirements specifications, and for determining system interoperabilities at a finer level of technical detail.

**Product Detailed Description**. SV-1 links together the OV and SV by depicting the assignments of systems and systems nodes (and their associated interfaces) to the operational nodes (and their associated needlines) described in OV-2. OV-2 depicts the operational nodes representing organizations, organization types, and/or human roles, while SV-1 depicts the systems nodes that house operational nodes (e.g., platforms, units, facilities, and locations) and the corresponding systems resident at these systems nodes that support the operational nodes. The term *system* in the framework is used to denote a family of systems (FoS), SoS, nomenclatured system, or a subsystem. An item denotes a hardware or software item. Only

systems, subsystems, or hardware/software items and their associated standards are documented in this product, where applicable. Details of the communications infrastructure (e.g., physical links, communications networks, routers, switches, communications systems, satellites) are documented in the Systems Communication Description (SV-2).

In addition to depicting systems nodes and systems, SV-1 addresses system interfaces. An interface, as depicted in SV-1, is a simplified, abstract representation of one or more communications paths between systems nodes or between systems (including communications systems) and is usually depicted graphically as a straight line. SV-1 depicts all interfaces that are of interest for the architecture purpose.

An SV-1 interface is the systems representation of an OV-2 needline. A single needline shown in the OV may translate into multiple system interfaces. The actual implementation of an interface may take more than one form (e.g., multiple physical links). Details of the physical links and communications networks that implement the interfaces are documented in SV-2. Characteristics of the interface are described in Systems-Systems Matrix (SV-3). System functions and system data flows are documented in a Systems Functionality Description (SV-4a), and the system data carried by an interface are documented in the Systems Data Exchange Matrix (SV-6).

An interface between systems nodes or systems may be annotated as a Key Interface (KI). A KI is defined as an interface where one or more of the following criteria are met:

- The interface spans organizational boundaries (may be across instances of the same system, but utilized by different organizations).
- The interface is mission critical.
- The interface is difficult or complex to manage.
- There are capability, interoperability, or efficiency issues associated with the interface.

If desired, annotations summarizing the system data exchanges carried by an interface may be added to SV-1.

Several versions of SV-1 can be developed to highlight different perspectives of the system interfaces. For example, an internodal version of the product describes systems nodes and the interfaces between them or the systems resident at the systems nodes. An intrasystem version describes subsystems of a single system and the interfaces among them. Other versions may also be developed, depending on the purposes of the particular architecture.

**Figure 5-1** provides a template of the internodal version, showing system interfaces between nodes from node edge to node edge. The pertinent systems within each node are also shown, but not their specific system-system interfaces. In Figure 5-1, System 1 is depicted in all three nodes (i.e., Node A, Node B, and Node C), which means that the same hardware/software configuration is resident at all three systems nodes. (Here, the notion of same is relative to the purposes of the architecture.) All interfaces are assumed to be two-way unless otherwise noted. The naming convention used for interfaces in Figure 5-1 is purely for exposition purposes.

Additional information may be shown on the graphics. For example, information such as a system's hardware/software items or the system's functions can be added as annotations to the system's graphical icon.

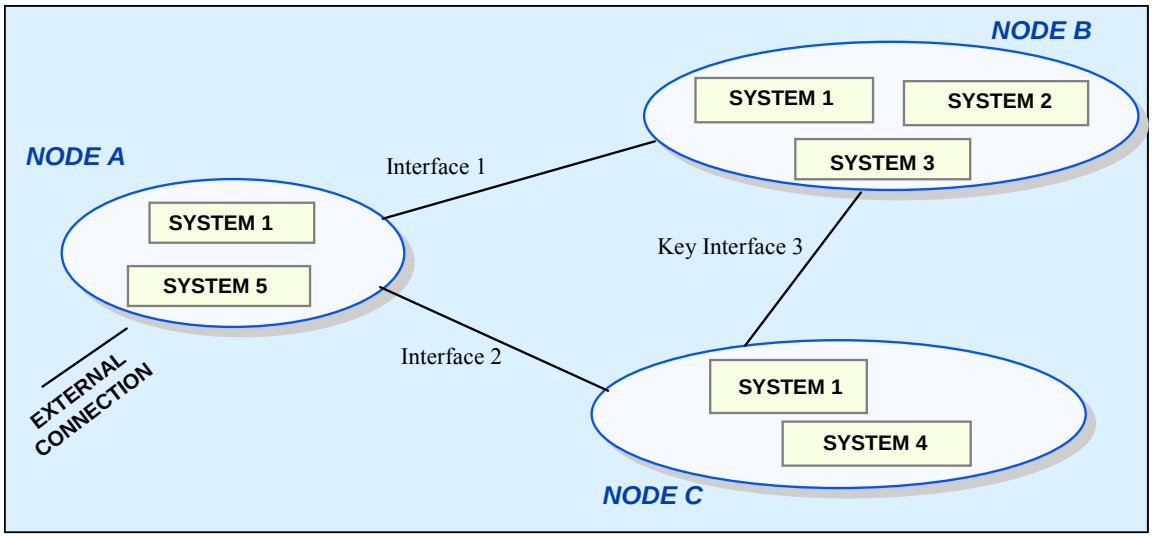


**Figure 5-1: SV-1 Internodal Template Showing Systems**

**Figure 5-2:** provides a notional example in which the system functions have been added for all the systems. This type of SV-1 might be useful in a target architecture, where major system functions have been allocated to systems, but other details have not yet been decided.

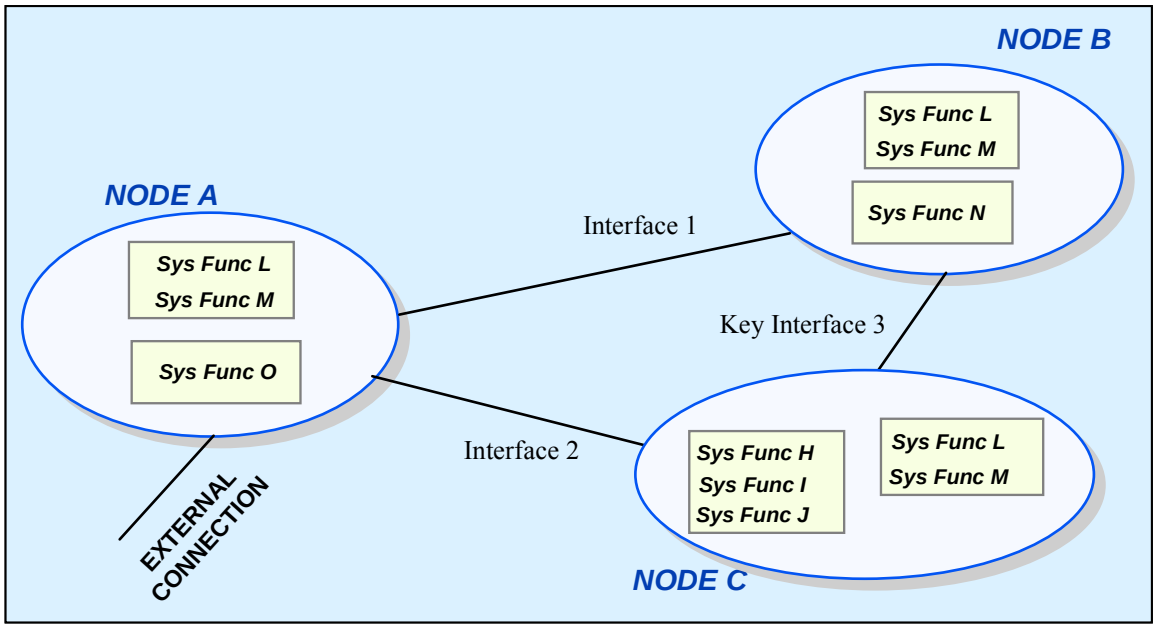


**Figure 5-2: SV-1 Internodal Version – Node Edge to Node Edge Showing System Functions**

**Figure 5-3** provides a template of the internodal version of SV-1 that extends the node edge connections to specific systems. In Figure 5-3, the line between System 1 at Node A and System 1 at Node B indicates that there is an interface between these two instances of System 1. Similarly, the line between System 5 at Node A and System 3 at Node B indicates that there is a second, logically distinct interface between Node A and Node B, connecting System 3 and System 5.

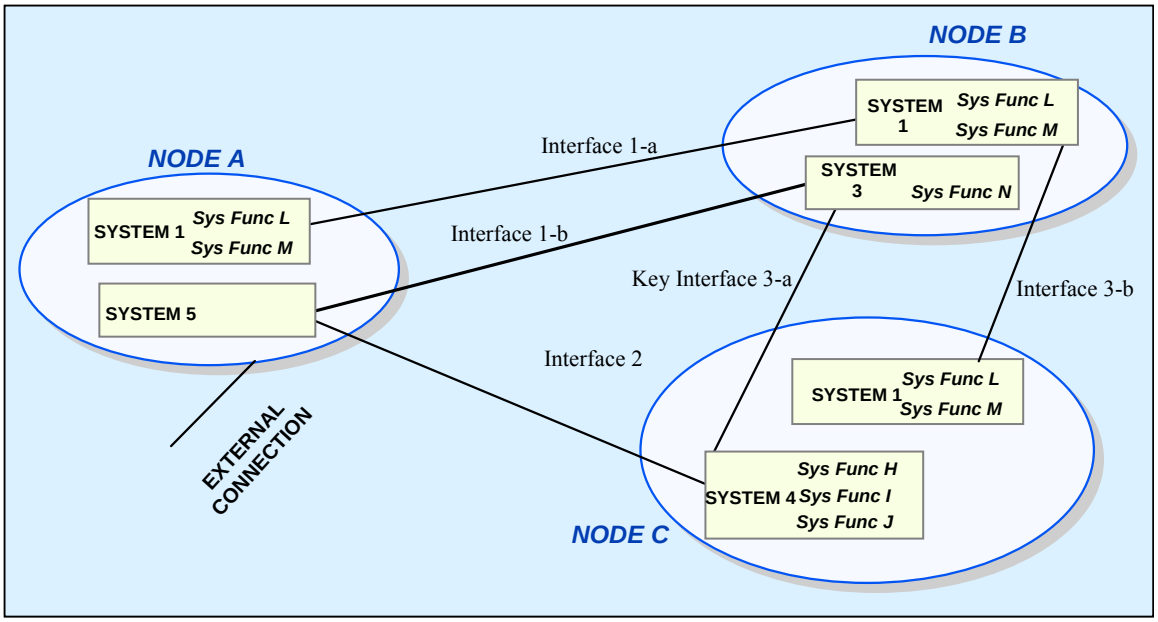


**Figure 5-3: SV-1 Internodal Version Showing System-System Interfaces – Template**

An intranodal version of SV-1 may also be useful to focus analysis on the interfaces between systems within each node and to examine the systems-systems connections within a systems node. This version also continues to show the external connections going out to other systems nodes. **Figure 5-4** provides a template of the intranodal version of SV-1. Note that the naming convention for the interfaces in Figure 5-4 is purely for exposition purposes. A naming convention for interfaces must assign unique identifiers for interfaces at the various levels of detail for SV-1.

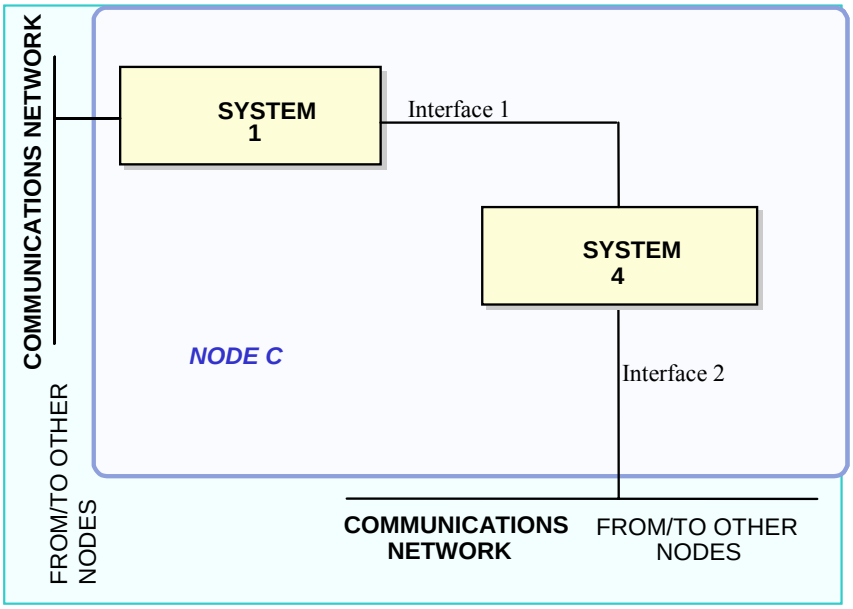


**Figure 5-4: SV-1 Intranodal Version – Template**

The intrasystem version can be used in conjunction with the internodal or intranodal versions to analyze and improve the configuration of systems. For example, a purpose of an architecture could be to determine more efficient distribution of software applications.

**Figure 5-5** provides a template of the intrasystem version of SV-1 and a notional example that includes a KI and a shared database as a subsystem.

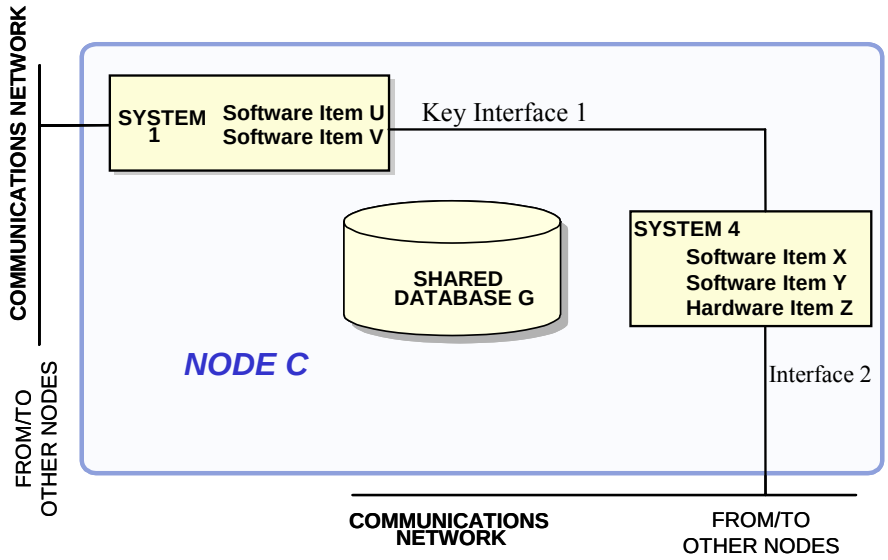


**Figure 5-5: SV-1 Intrasystem Version – Example Showing a KI, a Database, and Other Software and Hardware Items**

### 5.1.2 UML Representation

SV-1 may be developed in the UML using deployment diagrams to represent SV-1 systems nodes. A deployment diagram is a collection of node symbols connected by lines showing communication associations.

SV-1 internodal perspective showing systems may be modeled in UML using deployment diagrams that also show UML Components. This can be accomplished via the definition of new stereotypes for UML Components. Adding new stereotypes is neither necessary nor mandatory, as long as there is consistency in representing the same kind of nodes in each diagram (e.g., in any one diagram, all UML nodes are systems nodes, while all UML Components are systems that reside on the systems nodes). Components may be associated with notes (to specify allocations of resources, such as system functions, to the UML Components) and constraints.

**Figure 5-6** is a template for such a diagram. SV-1 systems nodes trace to operational nodes identified in OV-2. SV-1 interfaces correlate to OV-2 needlines (use case links).

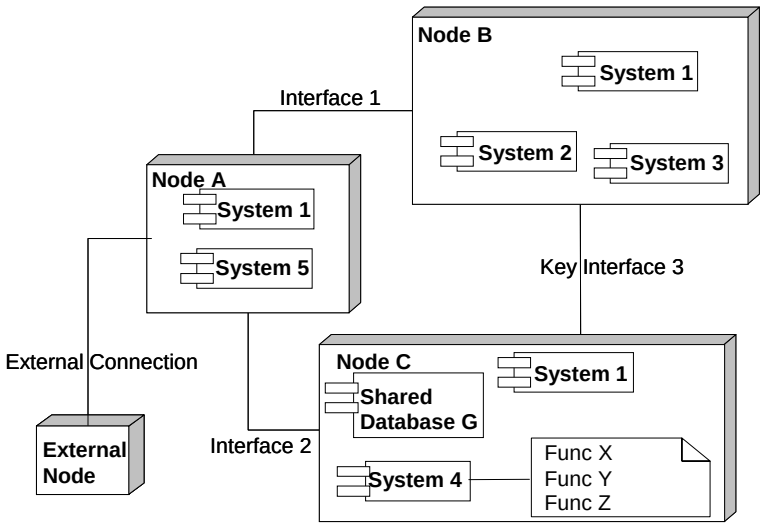


**Figure 5-6: UML Node/Component Diagram for SV-1 Internodal Version Showing Systems – Template**

**Figure 5-7** is a template for the SV-1 internodal perspective showing system-to-system interfaces. SV-1 UML Components correlate to the systems. In UML, classes or use cases (SV-4 system functions) can be assigned to UML Components to allow system functions to be associated with systems in SV-1.

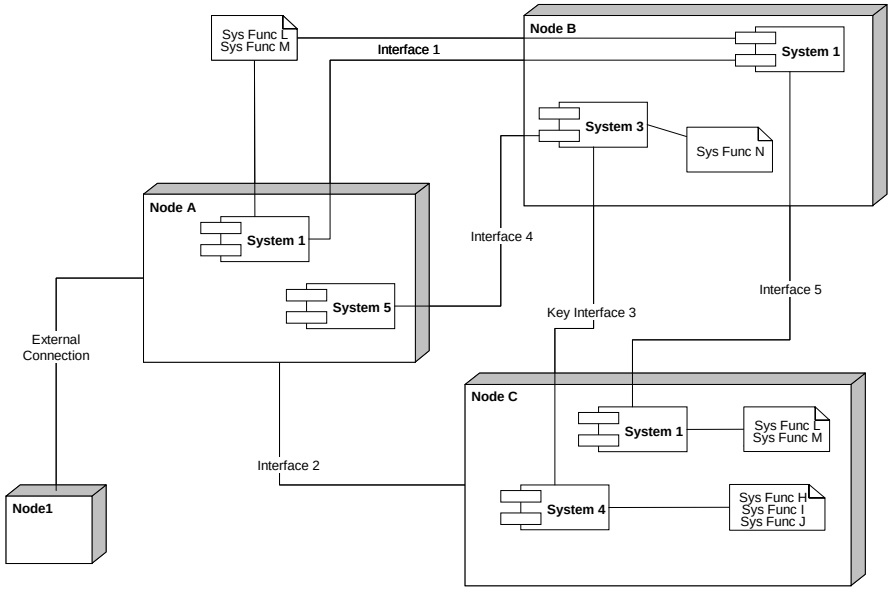


**Figure 5-7: UML Node/Component Diagram for SV-1 Internodal Version Showing System-System Interfaces – Template**

The SV-1 intranodal perspective may be modeled in UML using component diagrams with UML Components representing systems and nodes to specify allocations of resources, such as system functions and hardware/software items, to the UML Components.

### 5.1.3 Net-Centric Guidance for SV-1

**Augmented Product Purpose.** In a net-centric architecture, the SV-1 is used to depict system nodes and the items resident at those nodes to support the ***Service Functionality Provider***, ***Service Consumer***, and ***Unanticipated Consumer*** operational roles found within the net-centric OV-2. The net-centric SV-1 identifies the leveraged interface specifications utilized by systems to expose capability to the "net" with a separate distinction that identifies an instance of the specification as an interface between a provider and a consumer. This should conform to the abstract or technology independent aspect of net-centricity, focusing only on the protocols required for a consumer to access the provider. Additionally, net-centric SV-1 identifies the use or offering of any ***shared infrastructure*** underneath a system node that supports applications and services.

**Net-Centric Product Description.** The SV-1 traditionally depicts the assignments of systems, associated interfaces, and systems nodes to the operational nodes in the OV-2. In the NCE, the SV-1 captures the means designated to provide, discover, and consume information and capabilities. This may include the illustration of services-based software components such as 1) ***Services***, 2) ***Service Interfaces***, 3) Portals, and 4) Web-based Applications. The net-centric SV-1 may also include the illustration of any required service infrastructure software items relating to 1) registration, 2) discovery and enterprise discovery services, 3) messaging (i.e., Enterprise Service Bus), 4) service management, 5) information assurance, and 6) other supporting and enabling software items. Likewise, the net-centric SV-1 may include the identification and location of hardware items that host or support the aforementioned software components.

***Services*** are a key means to share information and capabilities in the NCE and can be identified in the SV-1. A net-centric SV-1 depicts which ***services*** and ***web-based technology management components***, including ***services management*** software/hardware, and servers, are necessary to design, build, provide, manage, and govern ***services*** in the NCE so they can be leveraged by others. Services in this context can refer to both information and functionality being offered to 1) machines through any common, open, web-services technology (i.e., SOAP, WSDL, REST, etc.) or 2) humans, who exploit the netted environment through web-based GUI technologies (websites, portals, etc.) that offer information and capabilities in the NCE.

To enable agility in NCO, providers and consumers depend on a standard way to describe services so that information and capabilities can be reused and rapidly assembled. ***Services*** make information and functionality available in the NCE through published ***service interface specifications*** and instances of the ***service interface specifications*** between the ***service provider*** and ***service consumer.*** The service specification enables interoperability among applications across the NCE. It provides a consistent way to describe and define the use, composition and implementation of a service to service providers, users, developers and managers. The SV-1 should capture and depict basic information about each service and its s***ervice interface specification***. A ***service specification*** should be identified for each service that provides capability to the NCE. The service specification enables architects to document service information in a consistent manner, and the DoD-wide SST should be used to the extent possible for describing each service ***in a Service Registry***. Regardless of the precise SST, the necessary minimum subset of information from the SST for each service must be captured in the SV-1:

- ***Information Model Category***: is the category that describes the capability the service provides, the expected input and output data model; outlines the available metadata for the service, and includes point-of-contact information for the service.
    - ***Service Name*** is a short descriptive name for the service to be provided.
- ***Interface Model Category*****:** is the category that describes the interface, available operations, any faults that an individual operation may generate, and points to access the service.
    - ***Service Description*** is a textual narrative that describes the service offering and its purpose.

In addition to the SST elements, DoDAF v1.5 extends the service interface specifications to include a ***Service Provider*** element. The ***Service Provider*** element identifies the organization providing the service (the organization that is the Service Functionality Provider operational role from the OV-2).

Although elements from two of the service specification categories are discussed in this view, additional elements from the rest of the service specification categories are identified and documented within other architecture views, resulting in an integrated view of the service specification across architecture products.

In the NCE, users will look to the NCE for information and functionality, hence, the SV-1 provides the user with what is needed, regardless of physical location. This "black box" approach requires that the architecture associate which system nodes support operational nodes, and which operational nodes or activities use which systems and services. This enables capability and information consumers in the NCE to move from a known consumer/user to a many-to-many model in the NCE, where they are able to find and get information and capabilities based on the providers' published specifications and standards. In a net-centric SV-1, system nodes are containers for service software items along with the corresponding infrastructure software items and physical computing resource items that enable their existence. A system node may contain one or many service, software, and hardware items.

In a net-centric SV-1, the interface lines within an SV-1 are a ***simplified, abstract representation of one or more communications paths between systems nodes, systems, or services***. The interface lines do not represent a service's software programming interface that defines the service's functionality or message content. Instead, the interface lines are leveraged communications infrastructure paths that represent the transport mechanisms, media, and hardware for the data flowing into and out of system nodes. The details of these interface lines are captured in the SV-2.

Net-centric systems, by their very nature, contain numerous items that may appear in system nodes (such as an entire ***Registry*** of services). Hence, it may be difficult to capture all system nodes, the items contained within the system nodes, and the connecting interface lines into a single SV-1 diagram. In such cases, it may be more beneficial to take a layering approach where several unique SV-1s capture different perspectives that are important to the program. Examples of such perspectives may include:

- Services being offered to or consumed from the NCE
- Services being offered to or consumed from the subject architecture

- Shared infrastructure: hardware, software, and virtual components that enable service deployment,
- Information assurance, service management, network operations, etc.

Documenting these various aspects of net-centricity in the SV-1 products will show what systems and services communicate with each other and support the operational nodes in the OV-2, and provide the basis for more efficient distribution of information and capabilities to the NCE.

**Figure 5-8** provides a template of the internodal version of a net-centric SV-1, showing system interfaces between nodes from node edge to node edge. Items shown to help illustrate net-centricity include: 1) an Enterprise Service Bus (ESB), 2) systems deploying high-level functional groupings of services [the boxes with rounded corners] and 3) a web-portal system. Information identifying service consumers and providers could be attached as metadata to each node. It is not necessary to depict individual services in this layer, as the sheer number of them would quickly add to the complexity of the diagram. However, a high-level grouping of services (service families) assists in identifying systems that may have large sets of services that may be offered. Individual services within the service families may be decomposed in the net-centric SV-4. Furthermore, the diagram illustrates that the same system may appear in different nodes, but offer different sets of service functional groupings. This is meant to highlight the fact that a system might offer a set of services to the NCE from different locations, but each set is still to be considered part of the same system. Figure 5-8 introduces an illustration of ESB usage, with the EIEMA location providing Core Enterprise Services.

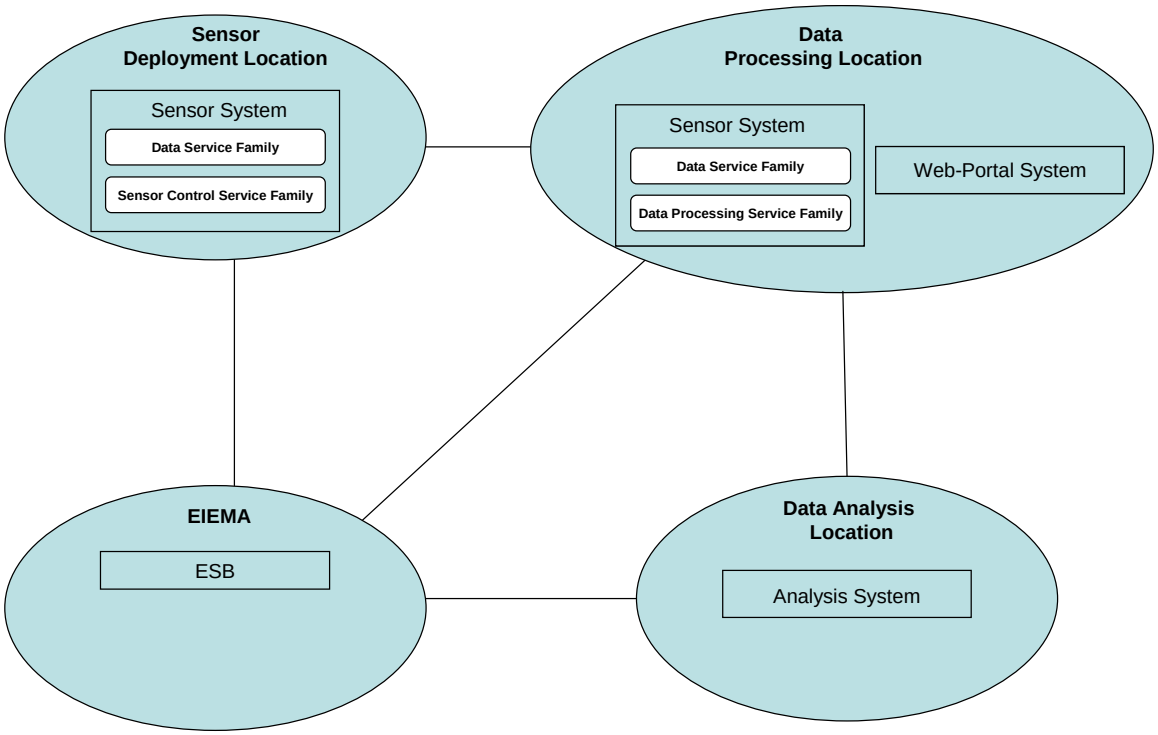


**Figure 5-8: Notional Example: SV-1: Layer 1 Example**

**Figure 5-9** provides a template of the intranodal version of an SV-1, showing interfaces from system-to-system, system-to-service, and service-to-service. Figure 5-9 is meant to provide an

example of a single diagram from a 2nd layer of SV-1s, which consists of a series of diagrams decomposed from Figure 5-8. Figure 5-9 illustrates services and their connections from the viewpoint of one node, the "Data Processing and Storage Location" node. Other 2nd layer SV-1 diagrams would be necessary to illustrate viewpoints from different nodes. The service families appearing in Figure 5-8 are decomposed in Figure 5-9 to show the specific set of services hosted at each node. Furthermore, Figure 5-9 highlights specific services provided by the ESB that are used by the program's owned systems and services. Note: Figure 5-9 is only an example of a layered approach to SV-1. Other viewpoints, other than the example nodal-view, are possible. The number of SV-1 layers will depend on the scope of the program's architecture.

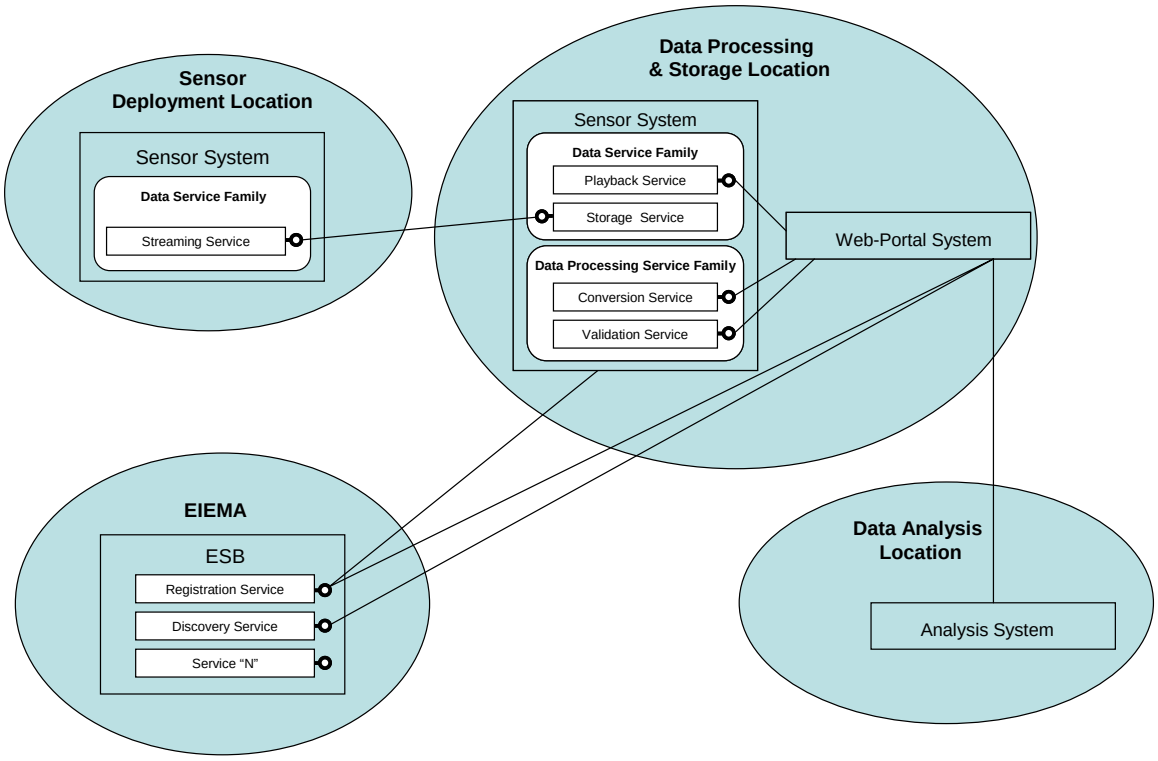


**Figure 5-9: Notional Example: SV-1: Layer 2 Example**

### 5.1.4 CADM Support for SV-1

SV-1 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-INTERFACE-DESCRIPTION. To capture the information content of the SV-1 product in CADM v1.5, each of its components (i.e., each specific interface) is linked to it via ObjectVersionAssociation (see Volume III for details).

The specific system interfaces, in turn, can be expressed in CADM v1.5 in terms of links between specific pairs of System instances coupled to a specific TechnicalInterface. Where required, the primary communications medium and relevant standards for the SV-1 can be expressed in CADM v1.5, the latter via the entities InformationTechnologyStandard and MessageStandard. The attribute CategoryCode in InformationTechnologyStandard can be set to PROTOCOL-STANDARD or INFORMATION-TECHNOLOGY-STANDARD-PROFILE, when one needs to refer to those types of technical standards in connection with DoDAF product SV-1.

Each system referenced in SV-1 is identified and described by populating the entity System. The set of System instances addressed in the Systems and Services View of an Architecture can

be captured in CADM v1.5 by linking them through ObjectVersionAssociation. As noted in the discussion of taxonomies (see AV-2 above), systems can also be related to other systems in CADM v1.5. Classification of systems according to general classes can be done through the entity SystemType. Finally, instances of Capability, DirectedConstraint, Document, EquipmentType, InformationAsset, Organization, ProcessActivity, Satellite, SecurityClassification, and SoftwareType can also be related to a given instance of System in CADM (not all of these appear in **Figure 5-10** provided below).

For some architectures, the operational requirements of equipment and subordinate organizations for each OrganizationType depicted in (or described by) SV-1 may be of fundamental importance. CADM v1.5 contains structures that can capture the information content of Tables of Organization and Equipment (TOEs) – see Volume III for details.

Similarly, the Modified Tables of Organization and Equipment (MTOE) for an Organization can be recorded in a CADM-structured database by linking the TOE to the instance of Organization. All the TOEs (and MTOEs) applicable to a specific Architecture can be recorded through the appropriate entries in ObjectVersionAssociation.

An SV-1 can apply to many architectures. This is expressible in CADM by establishing a relationship between the instances of Architecture to that instance of Document. Any other DoDAF system products related to SV-1 (such as SV-2, SV-3, and SV-4) can be linked to a given SV-1 by populating establishing associations among Document instances.

Figure 5-10 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-1 in a CADM-conformant database.

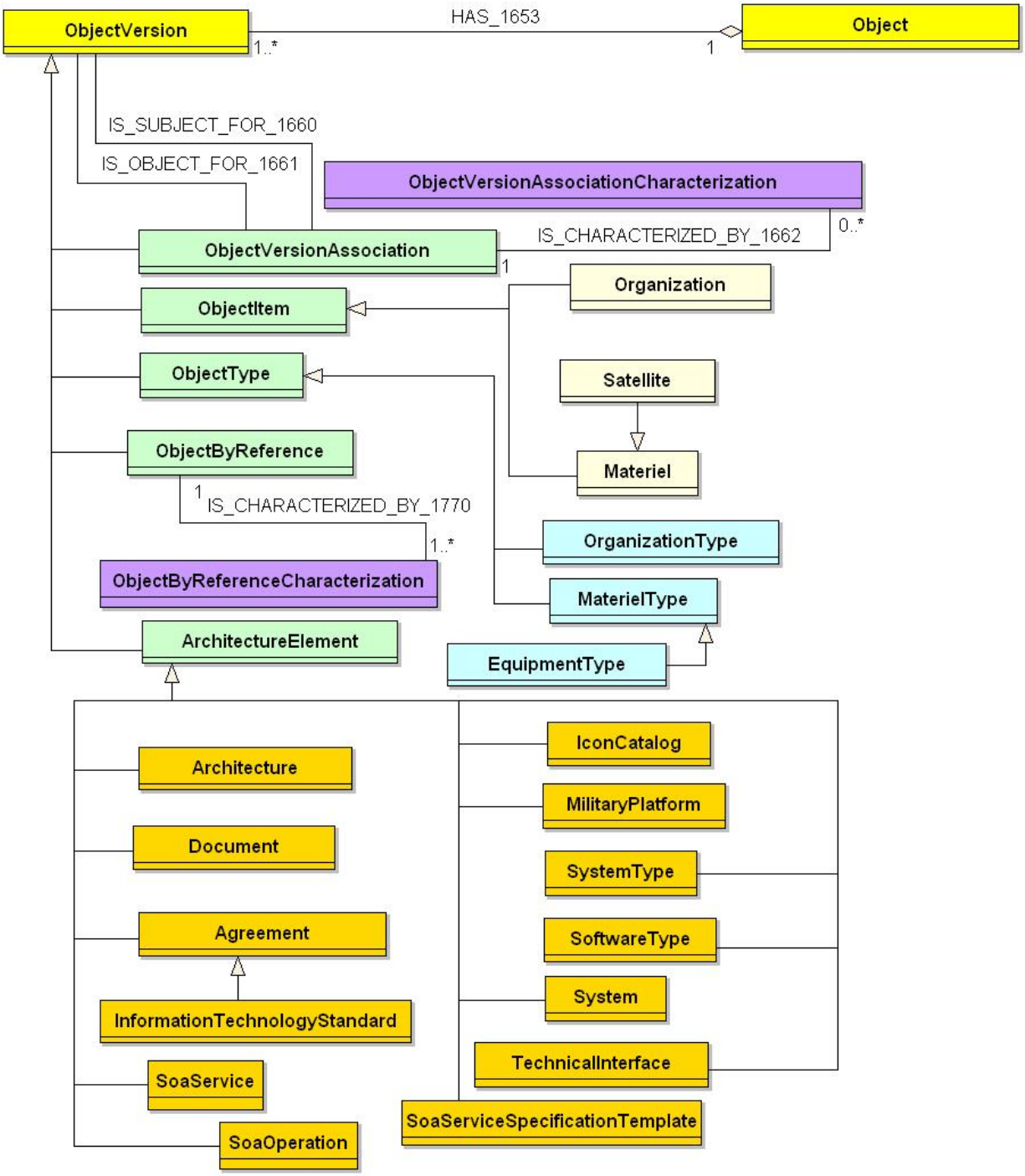


**Figure 5-10: CADM Diagram for SV-1**

### 5.1.4.1 SV-1 – Data Element Definitions

**SV-1 Information Space**

Agreement†
Architecture†
Document†
IconCatalog†
Materiel†
MaterielType†
MilitaryPlatform†
Organization†
Organization Type†
Satellite†
SoaOperation†
SoaService†
SoaServiceSpecificationTemplate†
System†
**EquipmentType**
**InformationTechnologyStandard**
**SoftwareType**
**SystemType**
**TechnicalInterface**

†) The descriptions of these elements have been provided in the preceding sections

**Table 5-1** describes the architecture data elements associated with SV-1.

**Table 5-1: Data Element Definitions for SV-1**[34]

| Data Elements | Attributes | Definition |
|---|---|---|
| **EquipmentType** | | |
| | alternateIdentifierText | The text for the identifier that alternatively represents a specific EquipmentType. |
| | cargoArea | The area required to store the EquipmentType when configured for transport. |
| | cargoDescriptionText | The free-form text describing the EquipmentType being defined. |
| | cargoHeightDimension | The height dimension of the EquipmentType when configured for transport. |
| | cargoLengthDimension | The length dimension of the EquipmentType when configured for transport. |
| | cargoVolume | The volume of the EquipmentType when configured for transport. |
| | cargoWeight | The weight of the EquipmentType when configured for transport. |
| | cargoWidthDimension | The width dimension of the EquipmentType when configured for transport. |
| | makeName | The name of the originator of a specific EquipmentType |
| | modelSeriesIdentifier Text | The text that identifies a specific manufacturer production series for an EquipmentType. |
| | peakPowerQuantity | The quantity that represents the maximum electrical power demanded under operation of a specific EquipmentType. |
| | receiver-transmitterQuantity | The quantity that represents the number of receiver/transmitter units for a specific EquipmentType. |
| | roleCategoryCode | The code that denotes a class of use to which the EquipmentType is commonly put. |
| **InformationTechnology Standard*** | | |

[34] As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

| Data Elements | Attributes | Definition |
|---|---|---|
| | categoryCode* | The code that represents a class of InformationTechnologyStandard. |
| | criterionDescriptionText | The text that characterizes the parameters against which an InformationTechnologyStandard is to be evaluated. |
| | designatorSource AbbreviatedName | The shortened form of the name commonly used to specify the standards body that promulgates a specific InformationTechnologyStandard. |
| | designatorSource IdentifierText | The text that describes the identifier assigned by the source standards body to a specific InformationTechnologyStandard. |
| | DevelopmentalStatus Code | The code that represents the state of preparation of an InformationTechnologyStandard. |
| | layerCode | The code that represents the predominant element of the seven-layer open systems interconnection (OSI) reference model that applies to a specific InformationTechnologyStandard. |
| | measureDescriptionText | The text that characterizes how the InformationTechnologyStandard is to be applied for conformance. |
| | profileTypeCode | The code that represents a kind of profile for a specific InformationTechnologyStandard. |
| | projectSpecificCode | The code that represents whether a specific InformationTechnologyStandard is used only for a specific implementation. |
| **SoftwareType** | | |
| | buildIdentifierText | The text that identifies a specific integration event for a SoftwareType. |
| | categoryCode | The code that represents the class of a SoftwareType. |
| | centralProcessingUnit RequirementText | The text that represents the characteristics (e.g., speed) of a central processing unit in order to satisfactorily operate the SoftwareType. |
| | commentText | The text that amplifies information regarding a specific SoftwareType. |
| | commercialOffTheShelf Code | The code that represents whether a specific SoftwareType is available as a commercial off-the-shelf product. |
| | complianceCode | The code that represents the level of compliance of the current version of a SoftwareType with the defense information infrastructure (DII) common operating environment (COE). |
| | diskSpaceRequirement Text | The text that describes the disk space required for a SoftwareType. |
| | executableLinesOfCode Quantity | The quantity that represents the number of linear elements of programming language, excluding comments, for a SoftwareType. |
| | governmentOffTheShelf Code | The code that represents whether a specific SoftwareType is available as a government-developed off-the-shelf product. |
| | longName | The complete (formal) name of a specific SoftwareType. |
| | manufacturerName | The name of the manufacturer of a SoftwareType. |
| | maximumSimultaneous UserQuantity | The quantity that represents the largest number of simultaneous users for a specific SoftwareType. |
| | memoryRequirement Text | The text that describes the central processing unit memory capacity required for the SoftwareType to function correctly. |
| | outputFormat | The text that summarizes the syntax used to export data for a |

| Data Elements | Attributes | Definition |
|---|---|---|
| | DescriptionText | specific SoftwareType. |
| | releaseCalendarDate | The calendar date a specific SoftwareType was distributed for general use. |
| | securityFeature CommentText | The text that briefly characterizes the access control for a specific SoftwareType. |
| | subcategoryCode | The code that represents a detailed classification of SoftwareType. |
| | versionChangeText | The text that describes the differences in functionality incorporated into the specific SoftwareType. |
| | versionIdentifierText | The text that identifies a specific release of the SoftwareType. |
| **SystemType** | | |
| | alternateIdentifierText | The text that pertains to the identifier that is alternatively used to specify a SystemType. |
| **TechnicalInterface** | | |
| | commentText | The text that provides additional information regarding a specific TechnicalInterface. |
| | importanceCode | The code that represents whether a specific TechnicalInterface has been determined to be crucial to a mission capability. |
| | statusCode | The code that represents the state of a specific TechnicalInterface. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| Architecture | uses | IconCatalog |
| EquipmentType | is operated using | SoftwareType |
| EquipmentType | is used in | System |
| InformationTechnologyStandard | is cited for use in | MaterielType |
| InformationTechnologyStandard | uses | System |
| InformationTechnologyStandard | pertains to | TechnicalInterface |
| InformationTechnologyStandard | applies to | SoaService |
| MaterielType | identifies | EquipmentType |
| MaterielType | may be a | SoftwareType |
| Organization | is assigned | TechnicalInterface |
| Organization | is source for | SoftwareType |
| SoaService | uses | EquipmentType |
| SoaService | uses | SoftwareType |
| SoaService | uses | TechnicalInterface |
| SoftwareType | is provided for | EquipmentType |
| SoftwareType | is related to | SoftwareType |
| System | uses | SoftwareType |

(All previous relationships for the listed entities that comprise the information space of SV-1 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 5.2 SYSTEMS AND SERVICES COMMUNICATIONS DESCRIPTION (SV-2)

### 5.2.1 SV-2 – Product Description

**Product Definition**. The SV-2 depicts pertinent information about communications systems, communications links, and communications networks. SV-2 documents the kinds of communications media that support the systems and implements their interfaces as described in SV-1. Thus, SV-2 shows the communications details of SV-1 interfaces that automate aspects of the needlines represented in OV-2.

**Product Purpose**. SV-2 can be used to document how interfaces (described in SV-1) are supported by physical media. This kind of communications media support information is critical in performing certain infrastructure and system acquisition decisions.

**Product Detailed Description**. SV-2 documents the specific communications links or communications networks (e.g., Intelink or Joint Worldwide Intelligence Communications System (JWICS)) and the details of their configurations through which systems interface. While SV-1 depicts interfaces between systems or systems nodes, SV-2 contains a detailed description of how each SV-1 interface is implemented (e.g., composing parts of the implemented interface including communications systems, multiple communications links, communications networks, routers, and gateways).

Communications systems (e.g., switches, routers, and communications satellites) are systems whose primary function is to control the transfer and movement of system data as opposed to performing mission application processing.

A communications link is a single physical connection from one system (or node) to another. A communications path is a (connected) sequence of communications systems and communications links originating from one system (or node) and terminating at another system (or node).

A communications network may contain multiple paths between the same pair of systems. The term *interface* used in SV-1 and referenced in SV-2 represents an abstraction of one or more communications path(s).

The graphical presentation and supporting text for SV-2 should describe all pertinent communications attributes (e.g., waveform, bandwidth, radio frequency, and packet or waveform encryption methods). Communications standards are also documented in this product, where applicable.

Because SV-2 depicts the implementation details for the interfaces described in SV-1 by decomposing them into communications systems, communications links, and communications networks, it can present either internodal or intranodal versions. The internodal version details the communications links and/or communications networks that interconnect systems nodes (node edge to node edge) or specific systems (system-system from one node to other nodes). The intranodal version of SV-2 looks inside each of the represented nodes to illustrate the communications links between specific systems.

**Figure 5-11** provides a template for the internodal version of SV-2. Note that Figure 5-11 translates the single-line representations of interfaces (as shown in the SV-1 internodal version) into an implementation detail of the communications infrastructure that provides the connections.

The small boxes in Figure 5-11 represent communications systems, as do the satellite icons. The lines between the communications systems represent communications links and, together with communications systems, can be organized into communications paths or networks.

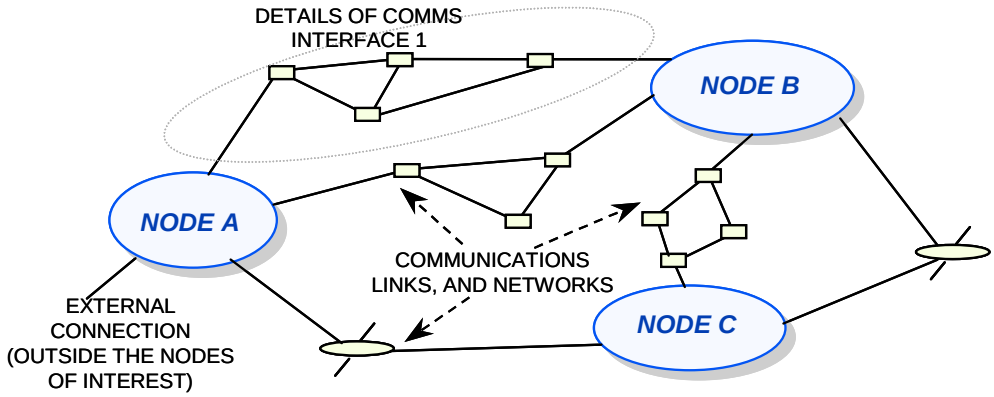


**Figure 5-11: Systems Communications Description, Internodal Version (SV-2) – Template**

**Figure** 5-12 provides a template for the intranodal version of SV-2.

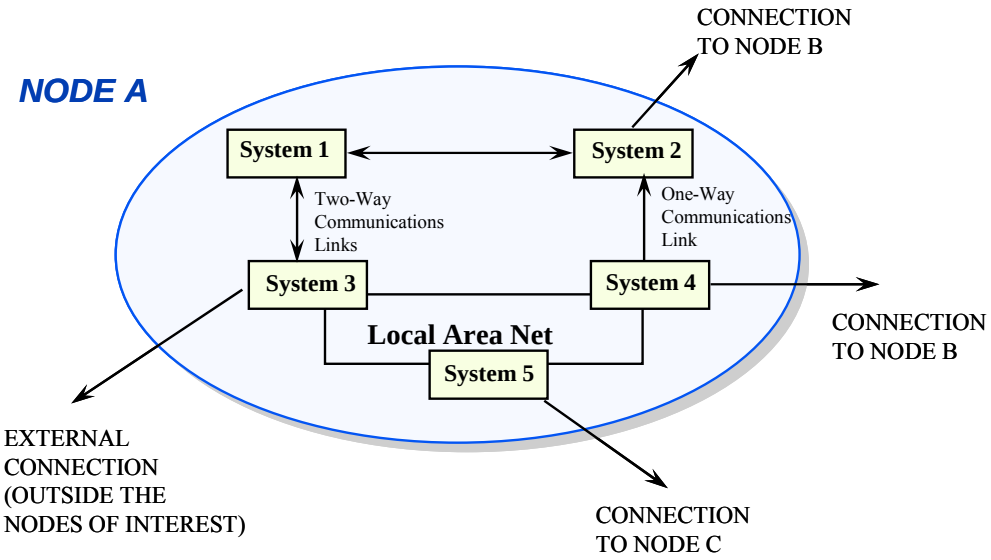


**Figure 5-12: Systems Communications Description, Intranodal Version (SV-2) – Template**

### 5.2.2 UML Representation

An effective way to develop SV-2 using the UML is with a class diagram. The class diagram association stereotyped is <<connection>> and named to identify the communications medium. Additionally, key interface elements further describe the relevant interface, its function and related operational view component. For complex architectures, the architect may choose not to depict interface elements and their underlying operational components.

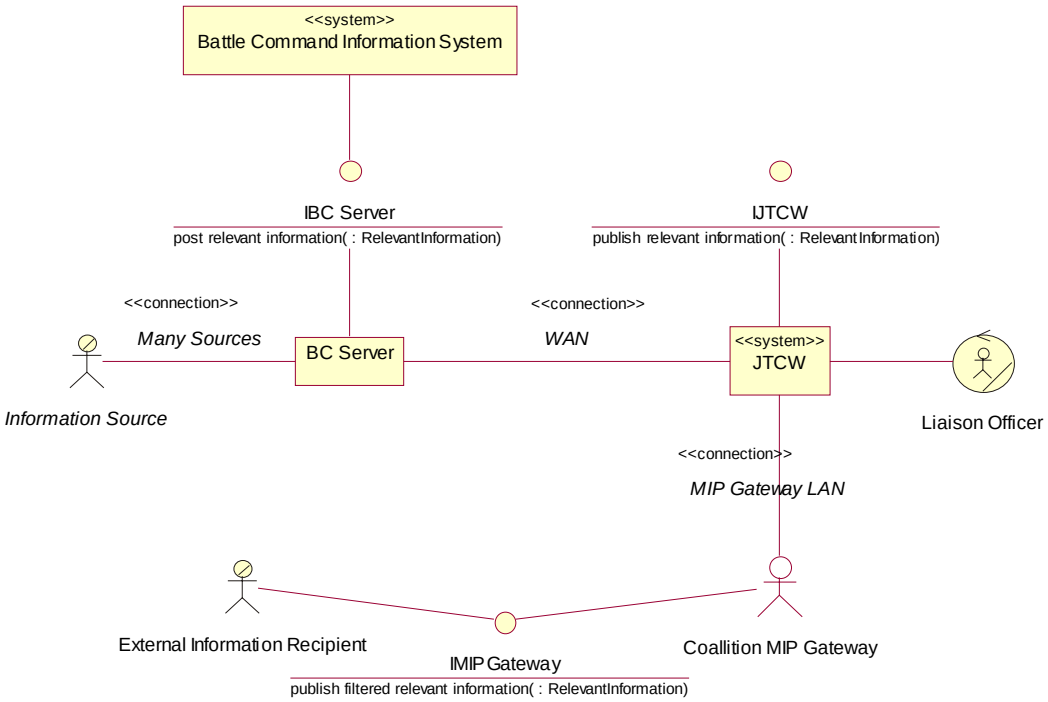


**Figure 5-13: UML Representation for SV-2**

Because actors aggregate to operational nodes, this information is contained in the model. For example, the Liaison Officer interacts with the JTCW; therefore, the JTCW belongs to the same operational node as the Liaison Officer. This is a good example of the difference between structured analysis and object-oriented technique. The two methods do not always map one-to-one on all views; however, the related intent and model information is still applied.

### 5.2.3 Net-Centric Guidance SV-2

**Augmented Product Purpose.** In a net-centric architecture, the SV-2 is used to 1) detail the communication paths used by the interfaces between services, systems, and system nodes, 2) highlight critical communications infrastructure that is connecting to or shared with the NCE, and 3) depict the physical mechanisms that host services provided to the NCE.

**Net-Centric Product Description.** The SV-2 traditionally documents the specific communications links or communications networks and the details of their configurations through which systems interface. Accordingly, in the NCE, the SV-2 contains a detailed description of how each SV-1 interface is implemented and depicts communications systems, links, protocols, standards, and networks that support the delivery of information and capabilities to services and consumers in the NCE. It is important to note that in a net-centric SV-1 a system node containing services should have interface lines that highlight the use of internet protocols (i.e., HTTP, SOAP).

***Services*** are a key means to share information and functionality in the NCE through published ***service interfaces***, as depicted in the SV-1, that enable interoperability among applications across the NCE. The details of how the ***service interfaces*** are physically implemented at the network layer can be captured in the SV-2 by depicting different views of the communications layers between services. The SV-2 provides a more detailed communications

analysis and can be depicted in separate SV-2s to show different layers of the communications network. For example, network layer messaging capabilities such as SOAP intermediary message routers can be captured in the SV-2. As part of the net-centric SV-2, the DoD-wide SST should be used to the extent possible for describing each service. Regardless of the precise SST, the necessary minimum subset of information from the SST for each service must be captured in the SV-2:

- ***Service Access Point Information Category*** includes information that describes the message format and transmission protocol, URL, the operational status and point of contact, and the lifecycle step of the service (i.e., development, testing, or production).
  - This would include information about the host layer that depicts hosting locations for services and lists the service implementations they are hosting. Implementations that should be represented include offered services that appear in the net-centric SV-1, ***enterprise service bus*** components, and infrastructure services.
- ***Quality Model Category*** includes information on the security requirements of the service, the QoS levels, and any performance considerations for service deployment.
  - ***Service Level Specifications*** identify performance specification details that stipulate expected service performance under identified circumstances and quality of service levels. This would include information at the physical layer that depicts physical components of communications channels between known providers and consumers and should illustrate network hops, bandwidth limits, and connectivity environment.

In addition to the SST elements, DoDAF v1.5 extends the service interface specifications, to include a ***Service Provider*** element. The ***Service Provider*** element identifies the organization providing the service (the organization that is the Service Functionality Provider operational role from the OV-2).

Separate SV-2s that show different communications layers can assist in understanding and depicting the complexity of the interoperability among applications and services across the NCE. The different depictions of the SV-2 should be linked among different layers to provide program managers a high-level view of the communications infrastructure.

Documenting these various aspects of net-centricity in the SV-2 products will describe service requirements on the capacity, timing, and reliability of services composing the architecture.

**Figure 5-14** illustrates an intranodal version of a net-centric SV-2 from the viewpoint of a single node that appears in the net-centric example SV-1. In this example, the single interface

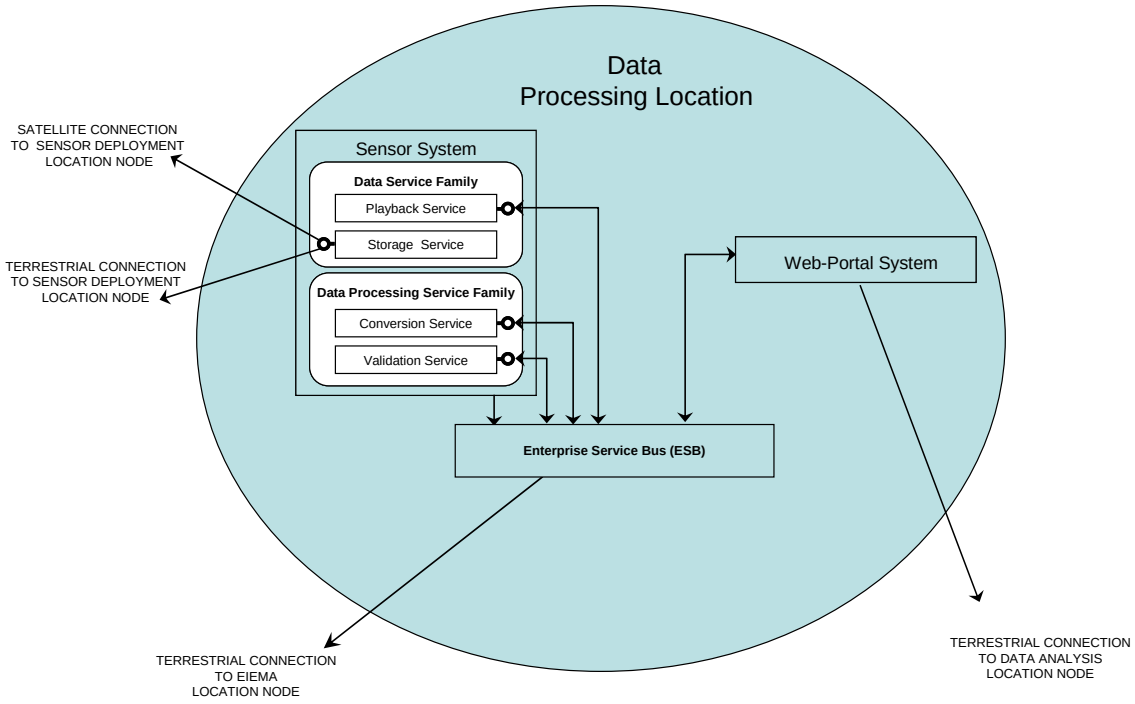


**Figure 5-14: Notional Example: SV-2: Layer 2 Example**

appearing in the net-centric SV-1 notional example between the Data Service Family's Storage Service in the Data Processing Location and the Data Service Family's Streaming Service in the Sensor Deployment location is supported by two communications paths, a satellite connection and a terrestrial connection. Also highlighted are interfaces to locally hosted ESB components, which provide service related messaging and transport mechanisms internal to the node. Specifics on communications networks and protocols should be attached as metadata to each communication path.

### 5.2.4 CADM Support for SV-2

SV-2 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-COMMUNICATION-DESCRIPTION. To capture the information content of the SV-2 product in CADM v1.5, each of its components are linked to it via ObjectVersionAssociation (see Volume III for details). The subject of each SV-2 is a set of Node instances and their associations defined as a specific Network. In CADM v1.5, instances of the entity Network can be linked to Capability, System, and InformationTechnologyStandard. The link to Capability serves to record quantifiable measures of performance (MOPs) for components of the Network.

Additional characteristics cited for a specific SV-2 are specified using the following entities, as applicable:

- CommunicationMedium
- EquipmentType (a subset of MaterielType)
- Materiel and its associations to other instances of Materiel, as well as associations to Organization
- SoftwareType

Nodal diagrams prepared for SV-2 can also be linked to IconCatalog in the CADM to associate graphical representations to the content of SV-2, and enable, for example, the specification of which fields shall be presented when users highlight (click) an icon. To that effect, the attribute NodeIconCategoryCode in IconCatalog can be set to LINK-ICON or NODE-ICON.

In CADM v1.5 Network can be linked to Architecture, Node, other instances of Network, Capability, CommunicationMedium, Organization, and NetworkType. Each Node can be related to other instances of Node as well as any of the following entities as required: ActivityModelInformationElementRole, CommunicationMedium, DataItemType, Capability, Organization, OrganizationType, ProcessActivity, System, and Task (not all are shown in **Figure** 5-15).

SV-2 can be populated with electronic addresses for each fielded communications device by linking them to instances of the entity ObjectByReference with its CategoryCode = INTERNET-ADDRESS.

Because many other CADM entities involved in SV-2 are the same as for SV-1, their discussion is not repeated here.

Figure 5-15 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-2 in a CADM-conformant database.

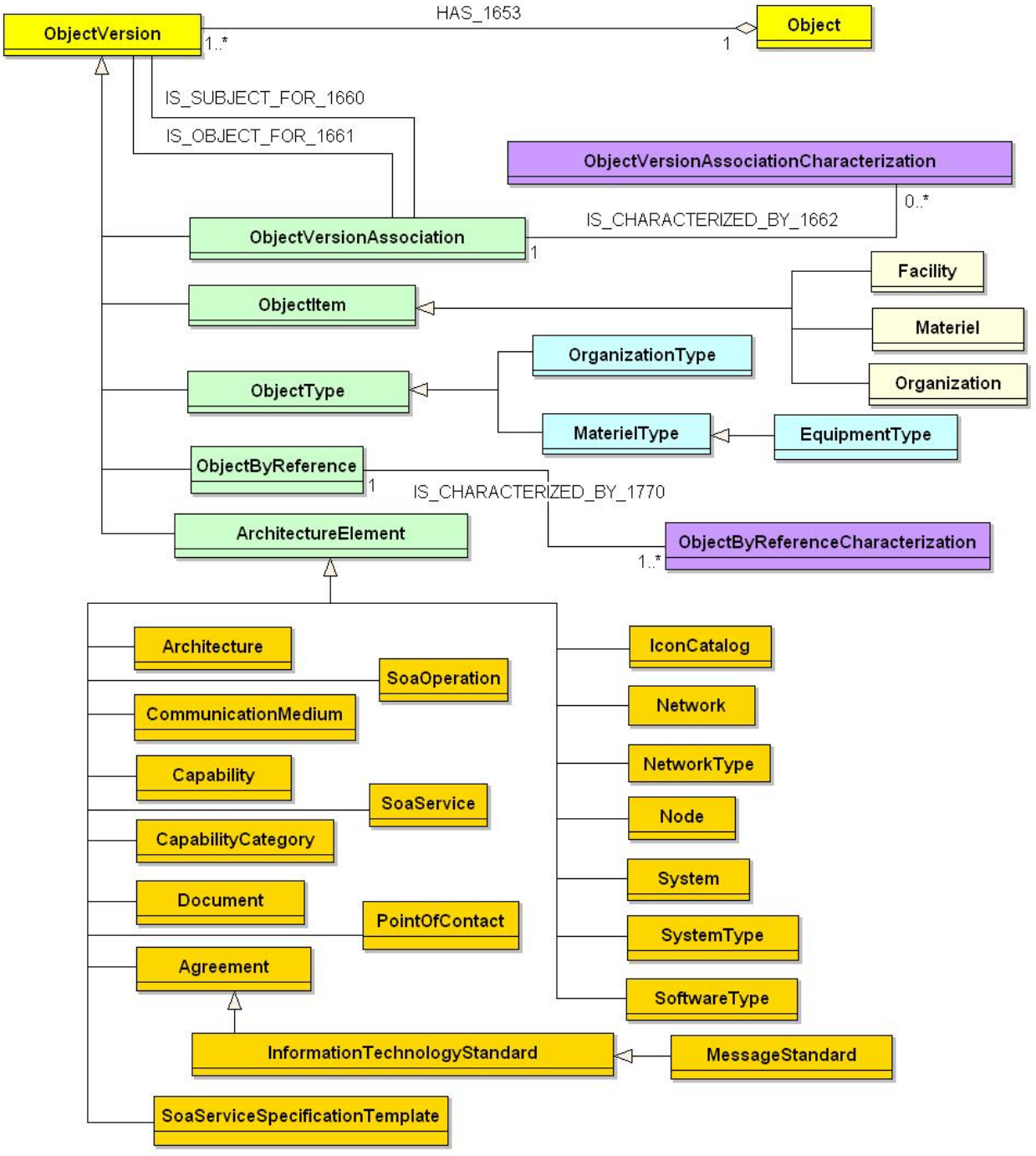


**Figure 5-15: CADM Diagram for SV-2**

#### 5.2.4.1 SV-2 – Data Element Definitions

SV-2 depicts the implementation of the interfaces from SV-1 as specific communications systems, communications links, communications paths, or communications networks and the details of their configurations through which the systems interface. **Table 5-2** describes the architecture data elements associated with SV-2.

## SV-2 Information Space

Agreement†
Architecture†
Capability†
CapabilityCategory†
CommunicationMedium†
Document†
EquipmentType†
Facility†
IconCatalog†
InformationTechnologyStandard†
Materiel†
MaterielType†
Network†
NetworkType†
Node†
Organization†
OrganizationType†
PointOfContact†
SoaOperation†
SoaService†
SoaServiceSpecificationTemplate†
SoftwareType†
System†
SystemType†
**MessageStandard**

†) The descriptions of these elements have been provided in the preceding sections

**Table 5-2 Data Element Definitions for SV-2**

| Data Elements | Attributes | Definition |
|---|---|---|
| **MessageStandard** | | |
| | categoryCode | The code that represents a class of MessageStandard. |
| | formatCode | The code that represents a kind of MessageStandard format. |
| | lastRevisionCalendar Date | The calendar date of last change of the MessageStandard as approved for information system usage. |
| | referenceIdentifierText | The text to describe the identifier of the MessageStandard as cited for its message set. |
| | transactionTable GenerationName | The name that represents the physical source of a transaction for a specific MessageStandard. |
| | transactionUsageName | The name that represents the primary employment of a transaction for a specific MessageStandard. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| PointOfContact | is cited for | SoaServiceSpecificationTemplate |

(All previous relationships for the listed entities that comprise the information space of SV-2 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 5.3 SYSTEMS-SYSTEMS, SERVICES-SYSTEMS, SERVICES-SERIVCES MATRICES (SV-3)

### 5.3.1 SV-3 – Product Description

**Product Definition**. The SV-3 provides detail on the interface characteristics described in SV-1 for the architecture, arranged in matrix form.

**Product Purpose**. SV-3 allows a quick overview of all the interface characteristics presented in multiple SV-1 diagrams. The matrix form can support a rapid assessment of potential commonalities and redundancies (or, if fault-tolerance is desired, the lack of redundancies).

SV-3 can be organized in a number of ways (e.g., by domain, by operational mission phase) to emphasize the association of groups of system pairs in context with the architecture purpose. SV-3 can be a useful tool for managing the evolution of systems and system infrastructures, the insertion of new technologies/functionality, and the redistribution of systems and processes in context with evolving operational requirements.

**Product Detailed Description**. SV-3 is a summary description of the system-system interfaces identified in SV-1. SV-3 is similar to an $N^2$-type matrix, where the systems are listed in the rows and columns of the matrix, and each cell indicates a system pair interface, if one exists. Many types of interface information can be presented in the cells of SV-3. The system-system interfaces can be represented using a number of different symbols and/or color codes that depict different interface characteristics. The following are examples:

- Status (e.g., existing, planned, potential, deactivated)
- Purpose (e.g., C2, intelligence, logistics)
- Classification level (e.g., SECRET, TS/SCI)
- Means (e.g., JWICS, Secret Internet Protocol Router Network (SIPRNET))
- Standard
- Key Interface

**Figure 5-16** provides a template for SV-3. Each cell may contain several interface characteristics, but this is not shown in the notional example provided below.

| | SYSTEM 1 | SYSTEM 2 | SYSTEM 3 | SYSTEM 4 | SYSTEM 5 | SYSTEM 6 | SYSTEM 7 | SYSTEM 8 | SYSTEM 9 | SYSTEM 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| SYSTEM 1 | | ● | | | | | | | | |
| SYSTEM 2 | ● | | ● | ● | ● | ● | | | | |
| SYSTEM 3 | | ● | | ● | ● | ● | | | | |
| SYSTEM 4 | | ● | ● | | ● | ● | | | | |
| SYSTEM 5 | | ● | ● | ● | | ● | | | | |
| SYSTEM 6 | ● | ● | ● | ● | ● | | ● | ● | ● | ● |
| SYSTEM 7 | | | | | | ● | | | | |
| SYSTEM 8 | | | | | | ● | | | | |
| SYSTEM 9 | | | | | | ● | | | | |
| SYSTEM 10 | | | | | | ● | | | | |

**Figure 5-16: SV-3 – Template**

### 5.3.2 UML Representation

There is no equivalent to this product in UML. Row and column headings should trace to systems of SV-1 (and SV-2).

### 5.3.3 Net-Centric Guidance for SV-3

**Augmented Product Purpose.** In a net-centric architecture, the SV-3 is used to capture ***service*** interactions, dependencies, and interface characteristics presented in the SV-1(s). The net-centric SV-3 highlights the services that the subject architecture is providing to the NCE, the services that the subject architecture is consuming from the NCE, and the dependencies between both.

**Net-Centric Product Description.** The SV-3 traditionally provides a summary description of the system-system interfaces identified in the SV-1. Accordingly, in the NCE, the SV-3 should also provide two additional summary products:

- **Services-Systems Matrix** to highlight 1) consuming non-SOA systems of the program interfacing with internal or external services obtained from the NCE, and 2) services provided interfacing with known internal or external NCE Service Consumers
- **Services-Services Matrix** to highlight services provided that interface with internal or external services obtained from the NCE (those relating to infrastructure are one example)

The Services-Systems Matrix and the Services-Services Matrix may provide a layer of detail under a higher level Systems-Systems Matrix if the systems concerned are decomposable into lower level services.

In the NCE, s***ervices*** are a key means to share information in the NCE, and are defined and captured in the SV-4 and SV-1. ***Services*** make information and capabilities available in the NCE through published ***service_interfaces*** that define the message exchange between the ***service provider*** and ***service consumer***, and enable interoperability among applications across the NCE. Documenting ***services-services interfaces*** in the SV-3 for a net-centric program will provide a quick overview of how services are being leveraged (i.e., the extent of net-centricity) and the ***service dependencies*** associated with delivering the systems capability. It also provides for a rapid assessment of commonalities and redundancies.

### 5.3.4 CADM Support for SV-3

SV-3 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-SYSTEM-MATRIX. The matrix is built via ObjectVersionAssociation, which links each of the components to the instance of SV-3. In CADM v1.5, it is also possible to capture semantics of Provider System and Recipient System. Provider System and Recipient System are related to each other in a CADM-structured database as one or more instances ObjectVersionAssociation. Further characterization of both the service-to-service and the system-to-system associations, e.g., communication means and constraints are also possible (see Volume III for details).

**Figure** 5-17 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-3 in a CADM-conformant database.

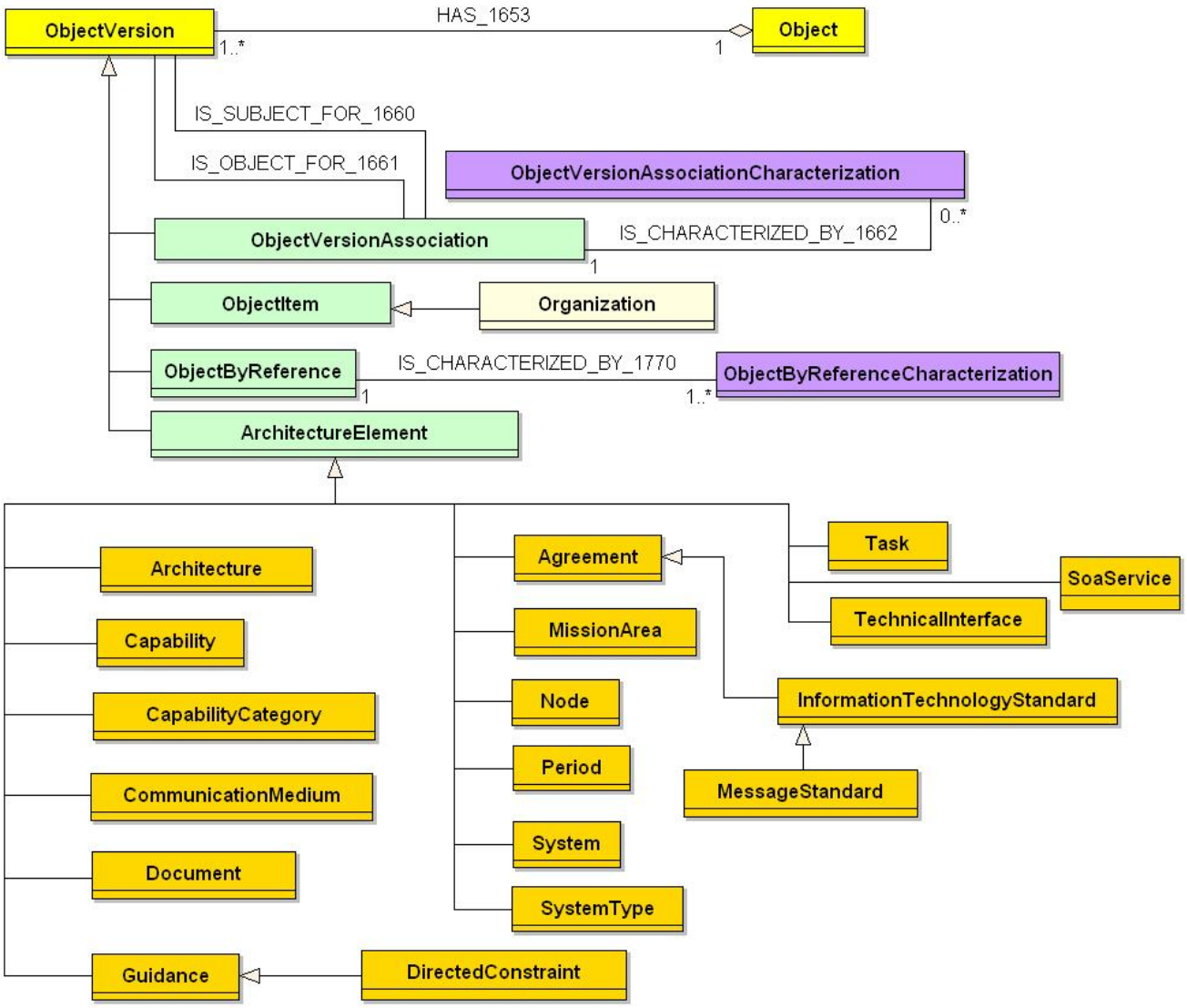


**Figure 5-17: CADM Diagram for SV-3**

In addition to the SV-3 linkages mentioned above, it is also possible to relate SV-3 to:

- Agreement (and its subtype InformationTechnologyStandard). The latter can be further specialized via its categoryCode. Possible values are: MESSAGE-STANDARD, PROTOCOL-STANDARD, and INFORMATION-TECHNOLOGY-STANDARD-PROFILE.
- SecurityClassification
- CommunicationMedium
- DirectedConstraint (a subtype of Guidance)

Linkage to SystemStatusType can be used to specify the status of systems that make up the SV-3. Details for each Provider System and Receiver System can also be captured (e.g., via the entity SystemType). SV-3 can be related to **Architecture** by the appropriate relationship of that instance of Document to Architecture in ObjectVersionAssociation. This allows the reuse of an

SV-3 in multiple architectures. The SV-3 can be related to other SV products such as SV-1, SV-2, and SV-4 by establishing the appropriate links to those instances of Document.

#### 5.3.4.1 SV-3 – Data Element Definitions

**SV-3 Information Space**

Agreement†
Architecture†
Capability†
CapabilityCategory†
CommunicationMedium†
Document†
Guidance†
InformationTechnologyStandard†
MessageStandard†
MissionArea†
Node†
Organization†
Period†
SoaService†
System†
SystemType†
Task†
TechnicalInterface†
**DirectedConstraint**

†) The descriptions of these elements have been provided in the preceding sections

**Table 5-3** defines the architecture data elements for SV-3.

**Table 5-3: Data Element Definitions for SV-3**

| Data Elements | Attributes | Definition |
|---|---|---|
| **DirectedConstraint** | | |
| | requirementCode | The code that represents whether a specific DirectedConstraint is required. |
| | statusCode | The code that denotes the state of a specific DirectedConstraint. |
| | typeCode | The code that represents a kind of a specific DirectedConstraint. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| System | has | DirectedConstraint |

(All previous relationships for the listed entities that comprise the information space of SV-3 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 5.4 SYSTEMS AND SERVICES FUNCTIONALITY DESCRIPTION (SV-4A AND 4B)

### 5.4.1 Systems Functionality Description (SV-4a) – Product Description

**Product Definition**. The SV-4a documents system functional hierarchies and system functions, and the system data flows between them. The SV-4 from DoDAF v1.0 is designated as 'SV-4a' in DoDAF v1.5. Although there is a correlation between OV-5 or business-process hierarchies and the system functional hierarchy of SV-4a, it need not be a one-to-one mapping, hence, the need for the Operational Activity to Systems Function Traceability Matrix (SV-5a), which provides that mapping.

**Product Purpose**. The primary purposes of SV-4a are to 1) develop a clear description of the necessary system data flows that are input (consumed) by and output (produced) by each system, 2) ensure that the functional connectivity is complete (i.e., that a system's required inputs are all satisfied), and 3) ensure that the functional decomposition reaches an appropriate level of detail.

**Product Detailed Description**. SV-4a describes system functions and the flow of system data among system functions. It is the SV counterpart to OV-5. SV-4a may be represented in a format similar to data flow diagrams (DFDs) [DeMarco, 1979]. The scope of this product may be enterprise wide, without regard to which systems perform which functions, or it may be system specific. Variations may focus on intranodal system data flow, internodal system data flow, system data flow without node considerations, function to system allocations, and function to node allocations.

The system functions documented in the SV-4a may be identified using the Service Component Reference Model (SRM),[35] or some other system function taxonomy, and correlated to SV-1 and SV-2 systems. System functions are not limited to internal system functions and can include Human Computer Interface (HCI) and Graphical User Interface (GUI) functions or functions that consume or produce system data from/to system functions that belong to external systems. The external system data sources and/or sinks can be used to represent the human that interacts with the system or external systems. The system data flows between the external system data source/sink (representing the human or system) and the HCI, GUI, or interface function can be used to represent human-system interactions, or system-system interfaces. Standards that apply to system functions, such as HCI and GUI standards, are also specified in this product.

Like OV-5, SV-4a may be hierarchical in nature and may have both a hierarchy or decomposition model and a system data flow model. The hierarchy model documents a functional decomposition. The functions decomposed are system functions. **Figure 5-18** shows a template for a functional decomposition model of SV-4a.

[35] The SRM is one of the reference models associated with the Federal Enterprise Architecture.

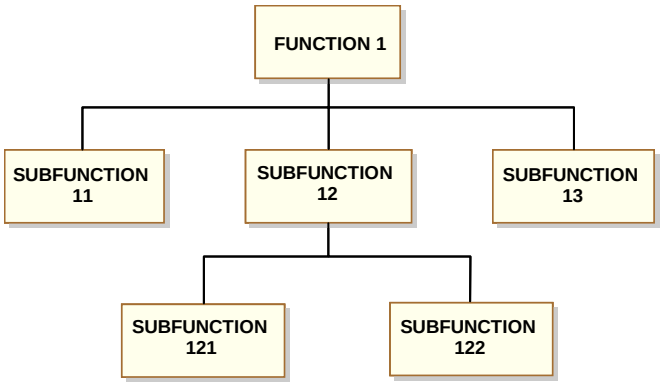


**Figure 5-18: SV-4a – Template (Functional Decomposition)**

SV-4a documents system functions, the flows of system data between those functions, the internal system data repositories or system data stores, and the external sources and sinks for the system data flows. It may represent external systems or the humans that interact with the system function. External sources and sinks represent sources external to the diagram scope but not external to the architecture scope. **Figure 5-19** shows a template for the DFD of SV-4a. The ovals represent system functions at some consistent level of decomposition, the squares are external system data sources and sinks, and the arrows represent system data flows. Internal system data repositories are represented by parallel lines. SV-4a(s) can be arranged hierarchically, with each system function at the parent level being decomposed into a child SV-4a at the next level.

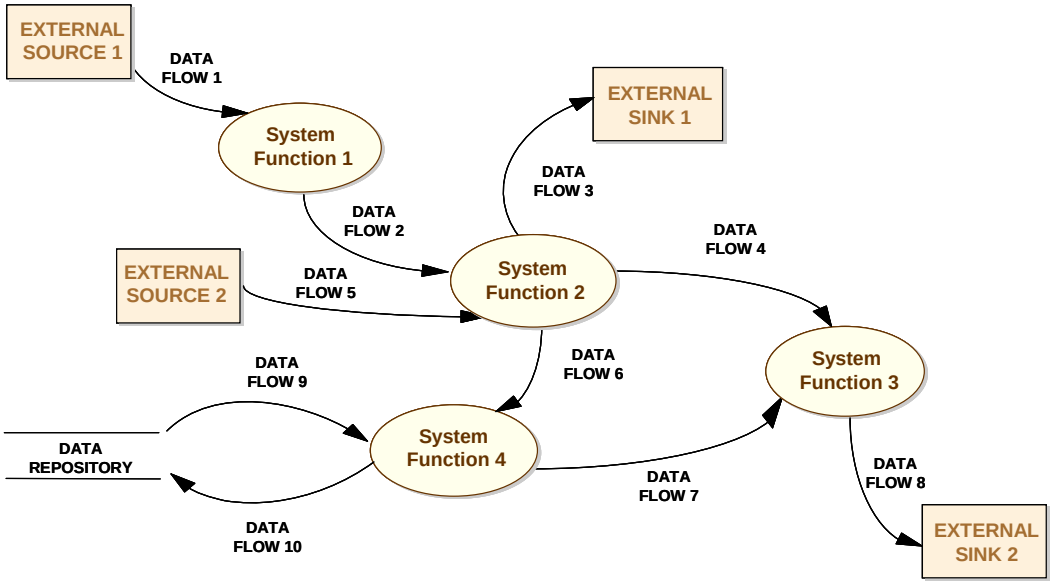


**Figure 5-19: SV-4a – Template (Data Flow Diagram)**

### 5.4.2 UML Representation

Use cases, classes, and class operations may be used to represent system or service functions in SV-4. Use case diagrams are used to model the interactions between humans, external systems, system functions, services, and service functions (use cases) within the scope of the diagram. Systems use cases may be identified as a refinement of the operational use cases (they have an <<include>> relationship with the operational use cases), and they represent the automated portions of those use cases representing operational activities from OV-5. Actors in

systems use case diagrams may represent a mix of both the humans supported by the system functions (correspond to those in OV-5 use case diagrams), and other systems external to the system being described but not necessarily external to the architecture. They are the equivalent of external sources and sinks in DFD notation. In addition, class diagrams are used to show static relationships between system functions. These diagrams collectively describe the systems or services support to the operational activities and operational use cases modeled in OV-5. **Figure 5-20** is a sample SV-4 template of a UML use case diagram.

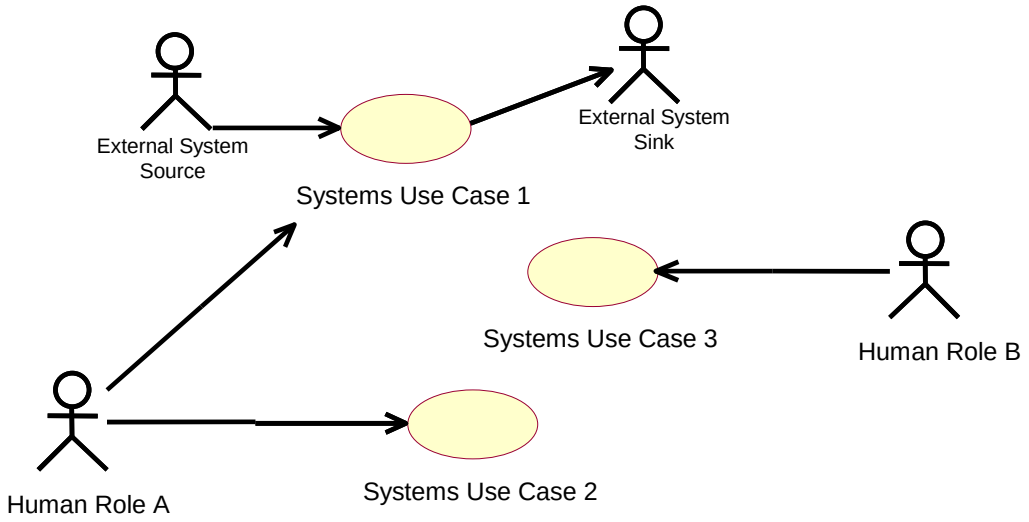


**Figure 5-20: UML Use Case Diagram for SV-4**

The systems' use cases and their relationships represented in this diagram should trace to the operational activities and operational use cases represented in OV-5 and to the systems identified in SV-1 and SV-2. The mapping between OV-5 to SV-4 use cases is not one to one; it is normally many to many going both ways. For those automated OV-5 operational activities, the operational activity maps to one or more systems use case(s) and to the realizations of the systems use cases via classes and class operations. SV-4 systems use cases depict system functional requirements, and actors represent entities that interface with the system functions.

Use case diagrams and class diagrams can be used to show system functional requirements (use cases) and system functions (classes and class operations that realize the use cases). Class diagrams are intended to model the static design perspective of an automated system. As SV-4 products, the classes represent the design perspective of the systems identified in SV-1 that execute the system functions. Attributes and operations for these classes (that show associated system data types and their permissible operations) may be specified or left out depending on the level of implementation detail needed. Packages and containment relationships can be used in conjunction with use case and class diagrams to show functional decomposition. **Figure 5-21** depicts relationships between SV-4a use cases and the collection (packages) of classes that implement them.

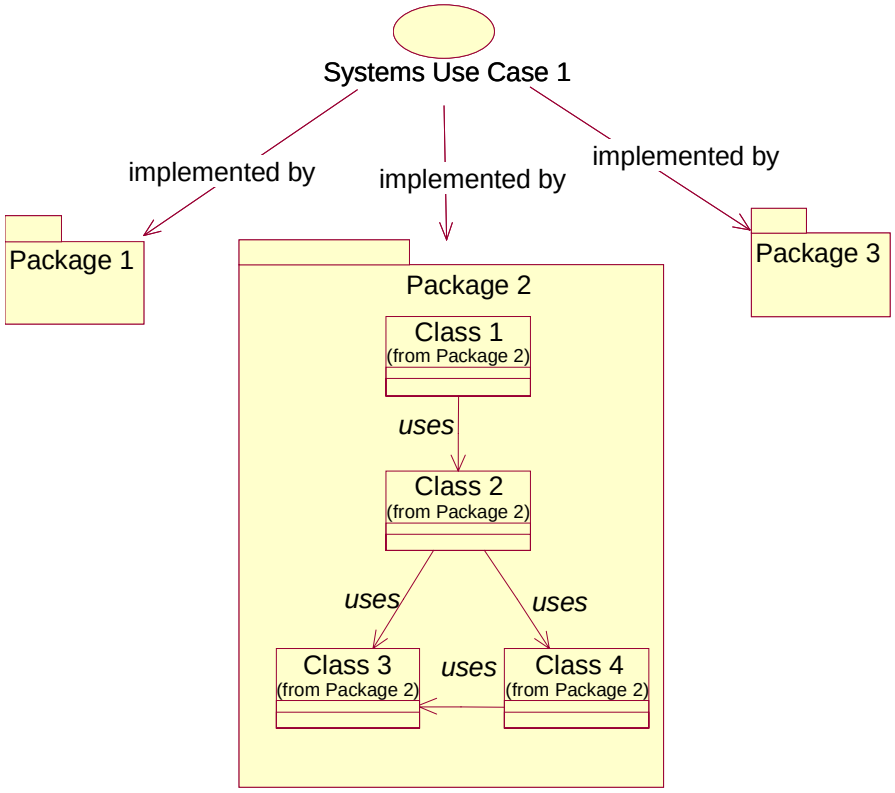


**Figure 5-21: UML Class Diagram for SV-4a**

Along with the system use case diagram, the system sequence diagram **Figure 5-22** also represents a good presentation of SV-4. This diagram depicts all the operations and related objects processed by the system component. In concert with the UML SV-2, which defines the communications <<connect>> type, the sequence diagram describes the patterns of behavior (functions) between the system elements to complete the desired result of value to the end actor.

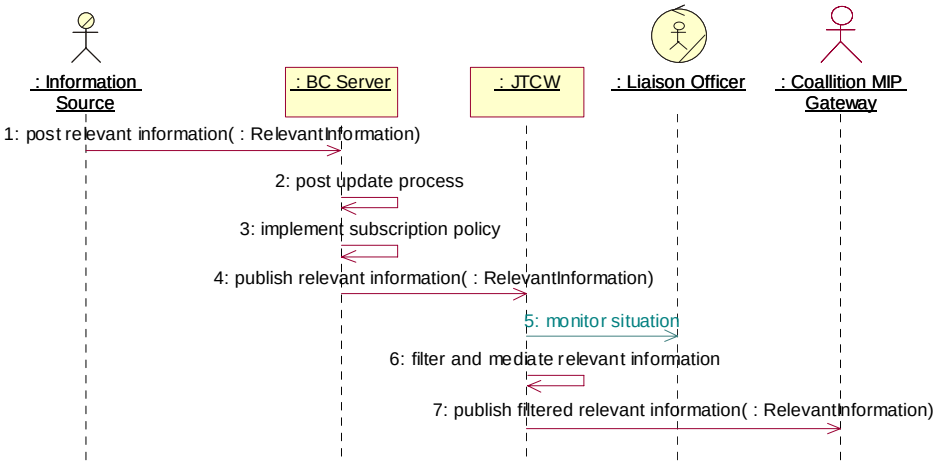


**Figure 5-22: Sequence Diagram**

### 5.4.3 Net-Centric Guidance for SV-4b

**Augmented Product Purpose**. In a net-centric architecture, the SV-4b is used to document service functionality that is exposed to the NCE, their respective grouping into service families, and their service specifications. It is the SV counterpart to OV-5. Although there is a correlation between OV-5 or business-process hierarchies and the service functional hierarchy of SV-4b, it need not be a one-to-one mapping, hence, the need for the Operational Activity to Services Traceability Matrix (SV-5c), which provides that mapping.

**Net-Centric Product Description**. The SV-4a traditionally describes system functions and the flow of system data between functions and correlated to SV-1 and SV-2 systems. In the NCE, the SV-4b should capture and depict how services are orchestrated together to deliver functionality associated with an operational need. In industry, this is often referred to as composeable applications.

Services are a key means to share information and capabilities in the NCE and can be captured in the SV-4b by relevant service groupings or families to assist in understanding how a set of services align with an operational domain or a system capability. The SV-4b also documents the data flows between services and may represent external services, systems, or humans that interact with the service. Multiple SV-4b products can be utilized to show deeper levels of detail as system nodes are decomposed into service families which further decompose into services that consist of specific operations and data.

In the NCE, services require robust and consistent descriptions to operate in the NCE where service capabilities are discoverable and able to be consumed in a scalable and flexible manner. The SV-4b should capture and depict information about each service that collectively represents the ***service specification***. A ***service specification*** should be provided for each service that is or will be provided to the NCE. The ***service specification*** enables services to be documented in a consistent manner, and the DoD-wide SST should be used to the extent possible for describing each service. Regardless of the precise SST, the necessary minimum subset of information from the SST for each service must be captured in the SV-4b:

- ***Interface Model Category*** includes information of the service specification that identifies the service and enables service consumers to discover the service and determine the service's suitability for their needs. It also provides assistance in the usage of the service, and includes ***service policies*** and the following types of attributes:
    - ***Service Name*** is a short descriptive name for the service to be provided and as it appears in the SV-1.
    - ***Service Version*** identifies the latest revision level of the service.
    - ***Service Description*** is a textual narrative that describes the service offering and its purpose.
- ***Service Access Point Information Category*** includes information of the service specification that identifies the lifecycle step of the service:
    - SAP Type identifies the lifecycle phase of the capability (e.g., Development, Testing, or Production).

- ***Information Model Category*** includes information of the service specification that identifies the data types that are used to interact with the service.
    - ***Data Types*** refers to the URI that points to documentation of complex data types and data structures that are used.
- ***Point Of Contact Information Category*** includes information on the types of contacts associated with a service, which may include developers, managers, or maintenance organizations.
- ***Service Access Point Information Category*** includes technology implementation details that identify the physical infrastructure the service is or can be deployed upon including hardware, software, message transport, and facilities. It is here (vs. the SV-1) where the transport binding details for the message exchange between services are captured (i.e., SOAP over HTTP, IDL over binary, XML over HTTP).
- ***Quality Model Category*** includes information on any performance considerations for service deployment.
    - ***Service Level Specifications*** identifies performance specification details that stipulate expected service performance under identified circumstances and quality of service levels.

In addition to the SST elements, DODAF v1.5 extends the service interface specifications to include a ***Service Provider*** element. The ***Service Provider*** element identifies the organization providing the service (the organization that is the Service Functionality Provider operational role from the OV-2).

For the ***Information Model Category*** of the SST, DoDAF v1.5 also extends the minimum set of information to include the following attributes***:***

- ***Overview*** identifies the attributes that include the name of the operation, a narrative that describes the operation, and the message Flow Pattern.
- ***Effects*** refer to the results that may come from invoking the operation.
- ***WSDL*** is the URI that points to a file that is composed of a bundle of other files including a WSDL and any supporting files for that WSDL.

Additional elements from the service specification categories are identified and documented within other architecture views, resulting in an integrated view of the service specification across architecture products.

As programs develop their SV-4s to document functions and services for systems, it may be difficult to distinguish between a service and a system function. Producing separate SV-4 products for system functions and services may enable the delineation between the two, particularly in hybrid environments. A new SV-4 product, the **Service Function Decomposition** only depicts the services decomposition, while maintaining compatibility of the SV-4 that depicts system functions.

**Figure 5-23** shows a template for the functional decomposition model for services of a net-centric SV-4b. It illustrates a hierarchy of services, with a high-level service or service family representation at its top. If the higher-level representation is a service family, services underneath it are those that are grouped into the service family. If the higher-level representation is an

individual service, the services below it are one that the higher-level service orchestrates to produce other functionality. Higher-level services or individual services may be represented in the SV-1 and may be mapped to services one-to-one or decomposed in the SV-4b. Points to note about the SV-4b are: 1) services may or may not be grouped into a service family 2) services can be decomposed into other services which are orchestrated together to provide other functionality, 3) Multiple SV-4b's can be used to highlight different service families or different orchestrations of services.

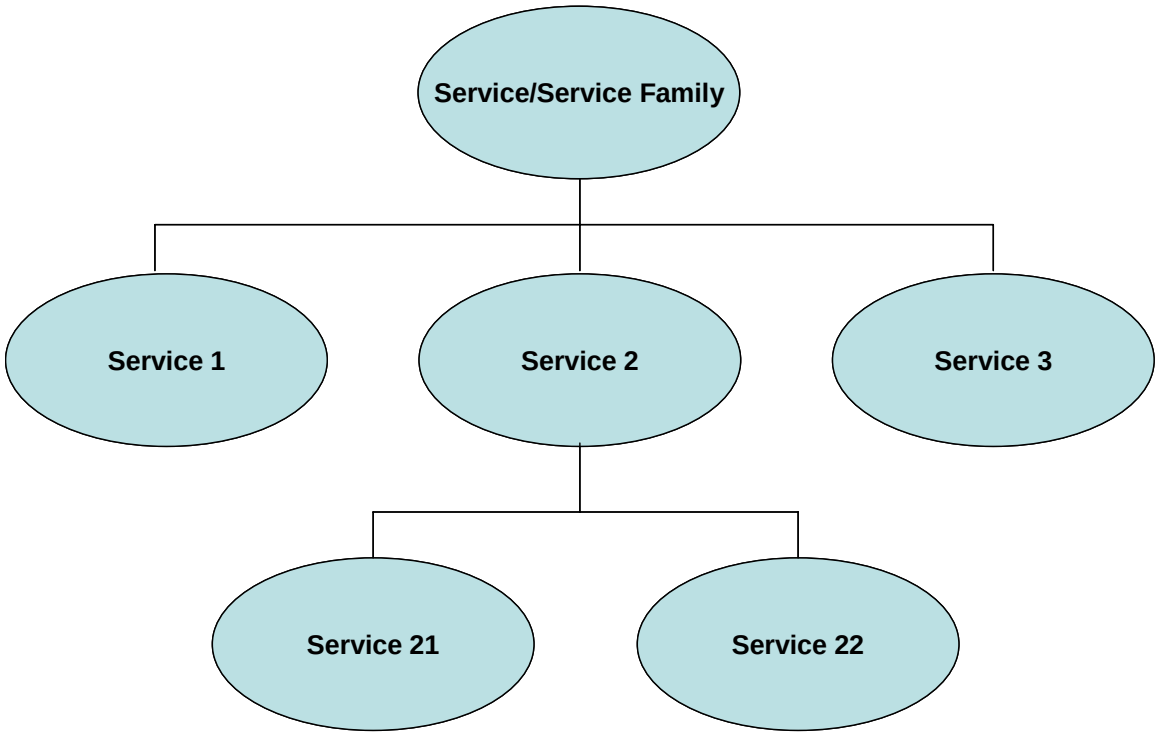


**Figure 5-23: Notional Example: SV-4b: Functional Decomposition**

**Figure** 5-24 shows a template for the Data Flow Diagram for services of a net-centric SV-4b. The ovals represent services, the squares are external system data sources and sinks, and the arrows represent the direction of the system data flows. The template illustrates exchanges between services internal to a view, between services internal to a view and services external to it, and services internal to a view and a web-portal external to it.

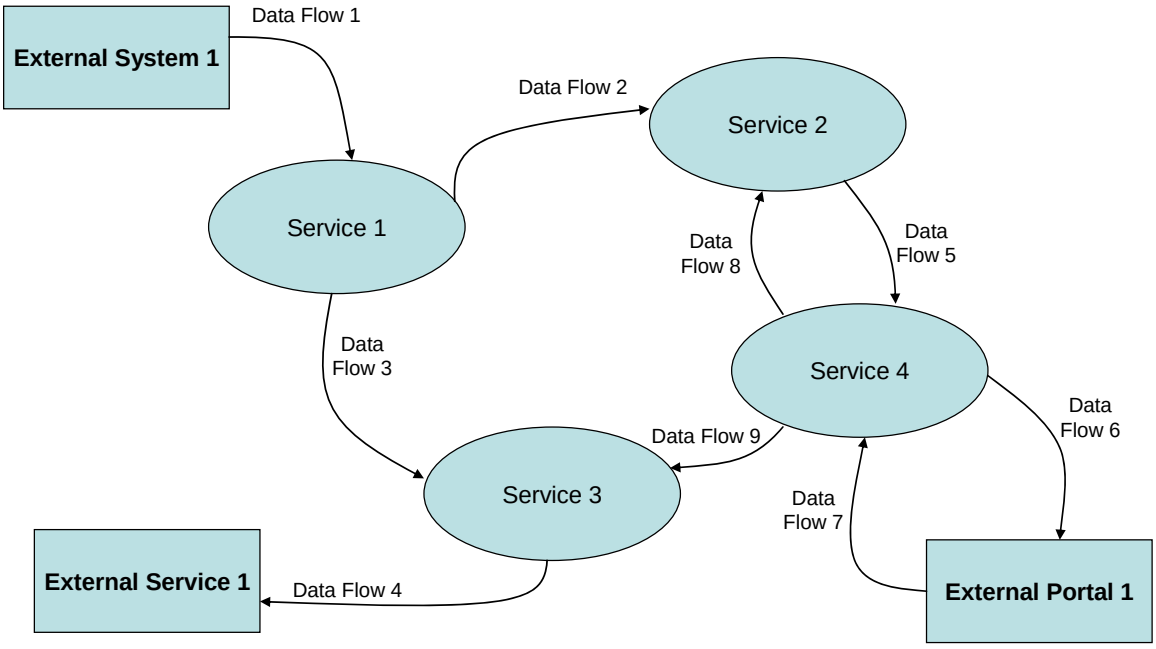


**Figure 5-24: Notional Example: SV-4b: Data Flow Diagram**

### 5.4.4 CADM Support for Systems and Services Functionality Description (SV-4)

SV-4 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-FUNCTIONALITY-SPECIFICATION. SV-4s can be specified by using the same entities and attributes as for ActivityModel. The specification of the activity model is thus stored as an instance of InformationAsset with a category code designating it as an ActivityModel (a subtype of InformationAsset). The key entities associated with defining system functions and their relationships to ActivityModel are shown in **Figure** 5-25.

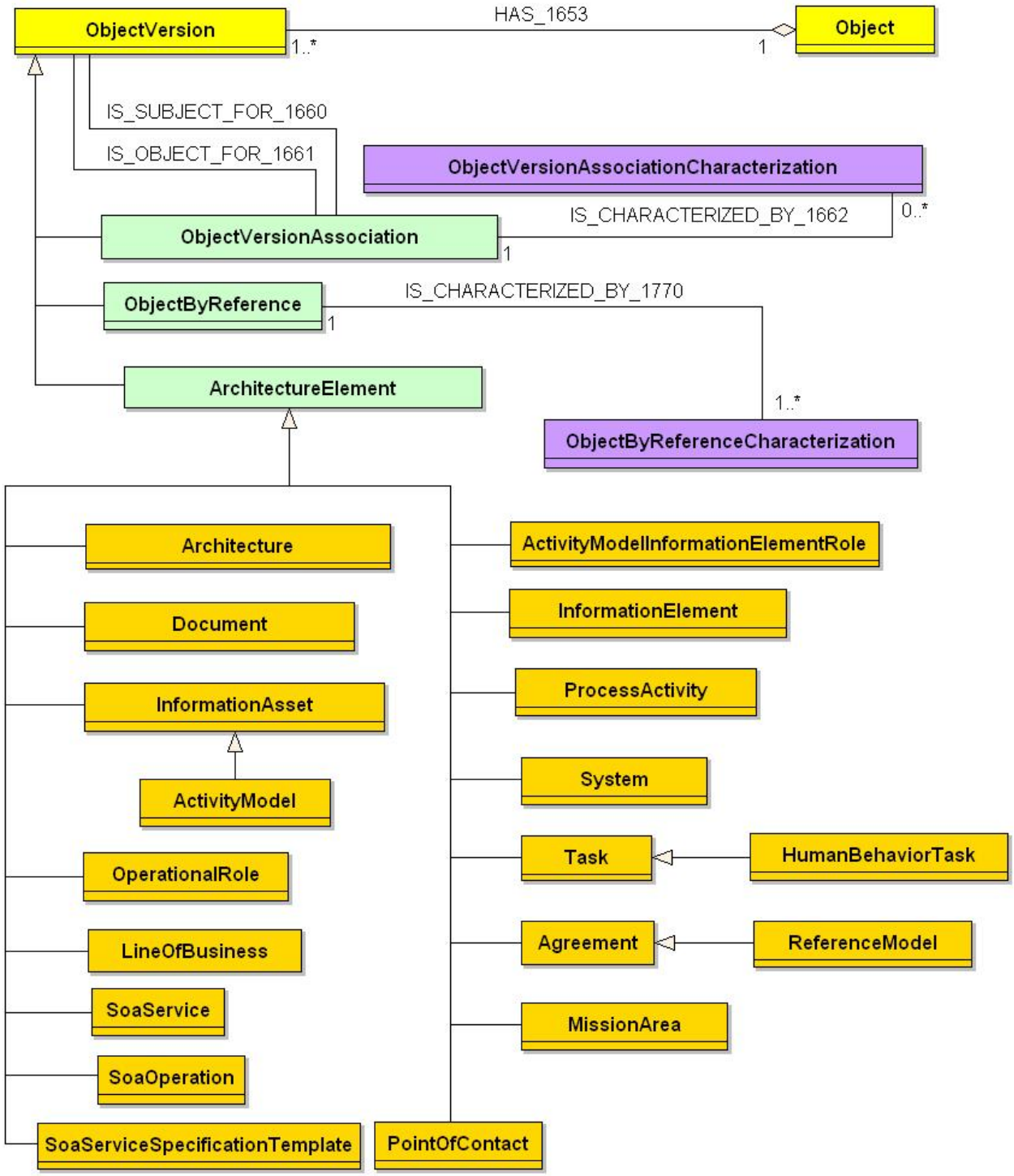


**Figure 5-25: CADM Diagram for SV-4**

SV-4 can be related to Architecture by the appropriate relationship of that instance of Document to Architecture in ObjectVersionAssociation. This allows the reuse of an SV-4 in multiple architectures. The SV-4 can be related to other SV products such as SV-1, SV-2, and SV-3 by establishing the appropriate links to those instances of Document.

Each function and subfunction cited in the ActivityModel for a SV-4 is stored as an instance of ProcessActivity with its categoryCode = SYSTEM-FUNCTION. A parallel description in terms of family of services, services and service operations is also possible. The relation between instances of ActivityModel and ProcessActivity, as well as between ProcessActivity and SoaService are established via ObjectVersionAssociation. Hierarchical breakdowns of the functions, as well as the SOA services in a specific SV-4, is done in a similar fashion (see Volume III for details). Note that the hierarchical breakdowns can be specific to an SV-4 even if one is dealing with the same system functions or SOA services.

In CADM v1.5, it is possible to specialize ProcessActivity to indicate that a system function specifies the source or destination (sink) of an information flow in the form of an information repository. This construct is not found in IDEF0 activity modeling but has been incorporated in the CADM as an additional specialization of ProcessActivity. In addition, where the level of granularity in the SV-4 requires having an explicit source and destination for *every* information flow, the attribute categoryCode in ProcessActivity can be set to: (1) Start State/Condition and (2) End State/Condition. These same two values can also used to identify an external source ProcessActivity (start condition) and an external sink ProcessActivity (end condition) when they are not considered data stores.

The information flows and their component information flows cited in the ActivityModel for a SV-4 are stored as instances of InformationElement, and their roles in the SV-4 are stored as instances of ActivityModelInformationElementRole. As noted in the discussion for OV-5, the decomposition of an InformationElement into its components is also possible in CADM v1.5 through ObjectVersionAssociation. (Such decomposition could be viewed as *not* dependent on the activity model or on the activities specified in the activity model. However, it is expected to be consistent across activity models.)

As mentioned above, each InformationElement occurs in a SV-4 for a specific function. Their roles (input and output) are expressed via the entity ActivityModelInformationElementRole. Note that these roles are in relation to a specific ProcessActivity that forms part of the ActivityModel for an SV-4.

When building a SV-4 all the additional details of the instances of InformationElement and ProcessActivity, together with associations between them, may be populated so that the system functions and information flows required for SV-5 and SV-6, respectively, are available for cross reference. In CADM v1.5, links for instances of ProcessActivity (specialized as SYSTEM-FUNCTION), can be established for the purpose of recording the cross references of system functions to other instances of ProcessActivity.

To satisfy key operational requirement instances of ProcessActivity (specialized as SYSTEM-FUNCTION), they can be related in CADM v1.5 to Task instances. When external documentation is cited for details of an ActivityModel (or other subtypes of InformationAsset) defined in a SV-4 the pertinent instances of Document can also be linked (see Volume III for details). Similarly, CADM provides the necessary functionality to store relationships among system functions and human factors, as well as lines of business.

#### 5.4.4.1 SV-4 – Data Element Definitions

## SV-4 Information Space

**ActivityModel**†
**ActivityModelInformationElementRole**†
**Agreement**†
**Architecture**†
**Document**†
**HumanBehaviorTask**†
**InformationAsset**†
**InformationElement**†
**LineOfBusiness**†
**MissionArea**†
**OperationalRole**†
**PointOfContact**†
**ProcessActivity**†
**ReferenceModel**†
**SoaOperation**†
**SoaService**†
**SoaServiceSpecificationTemplate**†
**System**†
**Task**†

†) The descriptions of these elements have been provided in the preceding sections

## 5.5 OPERATIONAL ACTIVITY TO SYSTEMS FUNCTION, ACTIVITY TO SYSTEMS, AND ACTIVITY TO SERVICES TRACEABILITY MATRICES (SV-5A, 5B, AND 5C)

### 5.5.1 Operational Activity to Systems Function and Activity to Systems Traceability Matrix (SV-5a and b) – Product Description

**Product Definition**. Operational Activity to SV-5a and SV-5b is a specification of the relationships between the set of operational activities applicable to an architecture and the set of system functions applicable to that architecture. The SV-5 and extension to the SV-5 from DoDAF v1.0 is designated as 'SV-5a' and ‘SV-5b’ in DoDAF v1.5 respectively.

**Product Purpose**. SV-5a depicts the mapping of operational activities to system functions and thus identifies the transformation of an operational need into a purposeful action performed by a system.

SV-5a can be extended (SV-5b) to depict the mapping of capabilities to operational activities, operational activities to system functions, system functions to systems, and thus relates the capabilities to the systems that support them. Such a matrix allows decision makers and planners to quickly identify stovepiped systems, redundant/duplicative systems, gaps in capability, and possible future investment strategies all in accordance with the time stamp given to the architecture. SV-5b correlates capability requirements that would *not* be satisfied if a specific system is *not* fielded to a specific DoD unit.

**Product Detailed Description**. The Framework uses the terms *activity* in the OVs and *function* in the SVs to refer to essentially the same kind of thing—both activities and functions are tasks that are performed, accept inputs, and develop outputs. The distinction lies in the fact that system functions are executed by automated systems, while operational activities describe business operations that may be conducted by humans, automated systems, or both. Typical systems engineering practices use both of these terms, often interchangeably. However, given the Framework’s use of activities on the operational side and functions on the systems side, and the fact that operational nodes do not map one-to-one to systems nodes, it is natural that operational activities do not map one-to-one to system functions. Therefore, SV-5b forms an integral part of the eventual complete mapping from operational capabilities to systems requirements. SV-5 is an explicit link between the OV and SV. The capabilities and activities are drawn from OV-5a, OV-6b, and OV-6c. The system functions are drawn from an SV-4. (SV-1 and SV-2 may also define system functions for identified systems.)

The relationship between operational activities and system functions can also be expected to be many-to-many (i.e., one operational activity may be supported by multiple system functions, and one system function may support multiple operational activities). **Figure 5-26** provides a notional example of SV-5a.

| | Operational Activities | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System Functions | 3.11 | 3.11.3 | 3.12 | 3.12.1 | 3.12.2 | 3.12.3 | 3.13 | 3.14 | 3.14.1 | 3.14.2 | 3.14.3 | 3.14.4 | 3.15 | 3.16 | 3.17 | 3.17.1 |
| | | | | | | | | | | | | | | | | |
| 1 | X | | | | | | | | | | | | | | | |
| 1.1 | | X | | | | | | | | | | | | | | |
| 1.1.1 | | | X | | | | | | | | | | | | | |
| 1.1.1.1 | X | | | | | | | | | | | | | | | |
| 1.1.1.2 | | | | | X | | | | | | | | | | | |
| 1.1.1.3 | | | | | | | X | | | | | | | | | |
| 1.1.2 | | | | | | | | | | X | | | | | | |
| 1.1.2.1 | | | | X | | | | | | | | | | | | |
| 1.1.2.2 | | | | | | X | | | | | | | | | | |
| 1.1.2.3 | | | | | | | | X | | | | | | | | |
| 1.1.3 | | | | | | | | | | | X | | | | | |
| 1.1.3.1 | | | | | | | | | | | | | X | | | |
| 1.1.3.2 | | | | | | | | | X | | | | | | | |
| 1.1.3.3 | | | | | | | | | | | | | | X | | |
| 1.1.3.4 | | | | | | | | | | | | | | X | | |

**Figure 5-26: Operational Activity to Systems Function Traceability Matrix (SV-5a)**

A key element of operational requirement traceability is the relation of system functions and operational activities to systems and capabilities. A capability may be defined in terms of the attributes required to accomplish a set of activities (such as the sequence and timing of activities, and the materiel that support them) in order to achieve a given mission objective. Capability-related attributes may be associated with specific activities or with the information exchange between activities, or both. A particular operational thread may be used to depict a capability. An operational thread is defined as a set of operational activities, with sequence and timing attributes of the activities, and includes the information needed to accomplish the activities. In this manner, a capability is defined in terms of the attributes required to accomplish a given mission objective by modeling the set of activities and their attributes. SV-5b can be used to map capabilities to operational activities, operational activities to system functions, and system functions to systems, and thus relate the capabilities to the systems that support them. First, the activities are related to the system functions that automate them (wholly or partially). Then a set of activities are associated with a capability (as defined in OV-6c). By labeling the system functions with the systems that execute them (as defined in SV-1, SV-2, and SV-4), SV-5b can be used as the planner's matrix for analyses and decision support. The traceability from capabilities/activities to system/system functions is described by populating the SV-5b matrix. Each mapping between an

operational activity to a system function is described by a stoplight colored circle to indicate the status of the system support. Red indicates functionality planned but not developed. Yellow indicates partial functionality provided or full functionality provided but system has not been fielded. Green indicates full functionality provided and system fielded. A blank cell indicates that there is no system support planned for an operational activity, or that a relationship does not exist between the operational activity and the system function. In this manner, the association between a certain capability and a specific system can be illustrated via a many-to-many relationship: *many* operational activities contribute to a capability, and *many* system functions are executed by a system.

**Figure 5-27** provides a notional example of the extended SV-5b that provides a mapping between capabilities and systems.

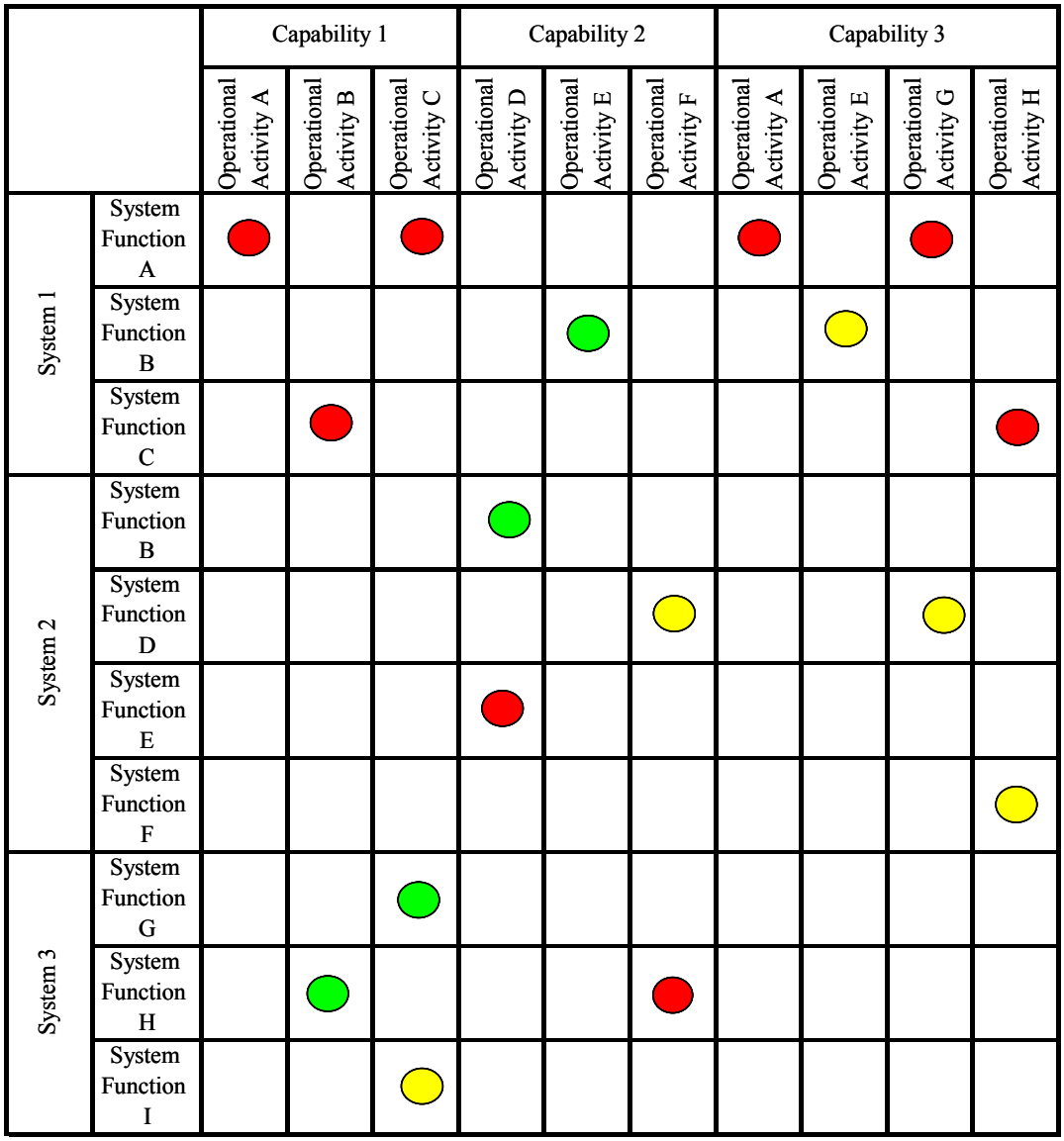


**Figure 5-27: Capability to System Traceability Matrix (SV-5b)**

### 5.5.2 UML Representation

There is no equivalent for this product in UML. However, the information for an SV-5a matrix may be gathered from OV-5 and SV-4 element adornments (e.g., <<include>> relationships between OV-5 use cases and SV-4 use cases). A UML modeling tool script may be used to extract the underlying architecture data and convert it to matrix form.

Since SV-4 use cases are refinements of OV-5 use cases, the relationship between the operational activities and associated capabilities on the OV side, and the system functions on the SV side, is already defined. System functions can also be allocated to systems in UML by allocating SV-4 classes and packages to UML Components (from SV-1) accomplishing the intent of SV-5a.

### 5.5.3 Net-Centric Guidance for Operational Activity to Services Traceability Matrix (SV-5c)

**Augmented Product Purpose**. In a net-centric architecture, ***services*** are a key means to share information and capabilities in the NCE, therefore, the SV-5c is used to depict the mapping of operational activities to ***services*** and provide an explicit linkage between the SV and OV products in support of providing and consuming capabilities from the NCE**.**

**Net-Centric Product Description**. The SV-5 traditionally depicts the mapping of operational activities to capabilities, system functions to operational activities, and systems to system functions. Accordingly, in the NCE, the SV-5a can be extended (SV-5c) to depict the traceability and mapping of ***services*** to operational activities to assist in understanding which services support operational activities. Services listed on the SV-5c are drawn from the services defined in the SV-4 (Services Functionality Description) and mapped to activities, which are drawn from OV-5, OV-6b, and OV-6c, to provide a matrix that clearly depicts where net-centric services are being utilized along side more traditional "stovepiped" application functionality. This provides a quick view of how extensive service oriented architecture or net-centric capabilities are utilized in the architecture. It can also be used to depict a migration from traditional application functionality to net-centricity by showing how the ratio of services to system function increases over time. It also assists in identifying duplicative functionality/***services***, gaps in capability, and possible future net-centric systems investments. The SV-5c matrix assists in understanding how services align with the operational activities of an operational domain.

As programs develop their SV-5(s) to document the mapping of operational activities to systems, system functions, and/or services, it may be difficult within a hybrid environment to distinguish between a system, a system function, or a service. Providing a series of SV-5 products for systems, system functions and services as alternatives to the traditional SV-5 product will enable the delineation between the three, particularly in hybrid environments. One or more of the following SV-5s may be employed:

- **Operational Activity to SV-5a**: currently prescribed product for legacy support, only depicts system functions mapped to operational activities
- **Operational Activity to SV-5b**: only depicts systems mapped to operational activities based on system mappings to system functions (for legacy systems)
- **Operational Activity to SV-5c**: only depicts services mapped to operational activities (for the NCE)

The depiction of the relationships between systems, system functions, or ***services*** and operational activities in separate matrices allows decision makers and planners to quickly identify redundancies and gaps. It may also provide a more concise and clear view due to the many-to-many relationships between system, system functions, or ***services,*** and operational activities.

**Figure 5-28** illustrates an Operational Activity to Service Traceability Matrix (SV-5c), which maps capabilities, through operational activities, to the individual services or combination of services, used to provide the capabilities. The matrix highlights the fact that multiple services can be used to support one or more operational capabilities. Additionally, operational activities can also be grouped by capabilities to provide additional information to portfolio managers as part of a capability based portfolio management approach, specifically, the ability of services to support multiple capabilities.

| | Capability 1 | | | | Capability 2 | | | | Capability 3 | | | | Capability 4 | | | | Capability 5 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Services** | Operational Activity A | Operational Activity B | Operational Activity C | Operational Activity D | Operational Activity E | Operational Activity F | Operational Activity G | Operational Activity H | Operational Activity I | Operational Activity J | Operational Activity K | Operational Activity L | Operational Activity M | Operational Activity N | Operational Activity O | Operational Activity P | Operational Activity Q | Operational Activity R | Operational Activity S | Operational Activity T |
| Service 1 | | | | | | | X | X | X | | | | | | | | | | | |
| Service 2 | X | X | | | | | | | | | X | | | | | | | | | |
| Service 3 | | | X | X | | | | | | | | | | | | | | X | | |
| Service 4 | X | X | X | | | | | | | | | | | X | X | | X | | | |
| Service 5 | | | X | | | | | | | X | | | | | | | | X | | |
| Service 6 | X | | | | | | X | X | X | | X | | | | | | | | | |
| Service 7 | | X | | X | | | | | | | | | | X | | | | | | |
| Service 8 | | | X | | | | X | | X | | | X | | | | | X | | X | X |

**Figure 5-28: Notional Example: Operational Activity to Services Traceability Matrix (SV-5c)**

### 5.5.4 CADM Support for Operational Activity to Systems Function and Services Traceability Matrices (SV-5)

SV-5 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-FUNCTION-TRACEABILITY-MATRIX. The properties of each cell are specified using relationships between SV-5 and the pertinent data structures in CADM v1.5 and recorded as entries in ObjectVersionAssociation.

An SV-5 can apply to many architectures. All the instances of Architecture to which that SV-5 applies are specified in ObjectVersionAssociation (see Volume III for details). Each function cited in the SV-5 is stored as an instance of ProcessActivity with a category code designating it as a SYSTEM-FUNCTION, and these instances can be linked to each other, as well as to instances of System to record ProcessActivity instances that are associated with a specific System. In CADM v1.5 the following semantics for these relations are: 1 = The instance of System is designed to carry out the associated instance of ProcessActivity; 2 = The instance of System performs (i.e., has a function represented by) the associated instance of ProcessActivity; 3 = The instance of

System provides partial support for the associated instance of ProcessActivity; or 4 = The instance of System provides an alternate capability for the associated instance of ProcessActivity.

A key element of operational requirement traceability is the relation of ProcessActivity instances to Task instances. CADM v1.5 supports this requirement through ObjectVersionAssociation.

In CADM v1.5 it is possible to relate System Functions to Operational Activities independent of a given architecture and architecture product, i.e., when the relation applies globally in all situations. The following kinds of associations are supported:

The System Function is derived from the Operational Activity
The System Function is identical to the Operational Activity
The System Function is part of the Operational Activity
The System Function directly supports the Operational Activity
The System Function indirectly supports the Operational Activity

Ideally, the global level of association of System Functions to Operational Activities can be specified as System Functions or Operational Activities are defined (whichever comes second). At a minimum, the global association would identify specific Operational Activities that would *not* be supported if *no* system providing the System Functions is fielded.

The second level of association can be specific to an architecture and its architecture product(s). This architecture-level association is stored as instances of SV-5 and their corresponding links to System, other ProcessActivity(s), and Task(s).

**Figure** 5-29 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-5 in a CADM-conformant database.

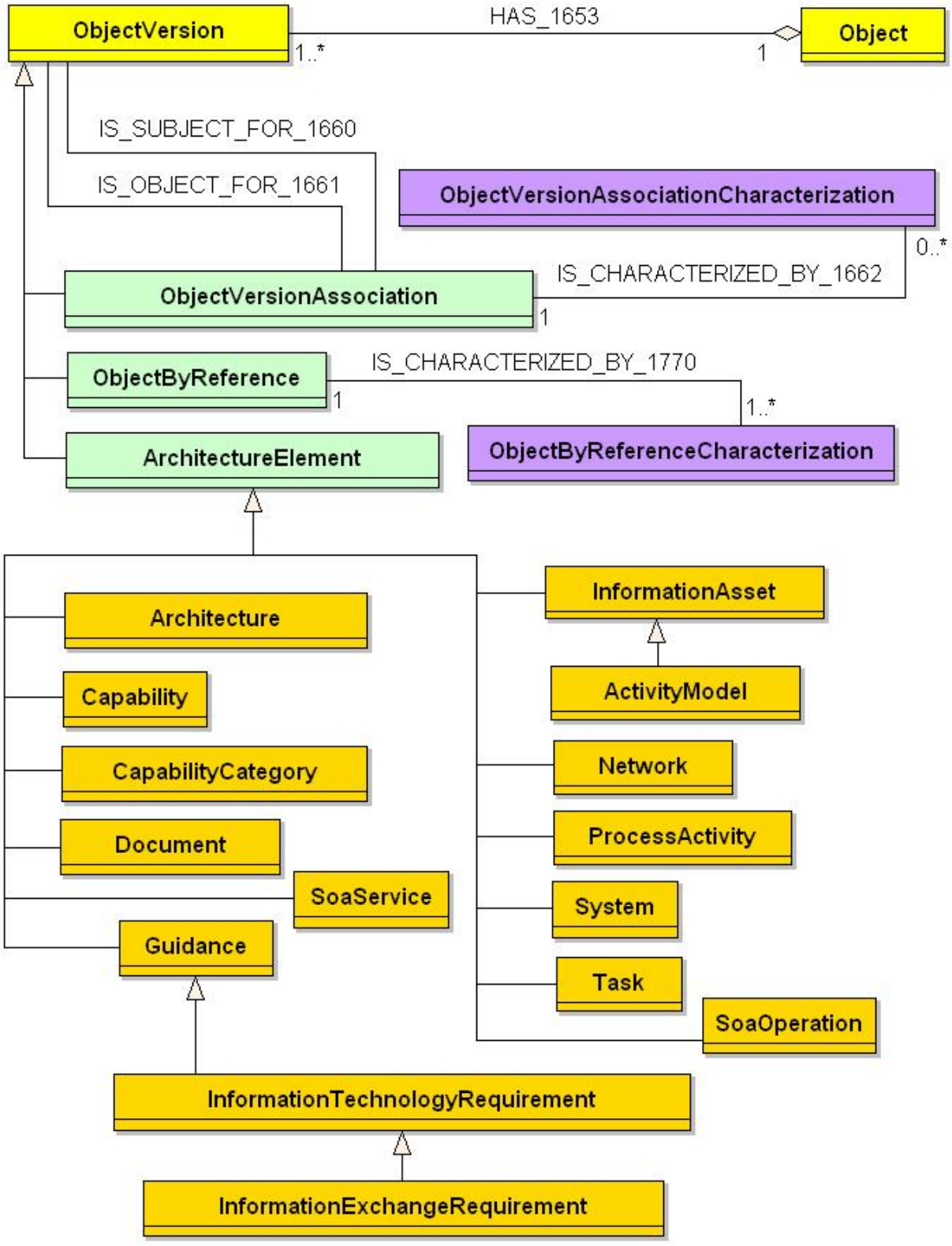


**Figure 5-29: CADM Diagram for SV-5**

#### 5.5.4.1 SV-5 – Data Element Definitions

## SV-5 Information Space

**ActivityModel**†
**Architecture**†
**Capability**†
**CapabilityCategory**†
**Document**†
**Guidance**†
**InformationAsset**†
**InformationExchangeRequirement**†
**InformationTechnologyRequirement**†
**Network**†
**ProcessActivity**†
**SoaOperation**†
**SoaService**†
**System**†
**Task**†

†) The descriptions of these elements have been provided in the preceding sections

## 5.6 SYSTEMS AND SERVICES DATA EXCHANGE MATRIX (SV-6)

### 5.6.1 Systems Data Exchange Matrix (SV-6) – Product Description

**Product Definition**. The SV-6 specifies the characteristics of the system data exchanged between systems. This product focuses on automated information exchanges (from OV-3) that are implemented in systems. Non-automated information exchanges, such as verbal orders, are captured in the OV products only.

**Product Purpose**. System data exchanges express the relationship across the three basic architecture data elements of an SV (systems, system functions, and system data flows) and focus on the specific aspects of the system data flow and the system data content. These aspects of the system data exchange can be crucial to the operational mission and are critical to understanding the potential for overhead and constraints introduced by the physical aspects of the implementation.

**Product Detailed Description**. SV-6 describes, in tabular format, system data exchanged between systems. The focus of SV-6 is on how the system data exchange is implemented, in system-specific details covering periodicity, timeliness, throughput, size, information assurance, and security characteristics of the exchange. In addition, the system data elements, their format and media type, accuracy, units of measurement, and system data standard are also described in the matrix.

SV-6 relates to, and grows out of, OV-3. The operational characteristics for the OV-3 information exchange are replaced with the corresponding system data characteristics. Performance attributes for the operational information exchanges are replaced by the actual system data exchange performance attributes for the automated portion(s) of the information exchange.

On SV-6, each operational needline is decomposed into the interfaces that are the systems equivalents of the needline. SV-1 graphically depicts system data exchanges as interfaces that represent the automated portions of the needlines. The implementation of SV-1 interfaces is described in SV-2 (if applicable). The system data exchanges documented in SV-6 trace to the information exchanges detailed in OV-3 and constitutes the automated portion(s) of the OV-3 information elements.

A partial format for the SV-6 matrix can be found in CJCSI 6212.01D, and that format is required for ISP development. However additions to the CJCSI 6212.01D matrix to meet program-unique needs should also be allowed. **Figure 5-30** shows a template for this product. The data element definition table for SV-6 contains detailed descriptions or references for each matrix column.

| Interface Identifier | Data Exchange Identifier | Data Description | | | | | | Producer | | | Consumer | | Nature of Transaction | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System Interface Name and Identifier | System Data Exchange Name and Identifier | Data Element Name and Identifier | Content | Format Type | Media Type | Accuracy | Units of Measurement | Data Standard | Sending System Name and Identifier | Sending System Function Name and Identifier | Receiving System Name and Identifier | Receiving System Function Name and Identifier | Transaction Type | Triggering Event | Criticality |

| Interface Identifier | Data Exchange Identifier | Performance Attributes | | | | Information Assurance | | | | | | | Security | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System Interface Name and Identifier | System Data Exchange Name and Identifier | Periodicity | Timeliness | Throughput | Size | Access Control | Availability | Confidentiality | Dissemination Control | Integrity | Non-Repudiation Producer | Non-Repudiation Consumer | Protection (Type Name, Duration, Date) | Classification | Classification Caveat | Releasability | Security Standard |

**Figure 5-30: Systems Data Exchange Matrix (SV-6) – Template**

Note that each system data element exchanged is related to the system function (from SV-4) that produces or consumes it via the leaf inputs and outputs of the system functions. However, there may not be a one-to-one correlation between system data elements listed in the matrix and the data flows (inputs and outputs) that are produced or consumed in a related SV-4. System data inputs and outputs between system functions performed at the same systems node (i.e., not associated with an interface on SV-1) will not be shown in the SV-6 matrix. System data inputs and outputs between functions for some levels of functional decomposition may be at a higher level of abstraction than the system data elements in the SV-6 matrix. In this case, multiple system data elements will map to a single function's system data flow. Similarly, the system data flows between functions at a low level of functional decomposition may be at a finer level of detail than the system data elements in the SV-6 matrix, and multiple system data flows may map to a single system data element.

### 5.6.2 UML Representation

The sending and receiving systems and the receiving system function names are easily identifiable from the UML logical service realization diagram (sequence diagram). A sending system function name is identified by looking at the closest previous message coming into to the sending system lifeline for the exchange in question – "out" or "inout" designations on system data change the sense of direction of the data flow. The triggering event is the sending function. The architect derives timeliness and throughput from non-functional requirements – identify size through analysis of parameters. The related IER or appropriate classification guide provides

classification at the time of SV-6 production. All the information necessary to script SV-6 is maintained in the UML model.

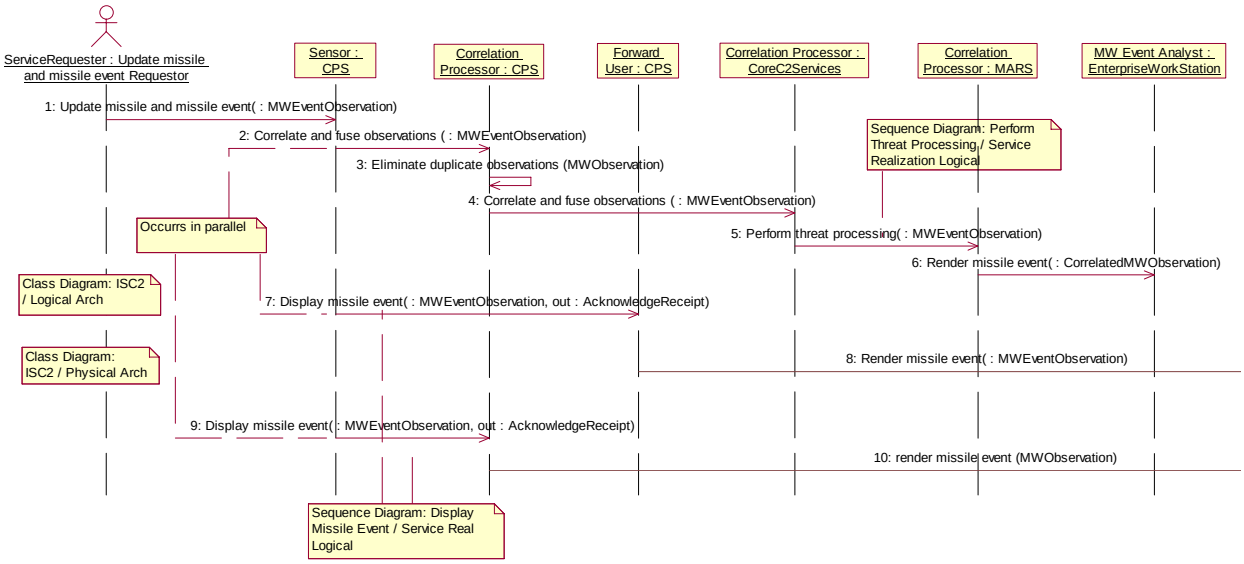


**Figure 5-31: UML Logical Service Realization Diagram (SV-6)**

This matrix product expands on the information associated with SV-1 systems, SV-4 use cases, and system data flows. If an automated tool is used to create the other products in UML, then SV-6 expanded definitions can be generated from adornments to the applicable SV-1 systems and interfaces and SV-4 system functions and system data flows.

### 5.6.3 Net-Centric Guidance for SV-6

**Augmented Product Purpose.** In a net-centric architecture, the purpose of the SV-6 is used to capture service data exchanges documented in SV-1 and the specific aspects of the service data content and how it is implemented in the NCE.

**Net-Centric Product Description.** The SV-6 traditionally describes system data exchanged between systems and how the system data exchange is implemented, in system-specific details. Accordingly, in the NCE, the SV-6 should describe, in a tabular format, the structure of each service data exchange such as availability, capacity, latency, reliability, information assurance, size, format (MIME Type), periodicity, and security.

***Services*** make information and capabilities available in the NCE through published interfaces between the ***service provider*** and ***service consumer.*** The SV-1 graphically depicts service data exchanges as interfaces that can represent automated portions of the information exchanges in the OV-3. The SV-6 relates to the OV-3 where operational characteristics for the information exchanges in the OV-3 are replaced with service data characteristics in the SV-6.

In the NCE, services within a program may consume data without always knowing what the providing service is and/or who the service provider is. The SV-6 may be depicted as three separate products:

- **System Data Exchange** (currently prescribed product for legacy systems) that describes the characteristics of the system data exchanged between systems

- **Service Data Provided** (for net-centric architectures or hybrid architectures) describes the data that is made available to the NCE, which includes known as well as those authorized, but beyond the original predefined set of users
- **Service Data Consumed** (for net-centric architectures or hybrid architectures) describes the data that is required to be obtained from the NCE, without predetermined knowledge of the producer

The SV-6 products facilitate wide spread utilization of information and capabilities across the NCE, by increasing the availability of information to beyond the architecture's original, predefined set of users. Specific characteristics about a service data exchange that are documented in the SV-6, are part of the service's ***specification,*** and include the dependencies depicted in the SV-1. The DoD-wide SST should be used to the extent possible for describing each service. Regardless of the precise service specification template, the minimum set of information that supports the service data exchanges include:

- ***Quality Model Category*** includes information on the security requirements of the service, the QoS levels, and any performance considerations for service deployment and the following types of attributes:
  - ***Authentication Mechanism Description*** describes the security mechanisms that the user needs to access the service.
  - ***Access Criteria and Restrictions Description*** includes both the Access Model to describe the user access model, criteria, and process for registering to use the service and the service restrictions that describe any restrictions (including OV-3 usage permissions) that have been placed on users that are allowed to access the service.
  - ***Information Security Markings*** includes attributes about the level and classification applicable to an information resource or portion within the domain of classified national security information.
- ***Information Model Category*** includes that part of the service specification that identifies the data types that are used to interact with the service.
  - ***Data Types*** refers to the URI that points to documentation of complex data types and data structures that are used in the operations.

Documenting these various data attributes and characteristics in the SV-6 products will provide a view of how programs are managing the data they make available to the NCE as well as the dependencies for accessible data required from the NCE to complete the mission of the subject architecture. The various data attributes and characteristics can be used to populate the Service Registry and the Enterprise Catalog.

### 5.6.4 CADM Support for SV-6

SV-6 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = INFORMATION-EXCHANGE-MATRIX. Each row of SV-6 is specified by the references (foreign keys) to the appropriate data structures of CADM v1.5. If a complete OV-3 is provided, SV-6 may be limited to providing implementation-level references only. The following entities can be related to a given SV-6:

- CommunicationMedium

- MaterielType (with appropriate specializations and roles as either sender or receiver)
- ExchangeNeedlineRequirement
- ExchangeRelationshipType
- Organization (with role = Destination or role = Resourcing)
- OrganizationType (with role = Receiver or role = Resourcing)
- InformationExchangeRequirement, which provides links between rows of OV-3 and SV-6 for the same IER
- InformationRequirement which provides links to InformationElement
- MessageStandard
- InformationTechnologyRequirement specialized as PROCESS-ACTIVITY EXCHANGE-REQUIREMENT which provides links to two instances of ProcessActivity, each of which can be a SYSTEM-FUNCTION
- SoftwareType (with role = Provider or role = Recipient)
- System (with role = Provider or role = Recipient)
- Period

In addition to the direct references mentioned above, which provide a rich set of characteristics to be associated with an SV-6, the primary entities can themselves be linked to the following CADM v1.5 constructs:

- SecurityClassification
- Task (with role = Source or role = Destination)
- DeploymentLocationType
- OperationalFacility
- DataItemType
- InformationElement
- Network
- Agreement
- Guidance
- TechnicalInterface

Note that both OV-3 and SV-6 cite instances of InformationExchangeRequirement. OV-3 specifies what is required whereas SV-6 specifies how each instance is supported by the Systems and Services View. The correlation is maintained by citing exactly the same InformationExchangeRequirement.

Note that in the NCE either the System providing or the System receiving the information but not necessarily both may be known. In that case, the SV-6 would show no link to the unknown instance of System. The same applies to SOA services.

**Figure** 5-32 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-6 in a CADM-conformant database.

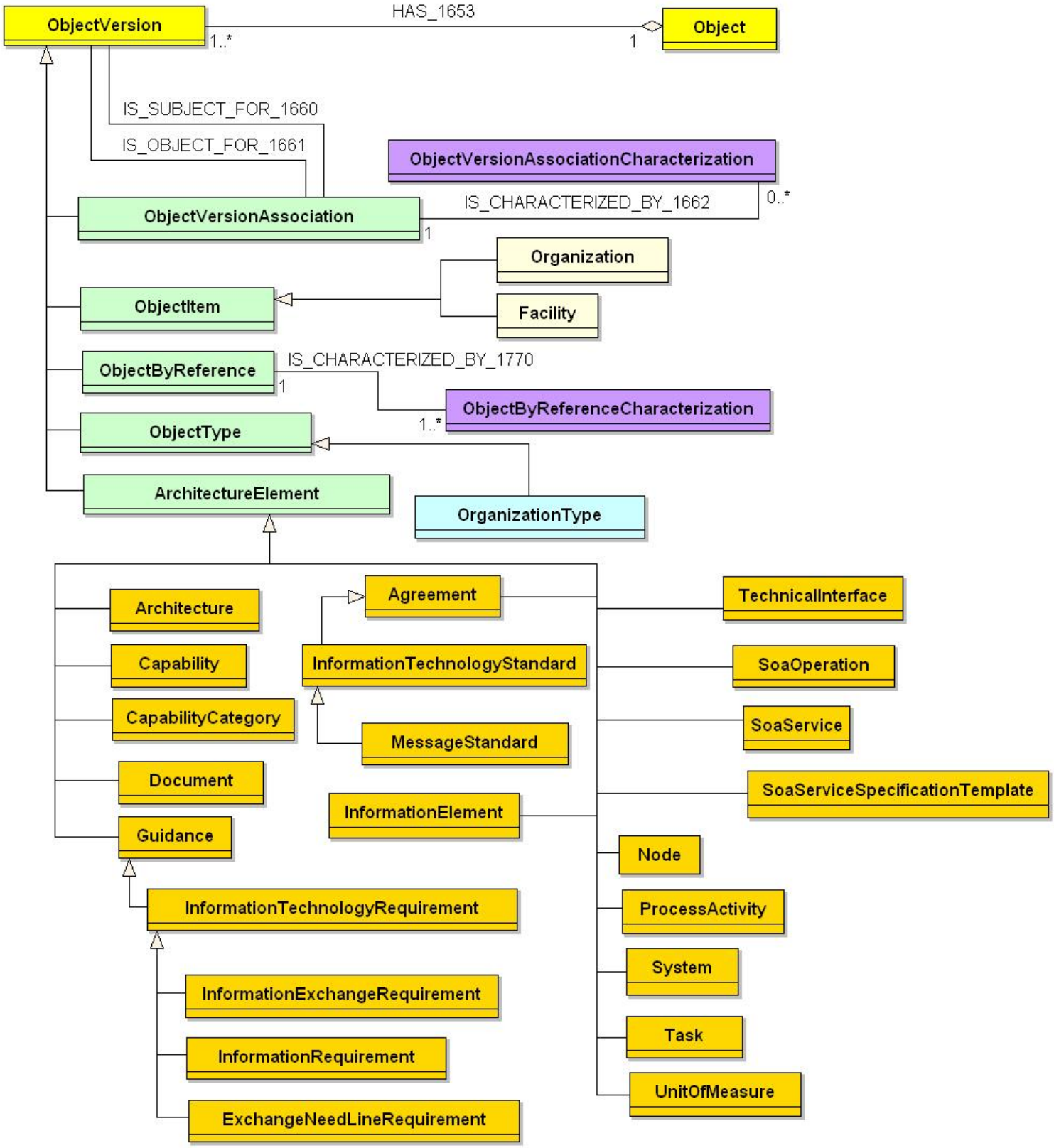


**Figure 5-32: CADM Diagram for SV-6**

#### 5.6.4.1 SV-6 – Data Element Definitions

SV-6 Template (Figure 5-30) illustrates how the end product should look to the user. **Table 5-4** describes the architecture data elements for SV-6.

**SV-6 Information Space**

Agreement†
Architecture†
Capability†
CapabilityCategory†
Document†
ExchangeNeedlineRequirement†
Facility†
Guidance†
InformationElement†
InformationExchangeRequirement†
InformationRequirement†
InformationTechnologyRequirement†
InformationTechnologyStandard†
MessageStandard†
Node†
Organization†
OrganizationType†
ProcessActivity†
SoaOperation†
SoaService†
SoaServiceSpecificationTemplate†
System†
Task†
TechnicalInterface†
**UnitOfMeasure**

†) The descriptions of these elements have been provided in the preceding sections

**Table 5-4 Data Element Definitions for SV-6**

| Data Elements | Attributes | Definition |
|---|---|---|
| **UnitOfMeasure** | | |
| | categoryCode | The code that represents a class of UnitOfMeasure. |
| | definitionText | The text that states the precise meaning of a specific UnitOfMeasure. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| UnitOfMeasure | applies to | Capability |
| UnitOfMeasure | is cited for | InformationElement |

(All previous relationships for the listed entities that comprise the information space of SV-6 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 5.7 SYSTEMS AND SERVICES PERFORMANCE PARAMETERS MATRIX (SV-7)

### 5.7.1 SV-7 – Product Description

**Product Definition**. The SV-7 product specifies the quantitative characteristics of systems and system hardware/software items, their interfaces (system data carried by the interface as well as communications link details that implement the interface), and their functions. It specifies the current performance parameters of each system, interface, or system function, and the expected or required performance parameters at specified times in the future.

Performance parameters include all technical performance characteristics of systems for which requirements can be developed and specification defined. The complete set of performance parameters may not be known at the early stages of architecture definition, so it should be expected that this product will be updated throughout the system's specification, design, development, testing, and possibly even its deployment and operations life-cycle phases.

**Product Purpose**. One of the primary purposes of SV-7 is to communicate which characteristics are considered most crucial for the successful achievement of the mission goals assigned to the system. These particular parameters can often be the deciding factors in acquisition and deployment decisions, and will figure strongly in systems analyses and simulations done to support the acquisition decision processes and system design refinement.

**Product Detailed Description**. SV-7 builds on SV-1, SV-2, SV-4, and SV-6 by specifying performance parameters for systems and system hardware/software items and their interfaces (defined in SV-1), communications details (defined in SV-2), their functions (defined in SV-4), and their system data exchanges (defined in SV-6). The term *system*, as defined for this product and all others in the Framework, may represent a family of systems (FoS), SoS, network of systems, or an individual system. Performance parameters for system hardware/software items (the hardware and software elements comprising a system) are also described in this product. In addition, performance parameters often relate to a system function being performed. Therefore, system functions and their performance attributes may also be shown in this product. If the future performance expectations are based on expected technology improvements, then the performance parameters and their time periods should be coordinated with a SV-9. If performance improvements are associated with an overall system evolution or migration plan, then the time periods in SV-7 should be coordinated with the milestones in a SV-8.

**Figure 5-33** is a template of SV-7, listing notional performance characteristics with a time period association.

| | **Performance Range (Threshold and Objective) Measures** | | |
|---|---|---|---|
| | **$Time_0$ (Baseline Architecture Time Period)** | **$Time_1$** | **$Time_n$ (Target Architecture Time Period)** |
| **System Name** | | | |
| ***Hardware Element 1*** | | | |
| Maintainability | | | |
| Availability | | | |

| | Performance Range (Threshold and Objective) Measures | | |
|---|---|---|---|
| | **$Time_0$ (Baseline Architecture Time Period)** | **$Time_1$** | **$Time_n$ (Target Architecture Time Period)** |
| System Initialization Time | | | |
| Architecture data Transfer Rate | | | |
| Program Restart Time | | | |
| ***S/W Element 1 / H/W Element 1*** | | | |
| Architecture Data Capacity (e.g., throughput or # of input types) | | | |
| Automatic Processing Responses (by input type, # processed/unit time) | | | |
| Operator Interaction Response Times (by type) | | | |
| Availability | | | |
| Effectiveness | | | |
| Mean Time Between S/W Failures | | | |
| Organic Training | | | |
| ***S/W Element 2 / H/W Element 1*** | | | |
| ***Hardware Element 2*** | | | |

**Figure 5-33: SV-7 – Notional Example**

### 5.7.2 UML Representation

There is no equivalent to this product in UML.

### 5.7.3 Net-Centric Guidance for SV-7

**Augmented Product Purpose**. In a net-centric architecture, the SV-7 is used to capture which characteristics are most crucial for the successful achievement of the mission goals through systems and ***services*** employed in the architecture. With traditional applications which, more often than not, reside on their own infrastructure, the performance information is more contained in a dedicated environment. However, services are smaller modules that can be deployed independently throughout the NCE providing geographic scalability and enhanced performance by placing the functionality where it best supports the user. This, more often than not, requires deploying services on shared infrastructure not dedicated infrastructure. This demands a provisioning model such as utility computing vs. the traditional vertical and horizontal scaling of systems.

**Net-Centric Product Description**. The SV-7 traditionally specifies performance parameters for systems and system hardware/software items and their interfaces (defined in SV-1), communications details (defined in SV-2), their functions (defined in SV-4), and their system data exchanges (defined in SV-6). Accordingly, in the NCE, the SV-7 specifies service usage and performance requirements for the ***services*** depicted in the net-centric SV-4.

In a net-centric architecture, the SV-7 captures specifications about a service's ***service levels***, ***performance characteristics***, ***users supported,*** and ***scalability*** in order that both known and

unanticipated users are able to rely on the service to perform according to time-sensitive parameters specified in their mission. Whereas, traditional systems generally have a narrow scalability variance, net-centric systems require the flexibility to handle a very large potential scalability variance as the service may provide extensive value to the NCE and the original consumers can end up being a small fraction of total users. Therefore, it is good design to capture the requirements of known users but have NCE scalability scenarios defined in preparation for unanticipated users.

The SV-7 should capture and depict information about each service's performance in accordance with the ***service specification***. The DoD-wide SST should be used to the extent possible for describing each service. Regardless of the precise service specification template, a minimum set of performance information for each service must be provided by the SV-7:

- ***Point of Contact Information Category*** includes information on the types of contacts associated with a service, which may include developers, managers, or maintenance organizations.
- ***Service Access Point Information Category*** includes technology implementation details that identify the physical infrastructure the service is or can be deployed upon including hardware, software, message transport, and facilities. It is here (vs. the SV-1) where the transport binding details for the message exchange between services are captured (i.e., SOAP over HTTP, IDL over binary, XML over HTTP).
- ***Quality Model Category*** includes information on the security requirements of the service, the QoS levels, and any performance considerations for service deployment.
    - ***Service Level Specifications*** identify performance specification details that stipulate expected service performance under identified circumstances and quality of service levels.

In addition to the SST elements, DODAF v1.5 extends the service interface specifications to include a ***Service Provider*** element. The ***Service Provider*** element identifies the organization providing the service (the organization that is the Service Functionality Provider operational role from the OV-2).

Additional elements from the service specification categories are identified and documented within other architecture views, resulting in an integrated view of the service specification across architecture products. The additional elements captured can be used to populate the Service Registry and the Enterprise Catalog.

In the NCE, performance expectations must be evaluated periodically to accommodate unanticipated use. Accordingly, updated performance parameters and their time periods should be coordinated with a SV-9.

### 5.7.4 CADM Support for SV-7

SV-7 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-PERFORMANCE-PARAMETER-MATRIX which enables the specification of its Name, Time Frame, and so forth.

The content of an SV-7 is created via the references that can be established between the corresponding instance of Document and the other structures of CADM v1.5 such as

DirectedConstraint, System, Capability, and Period. Each System has separate specifications in terms of its EquipmentType instances (a subtype of MaterielType), SoftwareType instances, and capabilities assignable to the system itself as well as its constituent hardware. Similarly, a SOA service has relations to components of the software and hardware infrastructure.

**Figure** 5-34 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-7 in a CADM-conformant database.

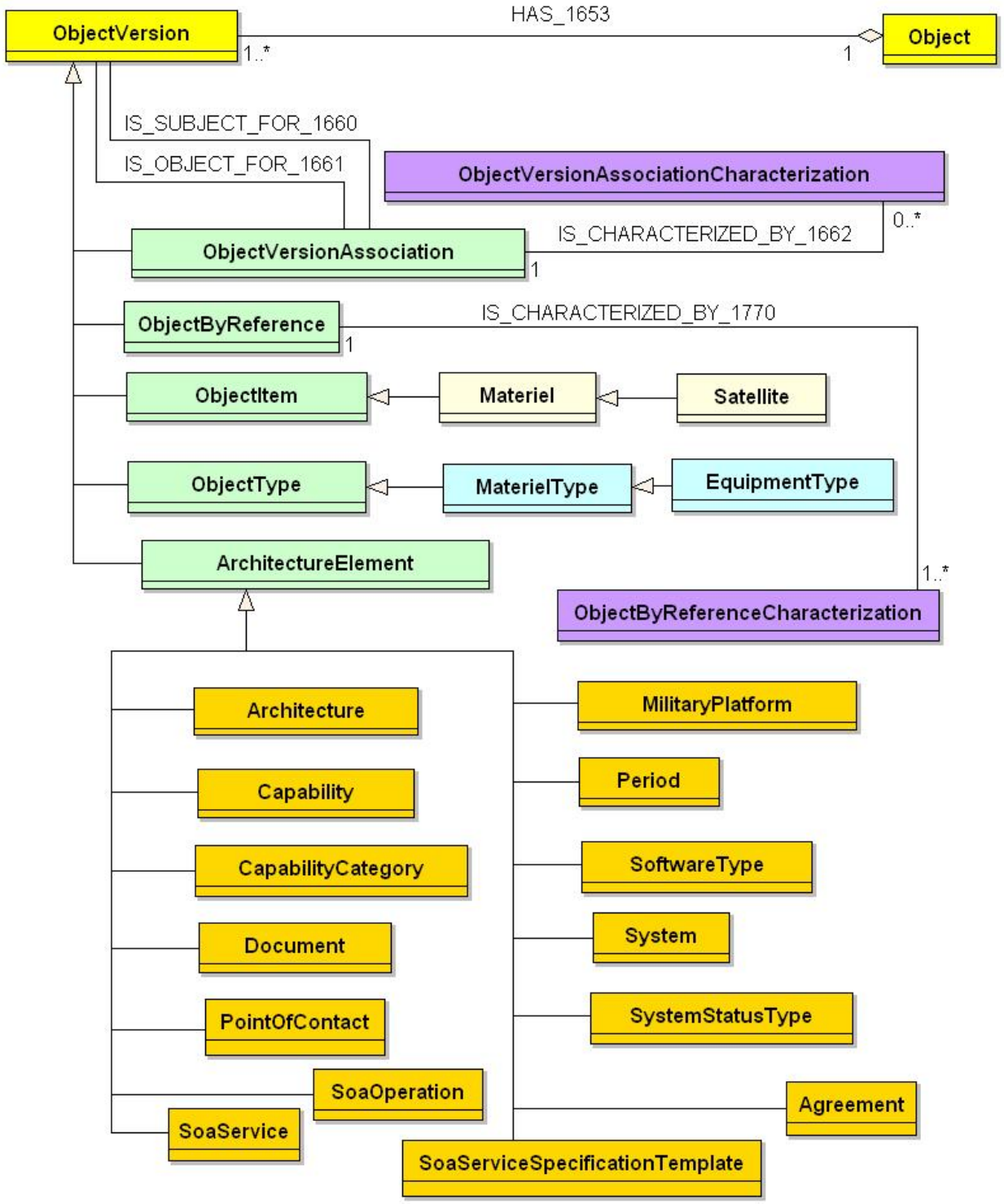


**Figure 5-34: CADM Diagram for SV-7**

#### 5.7.4.1 SV-7 – Data Element Definitions

**SV-7 Information Space**

Agreement†
Architecture†
Capability†
CapabilityCategory†
Document†
EquipmentType†
Materiel†
MaterielType†
MilitaryPlatform†
Period†
PointOfContact†
Satellite†
SoaOperation†
SoaService†
SoaServiceSpecificationTemplate†
SoftwareType†
System†
**SystemStatusType**

†) The descriptions of these elements have been provided in the preceding sections

**Table 5-5** describes the architecture data elements for SV-7.

**Table 5-5 Data Element Definitions for SV-7**

| Data Elements | Attributes | Definition |
|---|---|---|
| **SystemStatusType** | | |
| | sourceName | The name of the origin of a specific SystemStatusType. |

(There are no explicit relationships for SystemStatusType. All previous relationships for the listed entities that comprise the information space of SV-7 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 5.8 SYSTEMS AND SERVICES EVOLUTION DESCRIPTION (SV-8)

### 5.8.1 SV-8 – Product Description

**Product Definition**. The SV-8 captures evolution plans that describe how the system, or the architecture in which the system is embedded, will evolve over a lengthy period of time. Generally, the timeline milestones are critical for a successful understanding of the evolution timeline.

**Product Purpose**. SV-8, when linked together with other evolution products such as SV-9 and TV-2, provides a clear definition of how the architecture and its systems are expected to evolve over time. In this manner, the product can be used as an architecture evolution project plan or transition plan.

**Product Detailed Description**. SV-8 describes plans for *modernizing* system functions over time. Such efforts typically involve the characteristics of *evolution* (spreading in scope while increasing functionality and flexibility) or *migration* (incrementally creating a more streamlined, efficient, smaller, and cheaper suite) and will often combine the two thrusts. This product builds on other products and analyses in that planned capabilities and information requirements that relate to performance parameters (of SV-7) and technology forecasts (of SV-9) are accommodated in this product. The template for SV-8 consists of two generic examples. If the architecture describes a communications infrastructure, then a planned evolution or migration of communications systems, communication links, and their associated standards can also be described in this product. **Figure 5-35** illustrates a migration description, while **Figure 5-36** illustrates evolution. All entries in the graphics are for illustration only.

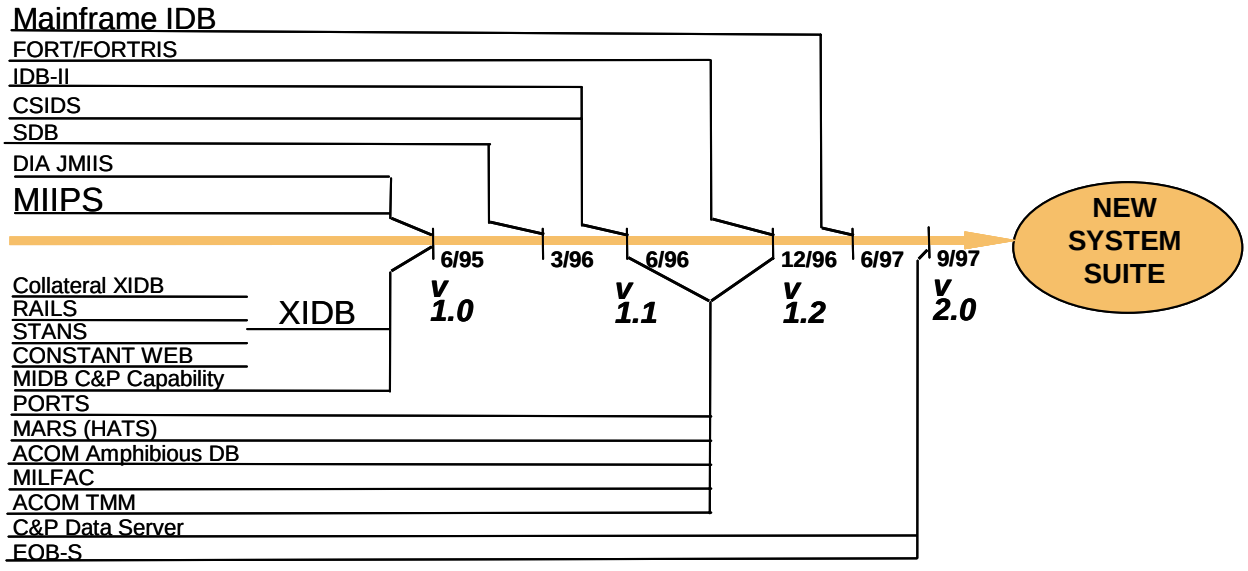


**Figure 5-35: Systems Evolution Description (SV-8) – Migration**

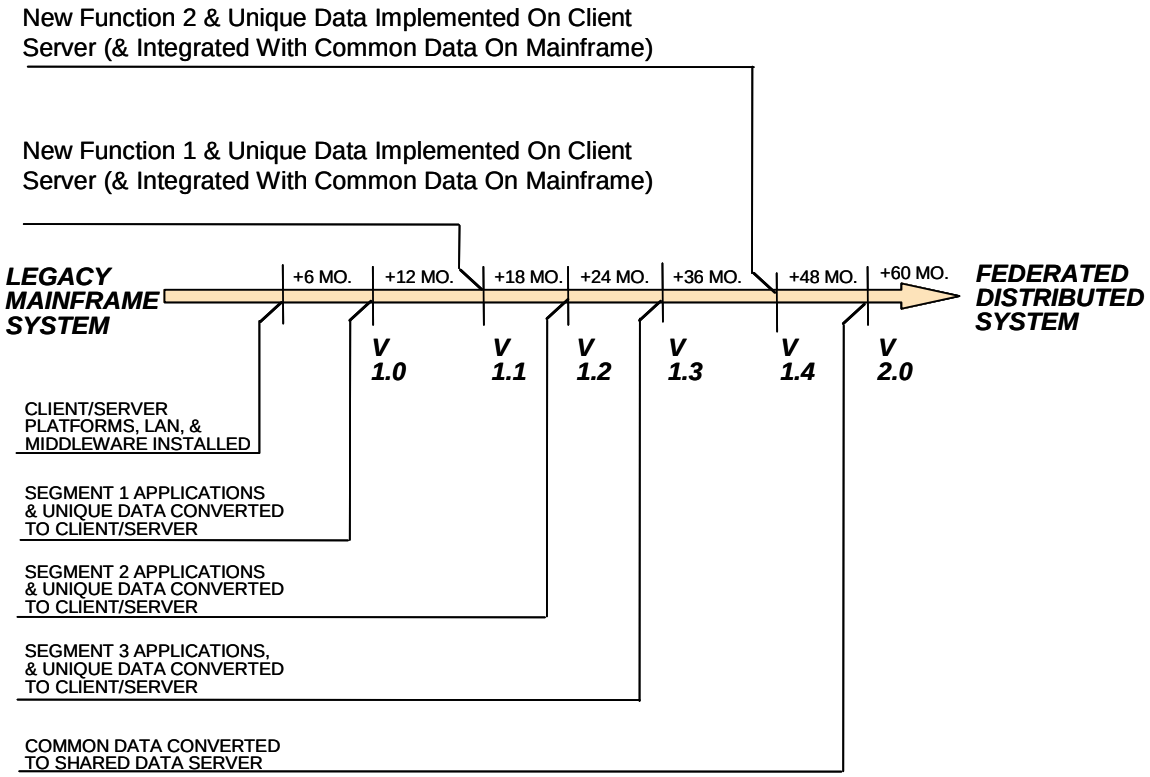


**Figure 5-36: Systems Evolution Description (SV-8) – Evolution**

### 5.8.2 UML Representation

There is no equivalent to this product in UML. However, performance attributes may be specified for all system elements where they apply using UML adornments. Furthermore, much of the desired purpose can be achieved by defining sets of UML products for different periods of system evolution, thus allowing a comparison between time periods to highlight the evolutionary changes. Textual descriptions of the evolution steps should be included.

### 5.8.3 Net-Centric Guidance for SV-8

**Augmented Product Purpose**. In the NCE, the SV-8 is used to depict the evolution and migration of 1) *services* and how their functional behavior evolves over a period of time, and 2) a legacy to a service oriented environment.

**Net-Centric Product Description**. The SV-8 traditionally describes plans for *modernizing* system functions over time. Accordingly, in the NCE, the SV-8 can describe the roadmap for how services as well as their planned usage will evolve over time. The SV-8 may capture the introduction of services into an architecture and/or the evolution of legacy systems into one or more services.

In the NCE, it is important to capture plans and schedules (with dependencies) for services that are provided by internal or external systems as well as keeping abreast of the direction of their evolution. The net-centric SV-8 may include:

- updates to existing service availability, capability, and performance,
- new service offerings,
- deprecation or removal of services

- programmatic dependencies on shared services and infrastructure.

The SV-8, when linked together with other evolution products such as SV-9 and TV-2, provides a clear definition of how the architecture and its systems and services are expected to evolve over time. The SV-8 builds on other products and analyses in that the planned capabilities and information requirements that relate to performance parameters (of SV-7) and technology forecasts (of SV-9) are accommodated in this product.

### 5.8.4 CADM Support for SV-8

SV-8 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-EVOLUTION-DESCRIPTION which enables the specification of Name, Time Frame, and so forth.

**Figure** 5-37 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-8 in a CADM-conformant database.

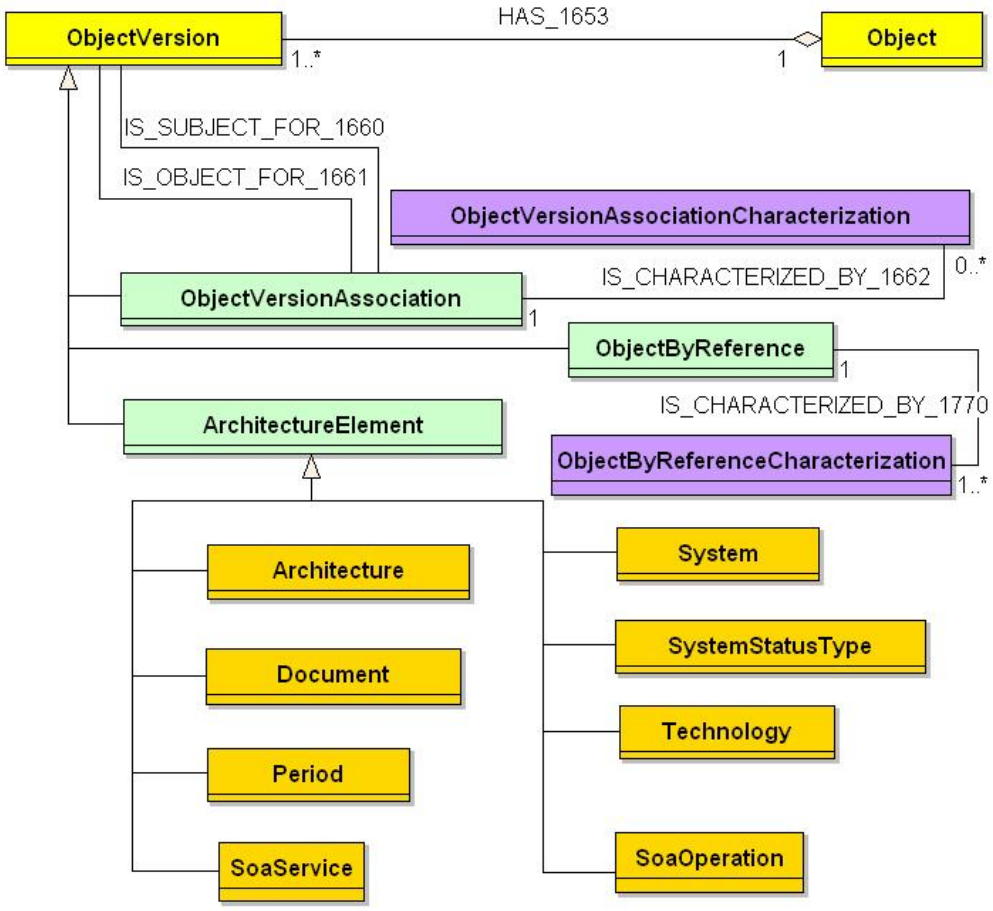


**Figure 5-37: CADM Diagram for SV-8**

An SV-8 is built through the appropriate references to System, SystemDirectedConstraint, Guidance or its subtype InformationTechnologyRequirement, Agreement (e.g., a standard or standard profile), and a Period. The migration of a system to another is captured by the appropriate relationships among them in ObjectVersionAssociation with attribution that can indicate interface status, interoperability level, etc. The Timeframe for a system migration can be matched with the Timeframes for TV-2.

#### 5.8.4.1 SV-8 – Data Element Definitions

## SV-8 Information Space

Architecture†
Document†
Period†
SoaOperation†
SoaService†
System†
SystemStatusType†
**Technology**

†) The descriptions of these elements have been provided in the preceding sections

**Table 5-6** describes the architecture data elements for SV-8.

**Table 5-6: Data Element Definitions for SV-8**

| Data Elements | Attributes | Definition |
|---|---|---|
| **Technology** | | |
| | developmentStatusCode | The code that represents the state of evolution of a specific Technology. |
| | scienceAreaCode | The code that represents the scientific discipline of a specific Technology. |
| | timeFrameCategory Code | The code that represents the class of temporal scope for the applicability of a specific Technology. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| Technology | is related to | Technology |

(All previous relationships for the listed entities that comprise the information space of SV-8 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 5.9 SYSTEMS AND SERVICES TECHNOLOGY FORECAST (SV-9)

### 5.9.1 SV-9 – Product Description

**Product Definition**. The SV-9 defines the underlying current and expected supporting technologies that have been targeted using standard forecasting methods. Expected supporting technologies are those that can be reasonably forecast given the current state of technology and expected improvements. New technologies should be tied to specific time periods, which can correlate against the time periods used in SV-8 milestones.

**Product Purpose**. SV-9 provides a summary of emerging technologies that impact the architecture and its existing planned systems. The focus should be on the supporting technologies that may most affect the capabilities of the architecture or its systems.

**Product Detailed Description**. SV-9 provides a detailed description of emerging technologies and specific hardware and software products. It contains predictions about the availability of emerging technological capabilities and about industry trends in specific time periods. The specific time periods selected (e.g., 6-month, 12-month, 18-month intervals) and the technologies being tracked should be coordinated with architecture transition plans (see SV-8). That is, insertion of new technological capabilities and upgrading of existing systems may depend on or be driven by the availability of new technology. The forecast includes potential technology impacts on current architectures and thus influences the development of transition and objective (i.e., target) architectures. The forecast should be focused on technology areas that are related to the purpose for which a given architecture is being described and should identify issues that will affect the architecture. If standards are an integral part of the technologies important to the evolution of a given architecture, then it may be convenient to combine SV-9 with the TV-2.

SV-9 is constructed as part of a given architecture and in accordance with the architecture purpose. Typically, this will involve starting with one or more overarching reference models or standards profiles to which the architecture is subject to using, such as the DoD Technical Reference Model (TRM) [DoD TRM, 2001] or the DoD Information Technology Standards Registry (DISR) [DISA, 2002]. Using these reference models or standards profiles, the architecture should select the service areas and services relevant to the architecture. SV-9 forecasts relate to the TV-1 in that a timed technology forecast may contribute to the decision to retire or phase out the use of a certain standard in connection with a system element. Similarly, SV-9 forecasts relate to TV-2 standards forecasts in that a certain standard may be adopted depending on a certain technology becoming available (e.g., the availability of Java Script may influence the decision to adopt a new HTML standard).

A template for SV-9 is shown in **Table 5-7**. The template organization is based on DISR service categories. The template entries contain the names of example technologies for the DISR service areas and services, and summary status predictions.

**Table 5-7: SV-9 – Notional Example**

| DISR Service | TECHNOLOGY FORECASTS | | |
|---|---|---|---|
| | **SHORT TERM (0-6 Months)** | **MID TERM (6-12 Months)** | **LONG TERM (12-18 Months)** |
| ***Application Software*** | | | |
| Support Applications | Microsoft (MS) Office 2000 available (for Windows 2000) | MS Office 2000 stable enough for full-scale implementation | MS Office available for Linux<br>E-mail on wireless PDAs commonplace |
| ***Application Platform*** | | | |
| Data Management | Oracle 9i available<br>MySQL (Open Source DBMS) available | | |
| Operating System | | Next MS Windows desktop upgrade expected<br>Next Red Hat Linux major release expected | Next MS Windows server upgrade expected |
| Physical Environment | | | Intel IA-64 becomes standard processor for desktops<br>Initial use of quantum computing technologies |
| ***External Environment*** | | | |
| User Interface | | Thin screen CRT monitors for PC desktops become price competitive | Thin screen LED monitors become price competitive for desktops<br>Conventional CRT technology monitors for desktops become obsolete |
| Persistent Storage | 5G PCMCIA type 2 card available | | Disk storage capacity doubles again |
| Communications Networks | | Cable modem service available for most telecommuting staff | Fiber optic connections available for most telecommuting staff |

Alternatively, SV-9 may relate technology forecasts to SV elements (e.g., systems) where applicable. The list of systems potentially impacted by the technology can be included directly in SV-9 by specifying a time period in the cell corresponding to the system element and the applicable DISR service area and service.

**Table 5-8** is a template showing this variant of SV-9.

**Table 5-8: SV-9 – Template**

| | | | SV-1 and SV-2 Systems<br>(includes SOS, FOS, Subsystem, communications systems) | SV-1 and SV-2 Hardware or Software Item | SV-2 Communications (Physical) Link | SV-4 System Function | SV-6 System Data Element | OV-7, SV-11 Model Standard or Source |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

| DISR Service Area | Service | Technology Forecast (Summary Prediction) | Applicable System ID or Name (with Time Period if applicable) | Hardware or Software ID or Name, Version (with Time Period if applicable) | System Data Link ID or Name (with Time Period if applicable) | System Function ID or Name | System Data Exchange ID or Name (with Time Period if applicable) | Model Standard or Source ID or Name (with Time Period if applicable) |
|---|---|---|---|---|---|---|---|---|

### 5.9.2 UML Representation

There is no equivalent to this product in UML.

### 5.9.3 Net-Centric Guidance for SV-9

Since the purpose of the SV-9 is to provide a summary of emerging technologies that impact the architecture and its existing planned systems, it would subsequently include any required services or other technologies that support NCO ***and may reference the Net-Centric Operations and Warfare Reference Model (NCOW RM) and associated emerging standards identified therein.*** Accordingly, the SV-9 is well suited to support the NCE.

### 5.9.4 CADM Support for SV-9

SV-9 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = SYSTEM-TECHNOLOGY-FORECAST which enables the specification of its Name, Timeframe, and so forth.

**Figure** 5-38 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-9 in a CADM-conformant database.

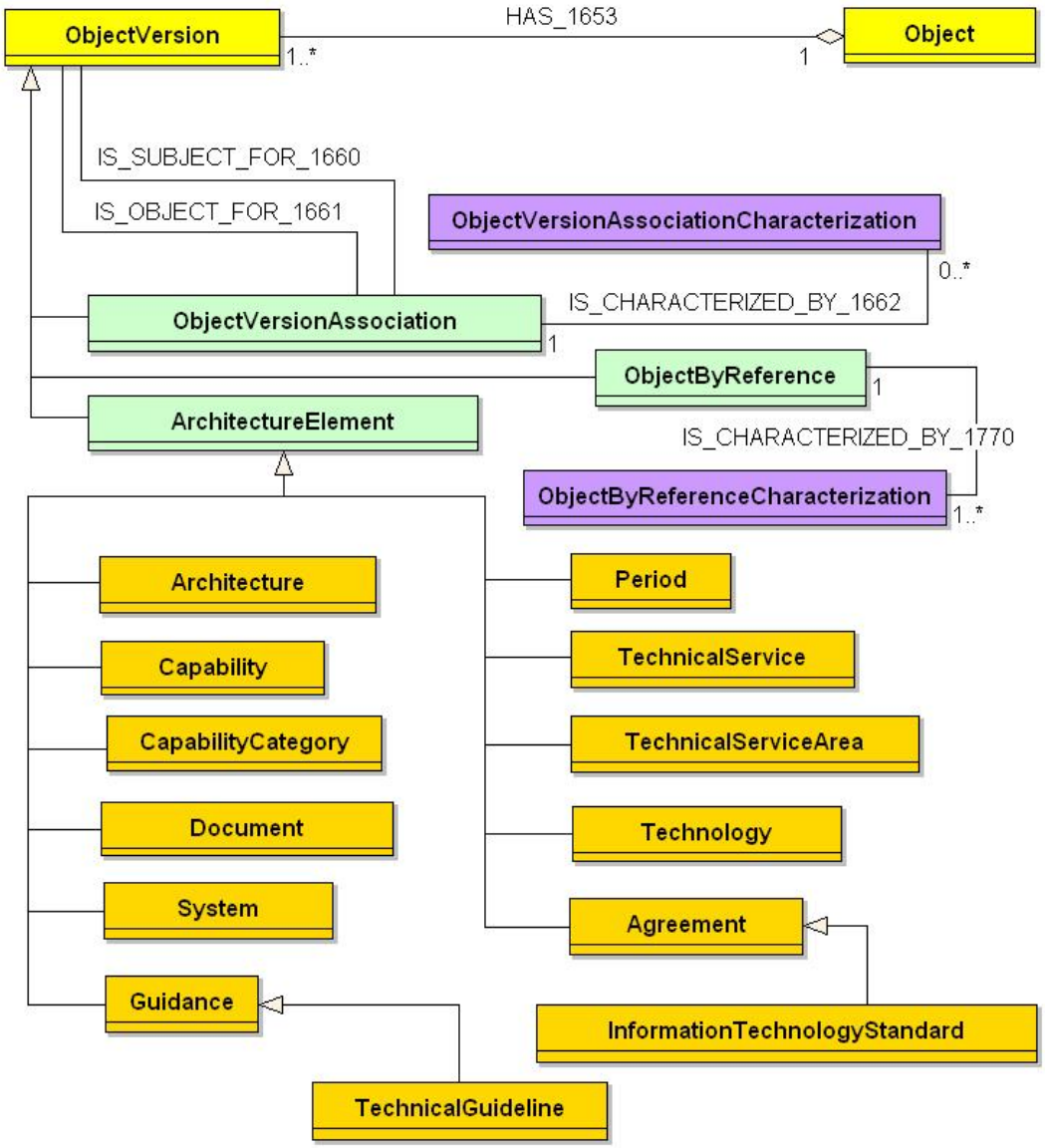


**Figure 5-38: CADM Diagram for SV-9**

The content of the SV-9 is associated through linkages to the appropriate CADM v1.5 structures, such as System, specific instances of TechnicalService and Period. The Period is the same entity used to characterize an SV-8 and a TV-2.

The CADM v1.5 provides specifications for Technology as well as linkages between two instances of Technology; through the use of ObjectByReference, it is also possible to establish relations to technology countermeasures, technical criteria, technology forecasts, and technology issues (see Volume III for details). Relations to other architecture products stored as instances of Document can also be recorded through ObjectVersionAssociation. Linkages to Guidance and its subtype TechnicalGuideline are also supported.

#### 5.9.4.1 SV-9 – Data Element Definitions

## SV-9 Information Space

Agreement†
Architecture†
Capability†
CapabilityCategory†
Document†
Guidance†
InformationTechnologyStandard†
Period†
System†
TechnicalGuideline†
Technology†
**TechnicalService**
**TechnicalServiceArea**

†) The descriptions of these elements have been provided in the preceding sections

**Table 5-9** describes the architecture data elements for SV-9.

**Table 5-9: Data Element Definitions for SV-9**

| Data Elements | Attributes | Definition |
|---|---|---|
| **TechnicalService** | | |
| | availabilityStatusCode | The code that represents how widely a specific TechnicalService has been implemented. |
| **TechnicalServiceArea*** | | |
| | versionIdentifierText* | The text that identifies a specific rendition of a TechnicalServiceArea. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| InformationTechnologyStandard | includes | TechnicalServiceArea |
| TechnicalService | is addressed by | InformationTechnologyStandard |
| TechnicalServiceArea | includes | TechnicalService |

(All previous relationships for the listed entities that comprise the information space of SV-9 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

## 5.10 SYSTEMS AND SERVICES RULES MODEL, STATE TRANSITION DESCRIPTION, AND EVENT-TRACE DESCRIPTION (SV-10A, 10B, AND 10C)

### 5.10.1 Overview of SV-10A, SV-10B, and SV-10C

**Models for SV-10**. Many of the critical characteristics of an architecture are only discovered when an architecture's dynamic behaviors are defined and described. These dynamic behaviors concern the timing and sequencing of events that capture system performance characteristics of an executing system (i.e., a system performing the system functions described in SV-4). Behavior modeling and documentation is key to a successful architecture description, because it is how the architecture behaves that is crucial in many situations. Although knowledge of the functions and interfaces is also crucial, knowing whether, for example, a response should be expected after sending message X to node Y can be crucial to successful overall operations.

Three types of models may be used to adequately describe the dynamic behavior and performance characteristics of a SV. These three models are:

- Systems and Services Rules Model (SV-10a)
- Systems and Services State Transition Description (SV-10b)
- Systems and Services Event-Trace Description (SV-10c)

SV-10b and SV-10c may be used separately or together, as necessary, to describe critical timing and sequencing behavior in the SV. Both types of diagrams are used by a wide variety of different systems methodologies.

Both SV-10b and SV-10c describe systems responses to sequences of events. Events may also be referred to as inputs, transactions, or triggers. When an event occurs, the action to be taken may be subject to a rule or set of rules as described in SV-10a.

### 5.10.2 CADM Support for Systems and Services Functionality Sequences and Threads

The CADM uses the entity Action and the associations of instances of Action to Action to support all the temporal and functional relationships among pairs of (operational and other) Action instances, as shown in **Figure 5-39**. Temporal attributes permit arbitrary sequencing of Action instances, as well as specifying timing offsets needed for planning concepts (e.g., a fire plan) such as relative timing from an H-Hour or a D-Day.

Threads of activities for sequences of IERs, threads for sequences of process activities, and threads for sequences of process activities embedded in a single activity model can also be expressed using CADM v1.5 structures. These and related entities are also shown in Figure 5-39. In addition, Capability can be linked to instances of ProcessActivity, and of InformationTechnologyRequirement to express specific capabilities for threads of IERs and sequences of operational activities.

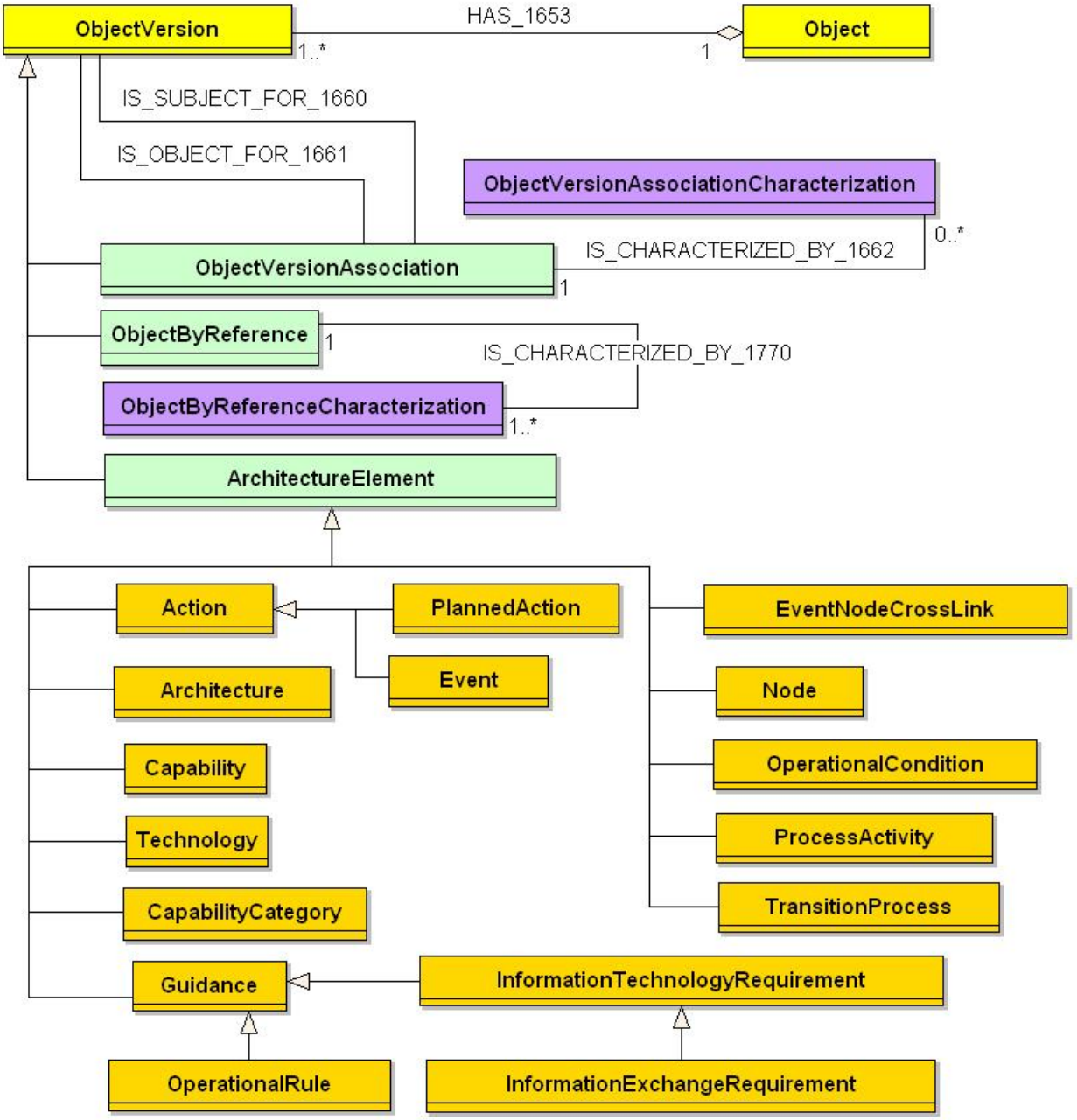


**Figure 5-39: CADM Diagram for Systems and Services Functionality Sequence and Threads**

### 5.10.3 SV-10a – Product Description

**Product Definition**. Systems rules are constraints on an architecture, on a system(s), or system hardware/software item(s), and/or on a system function(s). While other SV products (e.g., SV-1, SV-2, SV-4, SV-11) describe the static structure of the Systems and Services View (i.e., what the systems can do), they do not describe, for the most part, what the systems *must* do, or what it *cannot* do.

At the systems or system hardware/software items level, SV-10a describes the rules under which the architecture or its systems behave under specified conditions. At lower levels of decomposition, it may consist of rules that specify the pre- and post-conditions of system

functions. Such rules can be expressed in a textual form, for example, "If (these conditions) exist, and (this event) occurs, then (perform these actions)."

**Product Purpose**. The purpose of this product is to allow understanding of behavioral rules and constraints imposed on systems and system functions.

**Product Detailed Description**. *Rules are statements that define or constrain some aspect of the enterprise.* In contrast to the OV-6a, SV-10a focuses on constraints imposed by some aspect of operational performance requirements that translate into system performance requirements. At a lower level of detail, it focuses on some aspects of systems design or implementation. Thus, as the operational rules can be associated with the OV-5, the systems rules in SV-10a can be associated with SV-1 and SV-2 systems and hardware/software items or with SV-4 system functions.

Systems rules can be grouped into the following categories:

- Structural Assertion: These rules concern the implementation of business domain terms and facts that are usually captured in the file structures or physical database schemas. These assertions reflect static aspects of the implementation of business rules that may be already captured in the OV-07. (Sometimes these rules are embedded in application code.)
  - Terms: Entities, records
  - Facts: Association between two or more terms (i.e., relationship)
- Action Assertion: These rules concern some dynamic aspect of system functioning and specify constraints on the results of system functions or applications.
  - Condition: Guard or if portion of if-then statement; if the condition is true, it may signal enforcing or testing of additional action assertions
  - Integrity Constraint: Must always be true (e.g., a declarative statement)
  - Authorization: Restricts certain system functions or applications to certain human roles or class of users
- Derivation: These rules concern algorithms used to compute a derivable fact from other terms, facts, derivations, or action assertions.

Because the structural assertion rules are frequently captured in the architecture domain system data model, SV-10a usually focuses on the more dynamic action assertions and derivations rules. Additional rule characteristics include:

- Independent of the modeling paradigm used
- Declarative (non-procedural)
- Atomic (indivisible yet inclusive)
- Expressed in a formal language such as:

  - Decision trees and tables
  - Structured English
  - Mathematical logic
- Distinct, independent constructs

Each architecture may select the formal language in which to record its SV-10a. The notation selected should be referenced and well documented (i.e., there should be text books or articles that describe it and provide examples of its use).

**Figure 5-40** illustrates an example action assertion that might be part of a SV-10a. The assertion is an example of one that might be necessary midway through a system migration, when the databases that support three Forms (FORM-X, FORM-Y, and FORM-Z) have not yet been integrated. Thus, explicit user or application action is needed to keep related system data synchronized. The example is given in a form of structured English.

*If* field A *in* FORM-X *is set to* value T,
  *Then* field B *in* FORM-Y *must be set to* value T
  *And* field C *in* FORM-Z *must be set to* value T
*End If*

**Figure 5-40: SV-10a – Action Assertion Example**

### 5.10.4 UML Representation

There is no equivalent diagram in UML. However, if one considers systems rules to be equivalent to complex, nested If-Then-Else and CASE statements, then these statements can be unambiguously derived from UML statechart diagrams for the object classes defined as systems, system functions, or system data. Pre- and post-conditions can be specified for class operations as well as use cases of SV-4. SV-10a may be generated via the use of adornments, and the inclusion of guard conditions on the statecharts of SV-10b, and pre- and post-conditions on classes and use cases of SV-4.

### 5.10.5 Net-Centric Guidance for SV-10a

**Augmented Product Purpose**. In the NCE, the SV-10a describes behavioral rules and design constraints that guide the logical design of each service being offered by the system.

**Net-Centric Product Description**. The SV-10a traditionally captures the constraints imposed by some aspect of operational performance requirements that translate into system performance requirements. Accordingly, in the NCE, the SV-10a should depict the constraints and behaviors imposed on systems, system functions, and services associated with the SV-1, SV-2, and SV-4 that provide and consume information and capabilities from the NCE. Operational Rules from the OV-6a can constrain system rules in the SV-10a.

Since services entail interactions between provider and consumer, the net-centric SV-10a should provide rules that define *effects* of the interaction. Examples include 1) boundary conditions for inputs and outputs, 2) requirements for data reception, handling, and publishing, 3) exception and failure conditions, and 4) expected responses to exceptions and failures. Critical physical constraints imposed by the environment(s) the service is to operate in should be listed. This includes those imposed by, among others, operating systems, storage capability, communications bandwidth, and connectivity.

Information assurance constraints are of special significance because they are used in the securing of services for use by authorized consumers. *The Information Assurance rules are also special in that an infrastructure security service or an ESB may implement the IA rules outside of the service itself.* The net-centric SV-10a can highlight IA and authoritative policy that guard and/or enable access to services and capabilities. Service rules can include operational constraints, access controls, and policies around authorization, authentication, and access control that implement the service contract. The *service specification* enables these constraints of services to be documented in a consistent manner, and the DoD-wide SST should be used to the extent possible for describing each service. Regardless of the precise service specification template, a minimum set of information for the service rules for each service includes:

- ***Quality Model Category*** includes information on the security requirements of the service, the QoS levels, and any performance considerations for service deployment and the following types of attributes:
    - ***Authentication Mechanism Description*** describes the security mechanisms that the user needs to access the service.
    - ***Access Criteria and Restrictions Description*** includes both the Access Model to describe the user access model, criteria, and process for registering to use the service and the service restrictions that describe any restrictions (including OV-3 usage permissions) that have been placed on users that are allowed to access the service.
    - ***Information Security Markings*** includes attributes about the level and classification applicable to an information resource or portion within the domain of classified national security information.

For the ***Information Model Category*** of the SST, DoDAF v1.5 also extends the minimum set of information to include the following attribute***:***

- ***Effects*** refer to the results that may come from invoking the operation.

At a lower level of detail, the SV-10a focuses on some aspects of systems design or implementation. The SV-10a for services may provide a summary of the business rules embedded at a variety of levels and points. SV-10a may provide ***service rules*** that define the selection of paths within composite control structures at the level of process orchestration, internal conditions that determine the routing of data within the data flow models for composite processes, and the pre- and post-conditions, or effects, within individual service definitions for both atomic and composite services.

### 5.10.6 CADM Support for SV-10a

**Figure** 5-41 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-10a in a CADM-conformant database. Each SV-10a is represented as an instance of Document with its attribute ArchitectureProductTypeCode = RULE-MODEL. This allows the expression of Name, Timeframe, and so on for that architecture product.

The CADM specification for SV-10a also allows the user to describe structural assertions, action assertions with their respective conditions, as well as the applicable integrity constraints, authorizations, and derivations via the instantiation of OperationalRule (a subtype of Guidance) and the use of its attribute LogicalConditionText. Individual rules can be expressed explicitly, where appropriate, as relationships via the entities ConceptualDataModel, or ActivityModel. Where

the rules pertain to procedural applications of technologies they can also be stated in formal or informal terms, as appropriate, as instances of TechnicalGuideline. Where the rules pertain to needs or demands for the acquisition, storage, manipulation, management, movement, control, switching, interchange, transmission, or reception of data, they can be expressed via the entity InformationTechnologyRequirement, and other instances of Guidance. In CADM v1.5, the attribute TypeCode in OperationalRule can be set to either ACTION-ASSERTION-RULE, STRUCTURAL-ASSERTION-RULE, or DATABASE-RULE to refine the semantics of the rules in question. These rules can be related to each other and to various architecture products through ObjectVersionAssociation. This enables, for example, the linkage of a specific SV-10a to instances of OperationalRole.

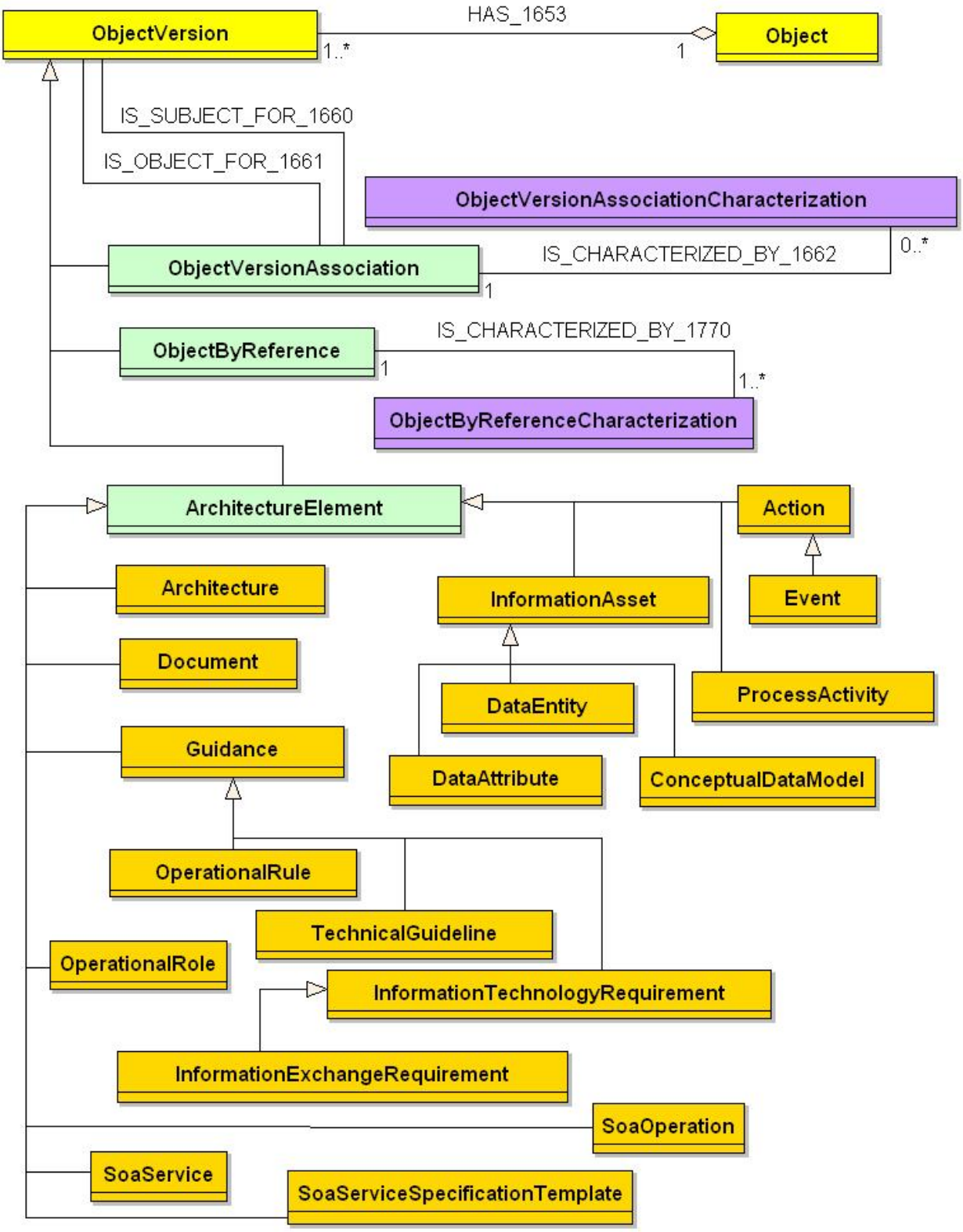


**Figure 5-41: CADM Diagram for SV-10a**

#### 5.10.6.1 SV-10a – Data Element Definitions

The architecture data elements for SV-10a should capture the type of the rule (e.g., action assertion or derivation) and the text for the rule, as well as the relationship between the rules and other architecture data elements. The SV-10a Information Space describes the architecture data elements for SV-10a.

**SV-10a Information Space**

| | |
|---|---|
| Action† | InformationExchangeRequirement† |
| Architecture† | InformationTechnologyRequirement† |
| ConceptualDataModel† | OperationalRole† |
| DataAttribute† | OperationalRule† |
| DataEntity† | ProcessActivity† |
| Document† | SoaOperation† |
| Event† | SoaService† |
| Guidance† | SoaServiceSpecificationTemplate† |
| InformationAsset† | TechnicalGuideline† |

†) The descriptions of these elements have been provided in the preceding sections

### 5.10.7 SV-10b – Product Description

**Product Definition**. The SV-10b is a graphical method of describing a system (or system function) response to various events by changing its state. The diagram basically represents the sets of events to which the systems in the architecture will respond (by taking an action to move to a new state) as a function of its current state. Each transition specifies an event and an action.

**Product Purpose**. The explicit time sequencing of system functions in response to external and internal events is not fully expressed in SV-4. SV-10b can be used to describe the explicit sequencing of the system functions. Alternatively, SV-10b can be used to reflect explicit sequencing of the actions internal to a single system function, or the sequencing of system functions with respect to a specific system.

Basically, statechart diagrams can be unambiguously converted to structured textual rules that specify timing aspects of systems events and the responses to these events, with no loss of meaning. However, the graphical form of the state diagrams can often allow quick analysis of the completeness of the rule set, and detection of dead ends or missing conditions. These errors, if not detected early during the systems analysis phase, can often lead to serious behavioral errors in fielded systems, or to expensive correction efforts.

**Product Detailed Description**. SV-10b is based on the statechart diagram [OMG, 2003]. A state machine is defined as "a specification that describes all possible behaviors of some dynamic model element. Behavior is modeled as a traversal of a graph of state nodes interconnected by one or more joined transition arcs that are triggered by the dispatching of series of event instances. During this traversal, the state machine executes a series of actions associated with various elements of the state machine." [OMG, 2003]

The product relates states, events, and actions. A state and its associated action(s) specify the response of a system or system function, to events. When an event occurs, the next state may vary depending on the current state (and its associated action), the event, and the rule set or guard conditions. A change of state is called a transition. Each transition specifies the response

based on a specific event and the current state. Actions may be associated with a given state or with the transition between states.

SV-10b can be used to describe the detailed sequencing of system functions described in SV-4. However, the relationship between the actions included in SV-10b and the system functions in SV-4 depends on the purposes of the architecture and the level of abstraction used in the models. The explicit sequencing of system functions in response to external and internal events is not fully expressed in SV-4. SV-10b can be used to reflect explicit sequencing of the system functions, the sequencing of actions internal to a single function, or the sequencing of system functions with respect to a specific system. **Figure 5-42** provides a template for a simple SV-10b. The black dot and incoming arrow point to initial states (usually one per diagram), while terminal states are identified by an outgoing arrow pointing to a black dot with a circle around it. States are indicated by rounded corner box icons and labeled by name or number and, optionally, any actions associated with that state. Transitions between states are indicated by one-way arrows labeled with event/action notation, which indicates an event-action pair, and semantically translates to: when an event occurs, the corresponding action is executed. This notation indicates the event that causes the transition and the ensuing action (if any) associated with the transition.

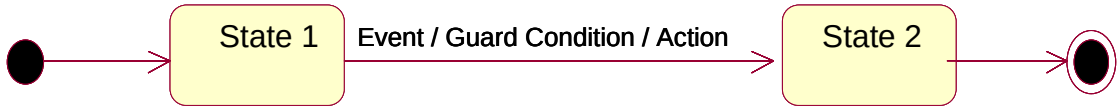


**Figure 5-42: SV-10b – High-Level Template**

### 5.10.8 UML Representation

SV-10b may be produced in UML using statechart diagrams. Statechart diagrams contain simple states and composite states. They also contain transitions, which are described in terms of triggers or events (generated as a result of an action) and guard conditions associated with the events, and an action or sequence of actions that are executed as a result of the event taking place (see Figure 5-42). Statechart diagrams specify the reaction of an object to stimuli as a function of its internal state. Guard conditions of a statechart diagram map to the pre- and post-conditions of an SV-4 use case. Events or triggers associated with the transitions on the state diagrams correlate to the triggering events documented in SV-6.

### 5.10.9 Net-Centric Guidance for SV-10b

Since the SV-10b is a graphical method of describing a system (or system function) response to various events by changing its state, it would subsequently include any services that support NCO. Accordingly, the SV-10b is well suited to support the NCE.

### 5.10.10 CADM Support for SV-10b

**Figure** 5-43 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-10b in a CADM-conformant database. Each SV-10b is represented as an instance of Document, with its attribute ArchitectureProductTypeCode = STATE-TRANSITION-DESCRIPTION. This permits recording the Name, Timeframe, and so forth for this DoDAF product.

The CADM specification for SV-10b also allows the user to describe all the relevant components of a state transition diagram by the proper instantiation of ProcessEvent,

TransitionProcess, and ProcessStateVertex. Additional characterization is also supported through the use of ObjectByReference (see Volume III for details).

In addition to the entities mentioned above, the CADM v1.5 structures, ProcessActivity, Action, and Event, can also be employed to capture the information content of an OV-10b. In this manner it is possible to relate TransitionProcess to Action as well as types of events called out in UML: SIGNAL-EVENT, CALL-EVENT, TIME-EVENT, and CHANGE-EVENT. In CADM it is also possible to link an OV-10b to a specific System (including a specific component), a SoftwareItem, or to a Task.

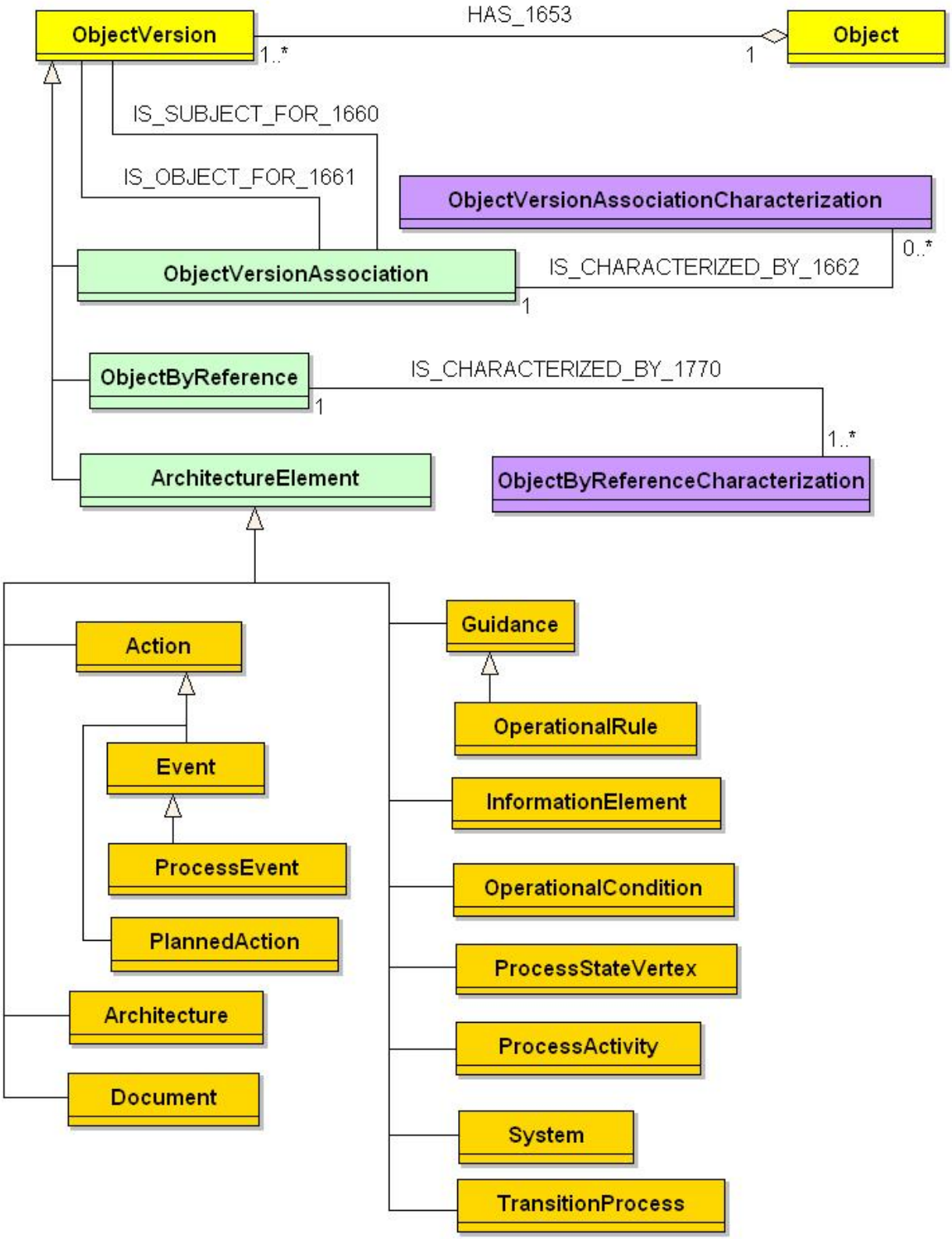


**Figure 5-43: CADM Diagram for SV-10b**

### 5.10.10.1 SV-10b – Data Element Definitions

SV-10b describes the detailed sequencing of functions in a system by depicting how the current state of the system changes in response to external and internal events, resulting in time-sequenced activities. The SV-10b Information Space describes the architecture data elements for SV-10b.

**SV-10b Information Space**

| | |
|---|---|
| Action† | OperationalRule† |
| Architecture† | PlannedAction† |
| Document† | ProcessActivity† |
| Event† | ProcessEvent† |
| Guidance† | ProcessStateVertex† |
| InformationElement† | System† |
| OperationalCondition† | TransitionProcess† |

†) The descriptions of these elements have been provided in the preceding sections

### 5.10.11 SV-10c – Product Description

**Product Definition**. The SV-10c provides a time-ordered examination of the system data elements exchanged between participating systems (external and internal), system functions, or human roles as a result of a particular scenario. Each event-trace diagram should have an accompanying description that defines the particular scenario or situation. SV-10c in the Systems and Services View may reflect system-specific aspects or refinements of critical sequences of events described in the Operational View.

**Product Purpose**. SV-10c products are valuable for moving to the next level of detail from the initial systems design, to help define a sequence of functions and system data interfaces, and to ensure that each participating system, system function, or human role has the necessary information it needs, at the right time, in order to perform its assigned functionality.

**Product Detailed Description**. SV-10c allows the tracing of actions in a scenario or critical sequence of events. With time proceeding from the top of the diagram to the bottom, a specific diagram lays out the sequence of system data exchanges that occur between systems (external and internal), system functions, or human role for a given scenario. Different scenarios should be depicted by separate diagrams. SV-10c can be used by itself or in conjunction with a SV-10b to describe dynamic behavior of system processes or system function threads.

**Figure 5-44** provides a template for SV-10c. The items across the top of the diagram represent systems, system functions, or human roles that take action based on certain types of events. Each system, function, or human role has a lifeline associated with it that runs vertically. Specific points in time can be labeled on the lifelines, running down the left-hand side of the diagram. An event may occur as a result of an action. An event in a sequence diagram implies the action that produced it. Labels indicating timing constraints or providing event descriptions can be shown in the margin or near the transitions of the event(s) that they label. One-way arrows between the lifelines represent events, and the points at which they intersect the lifelines represent the times at which the system/function/role becomes aware of the events. The direction of the events represents the flow of control from one system/function/role to another based on the event. Each diagram may represent systems (external and internal) or system functions, but

not both in the same diagram. Human roles may also be used in the diagram along with either systems or system functions in order to describe the humans' interfaces to the systems or system functions.

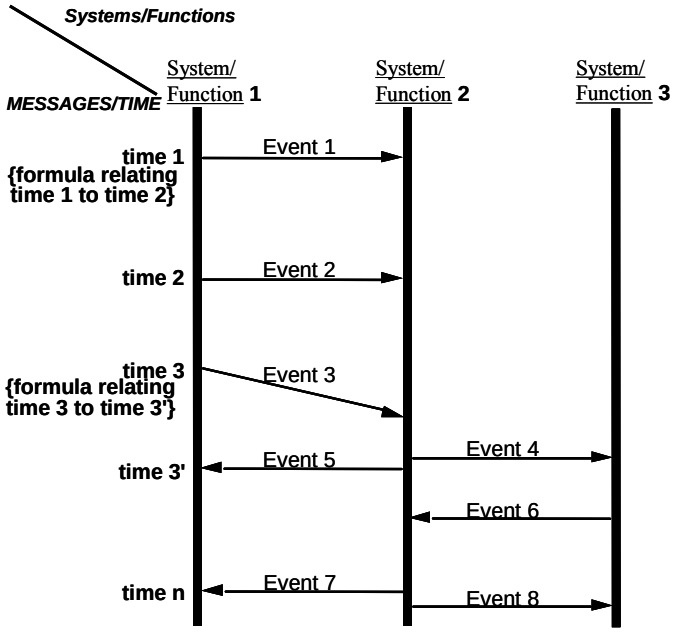


**Figure 5-44: SV-10c – Template**

### 5.10.12 UML Representation

UML sequence diagrams may be used to model SV-10c. Each diagram may represent systems (external and internal) or system functions, but not both in the same diagram.

Figure 5-44 provides a template for a UML sequence diagram.

### 5.10.13 Net-Centric Guidance for SV-10c

**Augmented Product Purpose.** In the NCE, the SV-10c is used to depict the sequencing and orchestration of services to fulfill a scenario and enable the execution of capabilities.

**Net-Centric Product Description.** The SV-10c traditionally depicts the tracing of actions and system data exchanges that occur in a scenario between systems, system functions or human role. Accordingly, in the NCE, the SV-10c is used to depict the sequencing and orchestration of services to fulfill a scenario and enable the execution of capabilities. It also can clearly depict the interaction of services with non-service oriented systems functions to show the hybrid environment and how it can evolve over time (similar to the SV-5a). The SV-10c graphically portrays service dependencies on other services and external entities. The SV-10c product depicts net-centric leverage and business process flexibility by capturing information on how architects have leveraged a single service across multiple business process. The SV-10c provides the underlying orchestration details captured in the SV-4.

***Services*** are a key means to share capabilities and information in the NCE so they can be leveraged by others; this is represented in the SV-10c by showing how ***services*** enable the execution of capabilities. The net-centric SV-10c depicts the methodologies of service usage to exchange information or fulfill capability between ***Service Providers*** and ***Service Consumers***.

To illustrate how services are used to fulfill operational considerations, architects should create one or more net-centric SV-10c(s) derived from the set of scenarios that originated the net-centric OV-6c(s) and depict when and how often ***information, data, applications, and services*** are ***posted*** to or retrieved from the NCE. However, a net-centric SV-10c needs to be derived directly from a specific net-centric OV-6c. A net-centric SV-10c can be used to highlight examples for ***service registration***, ***service discovery***, and ***service management***. Furthermore, additional net-centric SV-10c(s) may be created to illustrate patterns for the usage of NCE provided service infrastructure (collaboration, data handling, data storage, security, etc.). If the program responds to ***Unanticipated Users*** differently than known ***Service Consumers***, specific SV-10c(s) may be developed that capture any differences. Lastly, there may be a need to layer SV-10c(s) that describe different levels of abstraction or detail, so that the complete set of SV-10c products can be better bounded, organized, and presented.

The ***service specification*** enables these sequencing and orchestration of services to be documented in a consistent manner, and the DoD-wide SST should be used to the extent possible for describing these attributes. Regardless of the precise service specification template, a minimum set of information for sequencing and orchestration should be included in the SV-10c.

For the ***Information Model Category*** of the SST, DoDAF v1.5 extends the minimum set of information to include the following attributes***:***

- ***Overview*** identifies the attributes that include the name of the operation, a narrative that describes the operation, and the message Flow Pattern.
- ***Effects*** refer to the results that may come from invoking the operation.

Documenting these various aspects of net-centricity in the SV-10c products will provide a guide to managing ***services*** in order to accommodate reuse and providing data to the NCE.

**Figure 5-45** provides a template for a net-centric SV-10c. The items across the top of the diagram represent human roles and system components such as portal and services. Each human role or system component has a life-line associated with it that runs vertically. Running between life-lines are event-lines that represent requests for system components to provide functionality or initiate activity. The usage, dependencies, and orchestration of services within a scenario are then captured as a series of event-lines. The same or similar sequencing of events often appear in more than one scenario, which incurs wasted design efforts and adds risk of accuracy and confusion between scenarios. To solve the problem, a specific SV-10c can be created to describe the repeated sequence. The specific SV-10c acts then as a pattern which can be referenced from other SV-10c Net-Centric Implementation Document(s) provided by systems components in the form of service calls. Candidates for pattern usage will be program specific, but typically, any sequence of events that is repeated between scenarios should be considered for pattern creation. Often used examples include discovery, registration, authentication, and usage of infrastructure services.

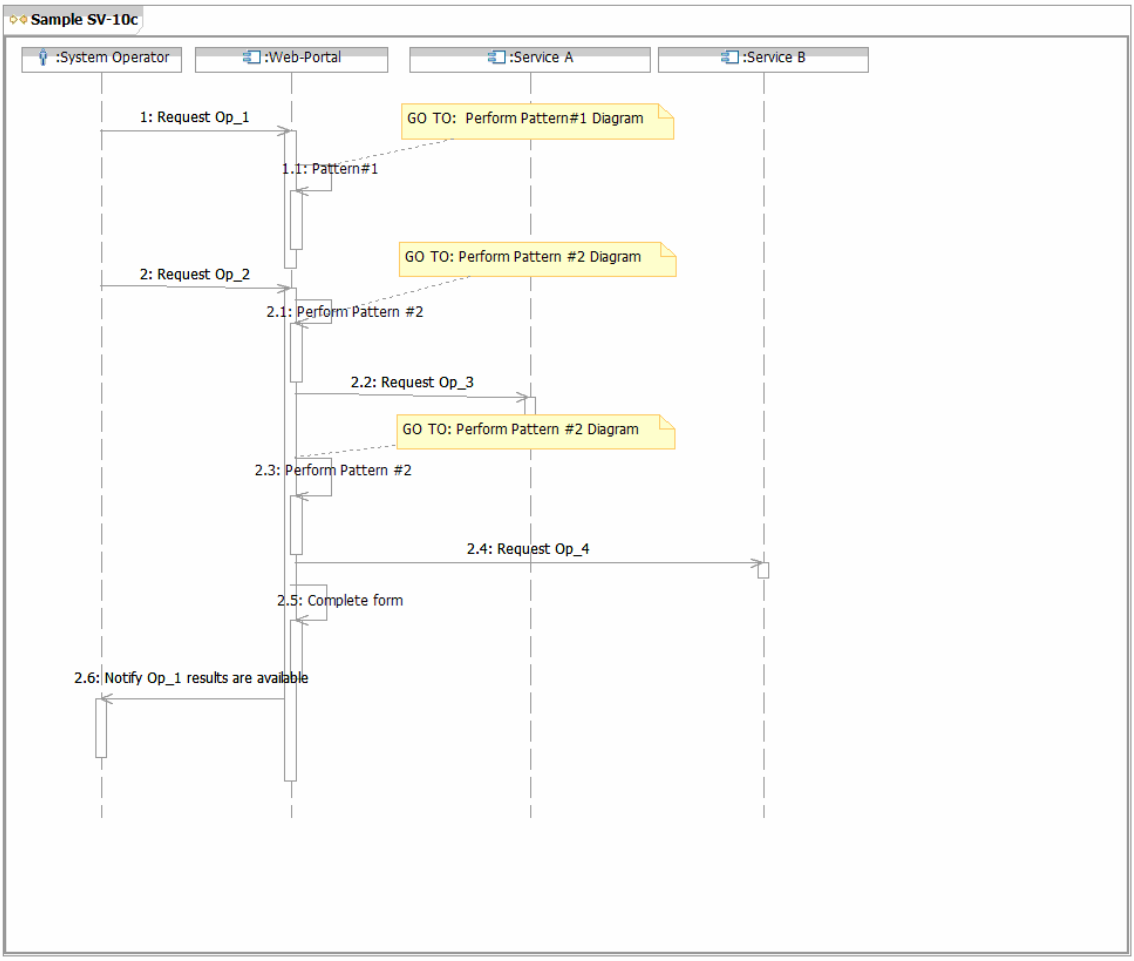


**Figure 5-45: Notional Example: SV-10c**

### 5.10.14 CADM Support for SV-10c

**Figure** 5-46 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for OV-10c in a CADM-conformant database. Each SV-10c is represented as an instance of Document with its attribute ArchitectureProductTypeCode = EVENT-TRACE-DESCRIPTION. This permits recording the Name, Timeframe, and so forth for this DoDAF product.

In CADM v1.5, it is possible to state (relative) timelines (or lifelines) for instances of Node. Each such Node can be explicitly associated with a MissionArea, Organization, OrganizationType, ProcessActivity[36], System, and Task. In addition one can also relate two Node instances differing with regard to their timelines. The definition of such relations can be treated as independent architectural statements and reused from one scenario to another. For these temporal relations one can specify their start at explicit or implicit (computed) absolute or relative times. Relative times can be specified in terms of the start or end of another temporal relation (using a method analogous to one defined for temporally related Action instances). A specific SV-10c can be

[36] Use of Node in SV-10c permits the same data structures to represent many kinds of event-traces, not only for systems and system functions but also for specific instances of Materiel, MilitaryPlatform, or Facility, among others. In CADM v1.5 all these associations are built via the ObjectVersionAssociation.

associated to an OperationalScenario. As noted in the general description of OV-10 products (above), CADM v1.5 also supports the linkage of OV-10c to capabilities.

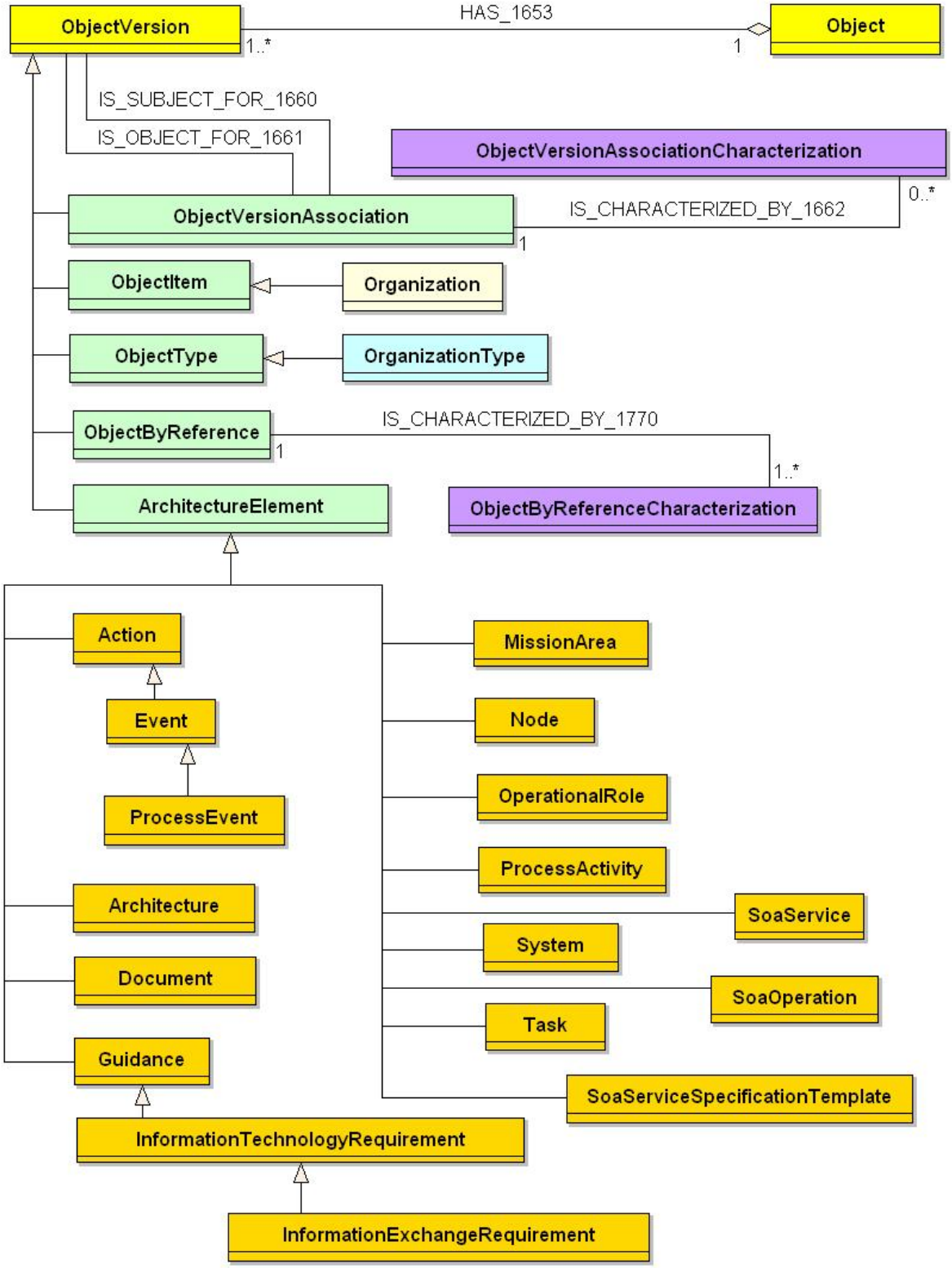


**Figure 5-46: CADM Diagram for SV-10c**

### 5.10.14.1 SV-10c – Data Element Definitions

## SV-10c Information Space

**Action**†
**Architecture**†
**Document**†
**Event**†
**Guidance**†
**InformationExchangeRequirement**†
**InformationTechnologyRequirement**†
**MissionArea**†
**Node**†
**OperationalRole**†
**Organization**†
**OrganizationType**†
**ProcessActivity**†
**ProcessEvent**†
**SoaOperation**†
**SoaService**†
**SoaServiceSpecificationTemplate**†
**System**†
**Task**†

†) The descriptions of these elements have been provided in the preceding sections

## 5.11 PHYSICAL SCHEMA (SV-11)

### 5.11.1 SV-11 – Product Description

**Product Definition**. The SV-11 is one of the architecture products closest to actual system design in the Framework. The product defines the structure of the various kinds of system data that are utilized by the systems in the architecture.

**Product Purpose**. The product serves several purposes, including 1) providing as much detail as possible on the system data elements exchanged between systems, thus reducing the risk of interoperability errors, and 2) providing system data structures for use in the system design process, if necessary.

**Product Detailed Description**. The SV-11 is an implementation-oriented data model that is used in the Systems and Services View to describe how the information requirements represented in OV-7 are actually implemented. Entities represent 1) system data flows in SV-4, 2) system data elements specified in SV-6, 3) triggering events in SV-10b, and/or 4) events in SV-10c.

There should be a mapping from a given OV-7 to SV-11 if both models are used. The form of SV-11 can vary greatly, as shown in **Figure 5-47**. For some purposes, an entity-relationship style diagram of the physical database design will suffice. References to message format standards (which identify message types and options to be used) may suffice for message-oriented implementations. Descriptions of file formats may be used when file passing is the mode used to exchange information. A Data Definition Language (DDL) (e.g., Structured Query Language [SQL]) may also be used in the cases where shared databases are used to integrate systems. Interoperating systems may use a variety of techniques to exchange system data and have several distinct partitions in their SV-11 with each partition using a different form. Standards associated with entities (e.g., entities are those defined in DoD XML Registry) are also documented in this product.

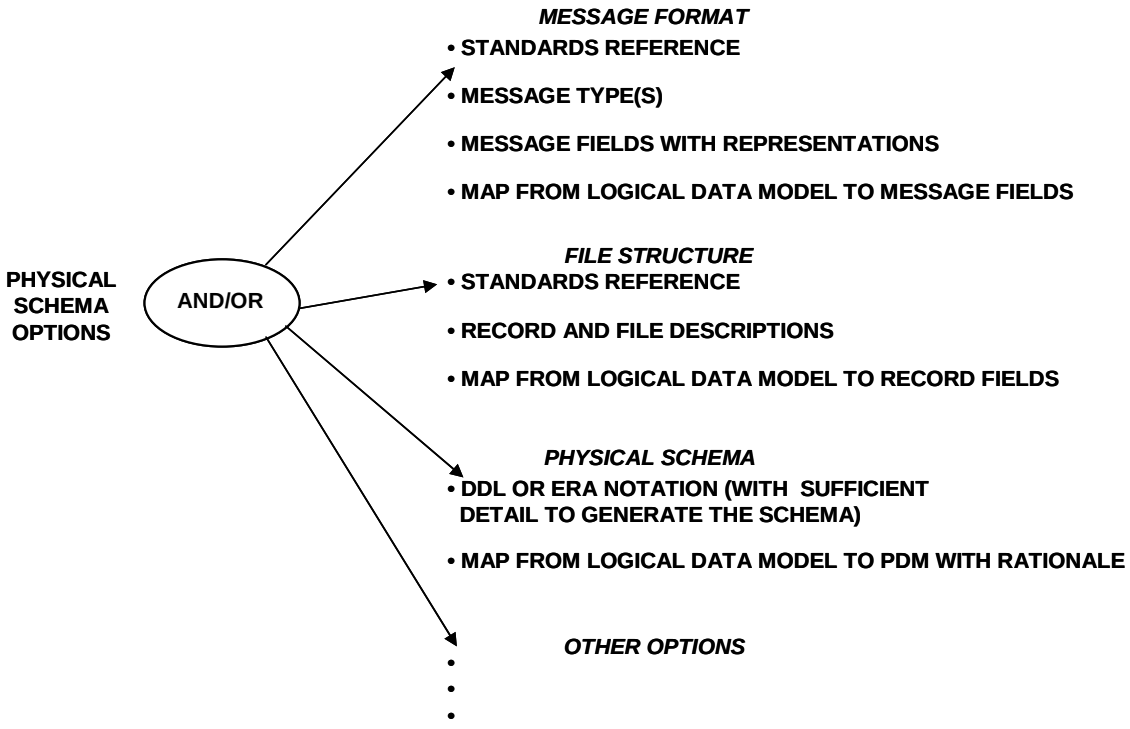


**Figure 5-47: SV-11 – Representation Options**

### 5.11.2 UML Representation

SV-11 may be specified in UML using a class diagram based on the OMG Database Profile. These stereotyped classes offer all the UML elements needed to produce entity-relationship diagrams. Class diagrams consist of classes, interfaces, collaborations, dependency, generalization, association, and realization relationships. The properties of these classes can be expanded to include associations and cardinality [Booch, 1999]. The class diagram with the profile extensions is the closest parallel to the IDEF1X entity-relationship diagram. **Figure 5-48** (which is the physical schema for the logical model shown in Figure 5-47 above) is an example of such a use of a UML class diagram. The small icon on the upper right-hand corner marks each of the classes as a "table". The stereotype «column» marks the properties of the classes as being physical columns. In addition, an attribute can be marked with PK (primary key), pfK (primary foreign key) or FK (foreign key) to highlight its role as a "key" in a given physical table. The associations go from child to parent, which is highlighted by the arrow lines. Cardinalities, physical-only class properties, foreign-key constraint names, and the mapping of the migrated keys can also be defined in these kinds of UML diagrams. Finally, the SQL data types can be specified to enable the automatic forward-engineering of the physical schema.

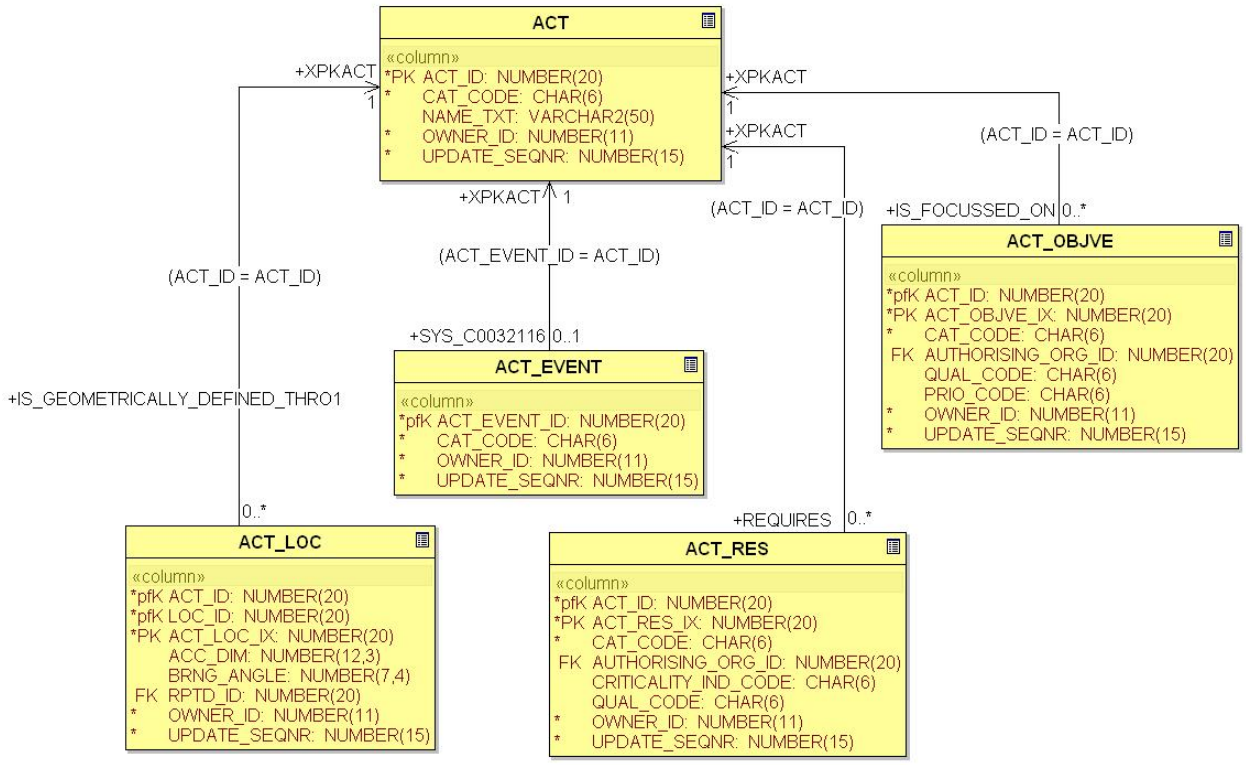


**Figure 5-48: UML Class Diagram for SV-11**

UML classes defined in the SV-11 should trace to (1) system data flows in SV-4, (2) system data elements specified in SV-6, (3) transition triggers in SV-10b, and/or (4) events in SV-10c. The SV-11 class diagram is at a lower level of detail than the class diagrams built to support the other SV products. However, the other products cannot be fully defined without reference to this more detailed level.

### 5.11.3 Net-Centric Guidance for SV-11

**Augmented Product Purpose**. In the NCE, a SV-11 describes the data schema for the information being exchanged by ***services***.

**Net-Centric Product Description**. The SV-11 traditionally describes how the information requirements represented in the OV-7 are actually implemented. Accordingly, in the NCE, the SV-11 focuses on the data being exchanged in the NCE. As such, the net-centric SV-11 provides structure for the data-types being passed through the service interfaces described in the net-centric SV-4 and used in the scenario traces of the net-centric SV-10c. In the case where both OV-7 and SV-11 products are included, the net-centric SV-11 provides the physical implementation structure of the portions of the OV-7 that define information exchanges and are mapped to those portions of the OV-7. It should also highlight any adaptations and extensions of the structures described in OV-7.

To support net-centric systems development, the net-centric SV-11 describes information structures and messages as XML schemas based on the NCE adoption of Web Services standards including XML, WSDL, and UDDI. The net-centric SV-11 may depict the use of appropriate data structures in the DoD Metadata Registry, or in the case where schemas are developed for the

net-centric SV-11, the schemas can be registered for consideration and used by other architecture and systems development efforts.

### 5.11.4 CADM Support for SV-11

**Figure** 5-49 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for SV-11 in a CADM-conformant database. Each SV-11 is represented as an instance of Document with its attribute ArchitectureProductTypeCode = PHYSICAL-SCHEMA-SPECIFICATION. This allows the specification of Name, Timeframe, etc., for this DoDAF product. The same view can be used for internal forms of data as actually stored or external forms of data presented to users.

SV-11 can be linked to specific instances of InternalDataModel and UserPresentationView (both subtypes of InformationAsset). The key entities in this specification include ConceptualDataModel, DataEntity, and DataAttribute. Additional data can be expressed via ObjectByReference (see Volume III for details). Each DataEntity can be directly related to an ActivityModelInformationElement**Role** (providing a link between data models and activity models).

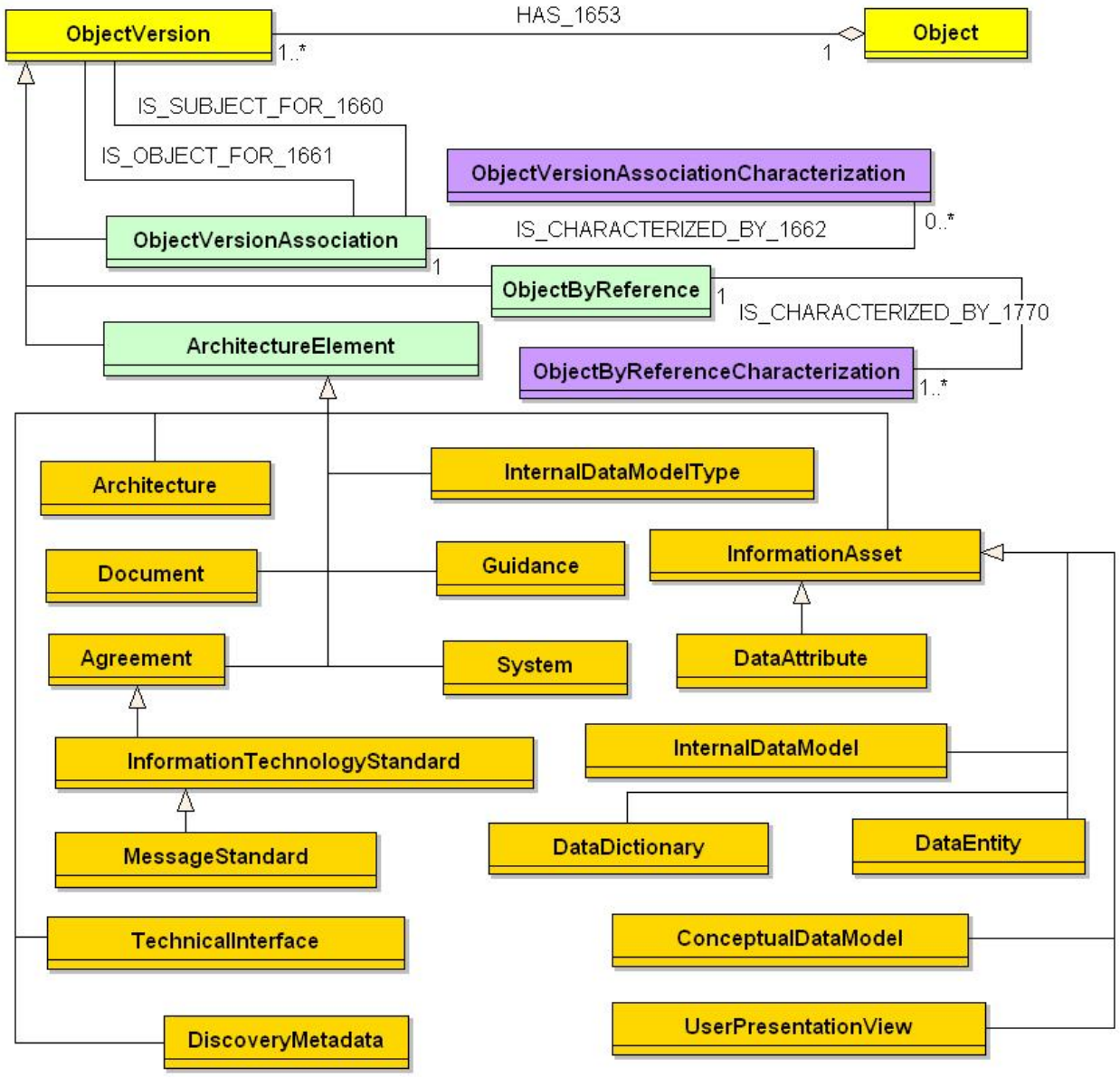


**Figure 5-49: CADM Diagram for SV-11**

### 5.11.4.1 SV-11 – Data Element Definitions

## SV-11 Information Space

**Agreement**†
**Architecture**†
**ConceptualDataModel**†
**DataAttribute**†
**DataDictionary**†
**DataEntity**†
**DiscoveryMetadata**†
**Document**†
**Guidance**†
**InformationAsset**†
**InformationTechnologyStandard**†
**MessageStandard**†
**System**†
**TechnicalInterface**†
**InternalDataModel**
**InternalDataModelType**
**UserPresentationView**

t) The descriptions of these elements have been provided in the preceding sections

**Table 5-10** describes the architecture data elements for SV-11.

**Table 5-10 Data Element Definitions for SV-11**

| Data Elements | Attributes | Definition |
|---|---|---|
| **InternalDataModel** | | |
| | fileStructureTypeCode | The code that represents a kind of creation mechanism of a data set for a specific InternalDataModel. |
| | languageTypeCode | The code that represents the kind of syntax in which the InternalDataModel is specified. |
| | migrationStatusCode | The code that represents the state of conversion of an InternalDataModel. |
| | revisionCalendarDate | The calendar date of the most recent amendment to a specific InternalDataModel. |
| | technologyName | The name of the technical aspects of an InternalDataModel. |
| **InternalDataModelType** | | |
| | technologyCode | The code that represents a kind of InternalDataModelType. |
| **UserPresentationView** | | |
| | typeCode | The code that represents a kind of a UserPresentationView. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| InternalDataModelType | classifies | InternalDataModel |

(All previous relationships for the listed entities that comprise the information space of SV-11 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III.)

# 6 TECHNICAL STANDARDS VIEW PRODUCTS

The TV provides the technical systems-implementation standards upon which engineering specifications are based, common building blocks are established, and product lines are developed.

The TV includes two products:

- Technical Standards Profile (TV-1)
- Technical Standards Forecast (TV-2)

## 6.1 TECHNICAL STANDARDS PROFILE (TV-1)

### 6.1.1 TV-1 – Product Description

**Product Definition**. The TV-1 collects the various systems standards rules that implement and sometimes constrain the choices that can be made in the design and implementation of an architecture.

**Product Purpose**. Primarily, this product is concerned with delineating systems standards rules and conventions that apply to architecture implementations. When the standards profile is tied to the system elements to which they apply, TV-1 serves as the bridge between the SV and TV.

**Product Detailed Description**. TV-1 consists of the set of systems standards rules that govern systems implementation and operation of that architecture. The technical standards generally govern what hardware and software may be implemented and what system data formats may be used (i.e., the profile delineates which standards may be used to implement the systems, system hardware/software items, communications protocols, and system data formats).

TV-1 is constructed as part of a given architecture and in accordance with the architecture purpose. Typically, this will involve starting with one or more overarching reference models or standards profiles, such as OMB's TRM [OMB, 2003], DoD TRM, Net-Centric Implementation Documents (NCIDs), Key Interface Profiles (KIPs), Net-Centric Operations and Warfare Reference Model Target Technical View (NCOW RM TTV), or the DoD Information Technology Standards Registry (DISR) [DISA, 2002]. Using these reference models or standards profiles, the architect should select the service areas relevant to the architecture. The identification of relevant services within service areas subsequently points to agreed-upon standards. The source document used for identifying each standard must also be cited.

In most cases, especially in describing architectures with less than a Military Service-wide scope, TV-1 consists of identifying the applicable portions of the DISR and other existing technical standards guidance documents, tailoring those portions, as needed, in accordance with the latitude allowed in these guidance documents, and filling in any gaps. This process of tailoring standards guidance from higher level, more general guidance, is called creating a standards profile. For example, a DoD mission area might create a common mission-area standards profile using TV-1. Each program or project in that mission area would further refine this common profile to create its own standards profile. Care should be taken in the refinement process to ensure that systems compliant with the child profile would continue to be interoperable with systems compliant with the parent profile. If service-level DISR-like documents are used, then the relationship between the DISR and those documents must be stated.

For a given domain, TV-1 may also state a common standard implementation for a particular standard, not just list the standard. Many standards can be implemented in compliant, but not interoperable ways, such as MIL STD 6016.

The standards are referenced as relationships to the systems, system functions, system data, hardware/software items or communication protocols in SV-1, SV-2, SV-4, SV-6, OV-7, and SV-11 products, where applicable. That is, each standard listed in the profile should be associated with the SV elements that implement or use the standard (e.g., SV-1, SV-2, SV-4, SV-6, OV-7 and SV-11 element standards, where applicable). Standards for OV-7 and SV-11 do not include system data standards such as naming conventions, attribute lists, and field types, but refer to the source for the data entities (e.g., DoD XML Registry), or the data modeling standard used (e.g., IDEF1X).

A template for TV-1 is shown in **Table 6-1**. The template contains a subset of DISR services by way of example.

**Table 6-1: TV-1 Template**

| DISR Service Area | Service | DISR Standard and Source Document |
|---|---|---|
| **Information-Processing Standards** | Higher Order Languages | |
| | Software Life-Cycle Process | |
| | Geospatial Data Interchange | |
| | Motion Imagery Data Interchange - Video | |
| | Distributed-Object Computing | |
| **Information-Transfer Standards** | Data Flow Network | |
| | Command and Control Information (C2I) Network | |
| | Physical Layer | |
| | Network Interface | |
| | Layer Management | |
| | File Transfer Standards | |
| | Remote Terminal Standards | |
| | Network Time Synchronization Standards | |
| | Web Services Standards | |
| | Connectionless Data Transfer | |
| | Transport Services Standards | |
| **Information Modeling, Metadata, and Information Exchange Standards** | Activity Modeling | |
| | Data Modeling | |
| | Object-Oriented Modeling | |
| **Human Computer Interface** | Mandates | |
| **Information Security / Information Infrastructure Standards** | Password Security | |
| | Application Software Entity Security Standards | |
| | Virtual Private Network (WAN) Service | |
| | Intrusion Detection Service | |
| | Human-Computer Interface Security Standards | |

Timed technology forecasts from SV-9 may be related to TV-1 standards in the following ways. When a certain technology becomes available, it may force a need to upgrade to a new version of a TV-1 standard. Similarly, a standard listed in TV-2 may not be adopted until a certain technology becomes available. This is how standards in TV-1, which are applicable to systems elements from SV-1, SV-2, SV-4, SV-6, and OV-7, may be related to future standards listed in TV-2, through the SV-9 product.

**Figure 6-1** illustrates the bridge concept.

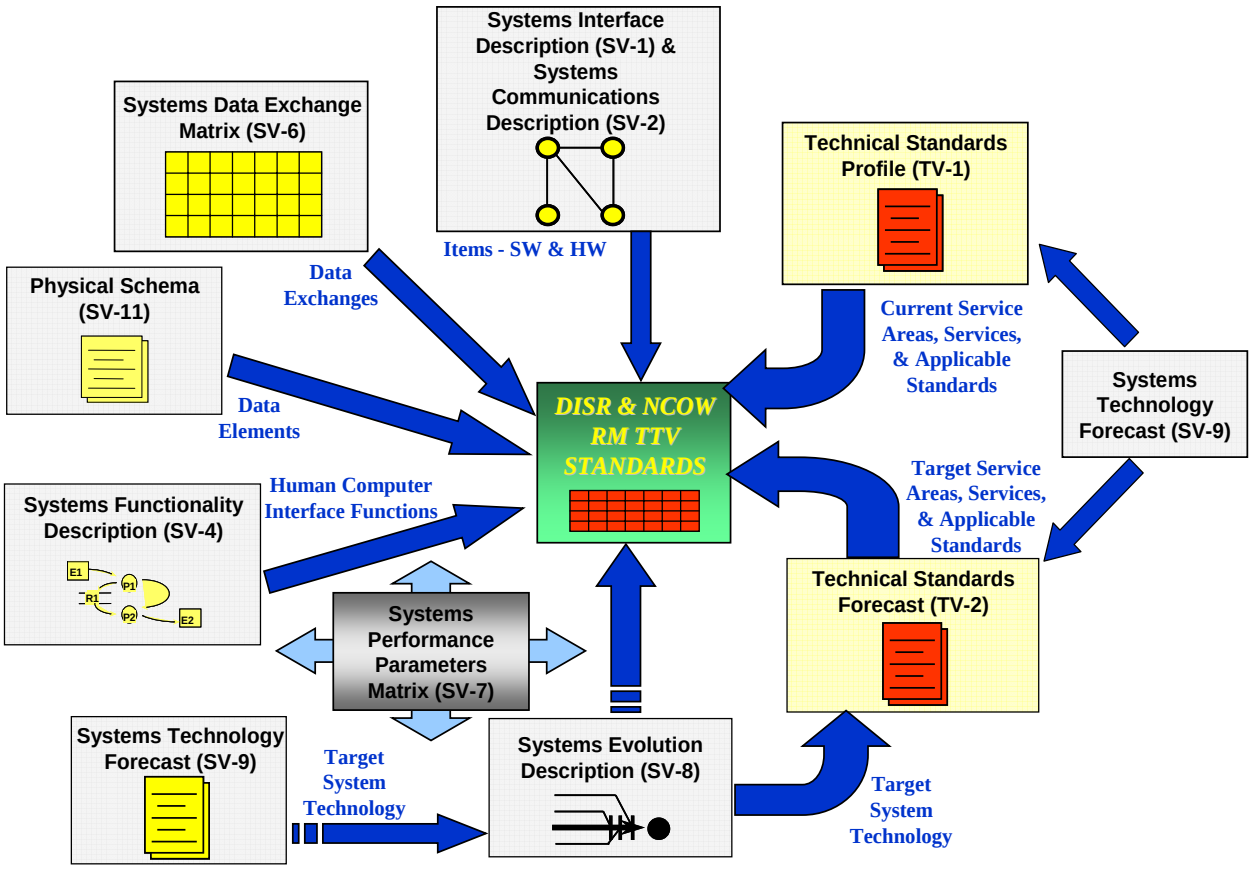


**Figure 6-1: Systems Products Associated with Standards**

Once the standards profile has been developed, another TV-1 product may be organized as a matrix that delineates the standards identified in the profile that apply to the relevant system elements. An example bridge matrix template appears in **Table 6-2**.

**Table 6-2: TV-1 Template with Corresponding System Elements**

| | | | SV-1 and SV-2 Systems (includes SOS, FOS, subsystem, communications systems) | SV-1 and SV-2 Hardware or Software Item | SV-2 Communications (Physical) Link | SV-4 System Function | SV-6 System Data Element | OV-7, SV-11 Model Standard or Source |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **DISR Service Area** | **Service** | **DISR Standard** | **Applicable System ID or Name (with Time Period if applicable)** | **Hardware or Software ID or Name, Version (with Time Period if applicable)** | **System Data Link ID or Name (with Time Period if applicable)** | **System Function ID or Name** | **System Data Exchange ID or Name (with Time Period if applicable)** | **Model Standard or Source ID or Name (with Time Period if applicable)** |
| **Information-Technology Standards** | Operating Environment | | | | | | | |
| **Information-Processing Standards** | Higher Order Languages | | | | | | | |
| | Geospatial Data Interchange | | | | | | | |
| **Information-Transfer Standards** | Data Flow Network | | | | | | | |
| | Physical Layer | | | | | | | |
| | Network Interface | | | | | | | |
| | Narrow-Band Video Conferencing | | | | | | | |
| **Information Modeling, Metadata, and Information Exchange Standards** | Object-Oriented Modeling | | | | | | | |
| **Human Computer Interface** | Mandates | | | | | | | |
| **Information Security / Information Infrastructure Standards** | PKI Certificate Profile Standards | | | | | | | |
| | Human-Computer Interface Security Standards | | | | | | | |
| | Web Security Standards | | | | | | | |
| **Physical Services Standards** | Chassis | | | | | | | |
| | Backplanes | | | | | | | |
| | Circuit Cards | | | | | | | |

As shown in **Table 6-3**, a separate matrix for each product or product element type may be developed showing a list of the same element type (e.g., system) as columns, with time periods specified in the cells (specifying when to apply the standards), where applicable. If time periods are used, then TV-1 also includes a bridge to the systems and their time periods in SV-8.

**Table 6-3: TV-1 Template for Systems with Corresponding Time Periods**

| Standards Applicable to SV-1 Systems | | | System A | System B | System C |
|---|---|---|---|---|---|
| | | | | | |
| **DISR Service** | **Service Area** | **Standard** | | | |
| **Information-Technology Standards** | Operating Environment | The DII COE as mandated by the DISR | Current Baseline: Jan. 12, 2003 | | |
| | Operating System Standard | ISO/IEC 9945-1:1996, Information Technology - Portable Operating System Interface (POSIX) - Part 1: System Application Program Interface (API) [C language] (Mandated Services). (DISR v2.0/3.1/4.0) http://webstore.ansi.org/ansidocstore/default.asp | | Current Baseline: Jan. 12, 2003 | Current Baseline: Jan. 12, 2003 |
| | Operating System Standard | ISO/IEC 9945-1:1996:(Thread Extensions) to ISO/IEC 9945-1:1996, Information Technology - Portable Operating System Interface (POSIX) - Part 1: System Application Program Interface (API) [C language] (Thread Optional Services). (DISR v2.0/3.1/4.0) http://webstore.ansi.org/ansidocstore/default.asp | 6 months from Baseline | 6 months from Baseline | |
| | Operating System Standard | IEEE 1003.2d:1994, POSIX - Part 2: Shell and Utilities - Amendment: Batch Environment. (DISR v2.0/3.1/4.0) http://standards.ieee.org/catalog/olis/search.html | 12 months from Baseline | 12 months from Baseline | |
| | Operating System Standard | Win32 APIs, Window Management and Graphics Device Interface, Volume 1 MS Win32 Programmers Reference Manual, 1993 or later, MS Press. (DISR v2.0/3.1) http://msdn.microsoft.com/default.asp | | | 6 months from Baseline |
| | Operating System Standard | Win32 APIs, as specified in the MS Platform Software Development Kit (SDK). (DISR v4.0) http://msdn.microsoft.com/library/default.asp | | | 12 months from Baseline |

### 6.1.2 UML Representation

There is no equivalent to this product in UML.

### 6.1.3 Net-Centric Guidance for TV-1

**Augmented Product Purpose**. In the NCE, the TV-1 provides the set of standards, rules, and guidelines that apply to architecture implementation, and are tied to services to which they apply.

**Net-Centric Product Description**. The TV-1 traditionally captures the technical guidance that govern systems implementation and operation of that architecture, more specifically, what hardware and software may be implemented and what system data formats may be used. Accordingly, in the NCE, the TV-1 highlights the standards and guidelines that apply to the general implementation of services. The net-centric TV-1 should not be a mere one dimensional list of chosen or decreed standards. Instead, it should contain enough dimensions to 1) identify standards along with their sources, 2) convey association with the service and service infrastructure related elements appearing in other OV and SV products, and 3) highlight any significant facts regarding tailoring and extension.

### 6.1.4 CADM Support for TV-1

As its name suggests, TV focuses on the state, use, and projected scope of information technology standards. The key CADM entities for specifying characteristics for information technology standards include subtypes of InformationAsset used to specify domains for data standards. Note that the TV products can be related to the system entities via System (and its subtypes), to SoftwareType, and Network, etc., as well as to specific time periods.

In addition, CADM v1.5 enables the relationship among pertinent SV and TV products. Specifically, links can be expressed from either InformationTechnologyStandard or its parent Agreement to all of the following:

- SV: Network, CommunicationMedium, Materiel, System, ProcessActivity (which can be specialized as SYSTEM-FUNCTION), and TechnicalInterface. Additional SV concepts can be also captured using ObjecByReference (see Volume III for details).
- TV: TechnicalServiceArea, TechnicalService, and InformationTechnologyStandard. Additional TV concepts can be also captured using ObjecByReference (see Volume III for details).

### 6.1.5 CADM Support for TV-1

TV-1 is stored as an instance of Document with its attribute ArchitectureProductTypeCode = TECHNICAL-STANDARD-PROFILE. Each row of TV-1 is focused on a specific standard. That standard is stored as an instance of AGREEMENT with a category code designating it as an InformationTechnologyStandard, which may be refined as being a MESSAGE-STANDARD, PROTOCOL-STANDARD, or INFORMATION-TECHNOLOGY-STANDARD-PROFILE (which identifies a set of standards, together with the implementation options and parameters chosen for those standards). More than one row of TV-1 may be focused on the same standard. Each row of TV-1 may specify a different ImplementationTimeFrame.

The hierarchy of standards (e.g., from the DISR) is specified in InformationTechnologyStandardCategory, to indicate which applies to each InformationTechnologyStandard.

InformationTechnologyStandard instances can be associated to other instances via ObjectVersionAssociation. Similarly, links to the standards document(s) issued by a standards-issuing body can be recorded in CADM v1.5 by the appropriate relationship to Document.

A TV-1 can apply to many architectures. All the Architecture instances to which that instance of Document applies are expressed in CADM v1.5 through the appropriate linkages in ObjectVersionAssociation.

**Figure 6-2** provides a high-level diagram from the CADM showing key entities that are used to store architecture data for TV-1 in an architecture database. In addition, relations to the DoD Information Standards Repository entries can be documented as well through the entities TechnicalGuideline, InformationTechnologyStandardCategory, InformationTechnologyStandard, and the appropriate entries in ObjectVersionAssociation.

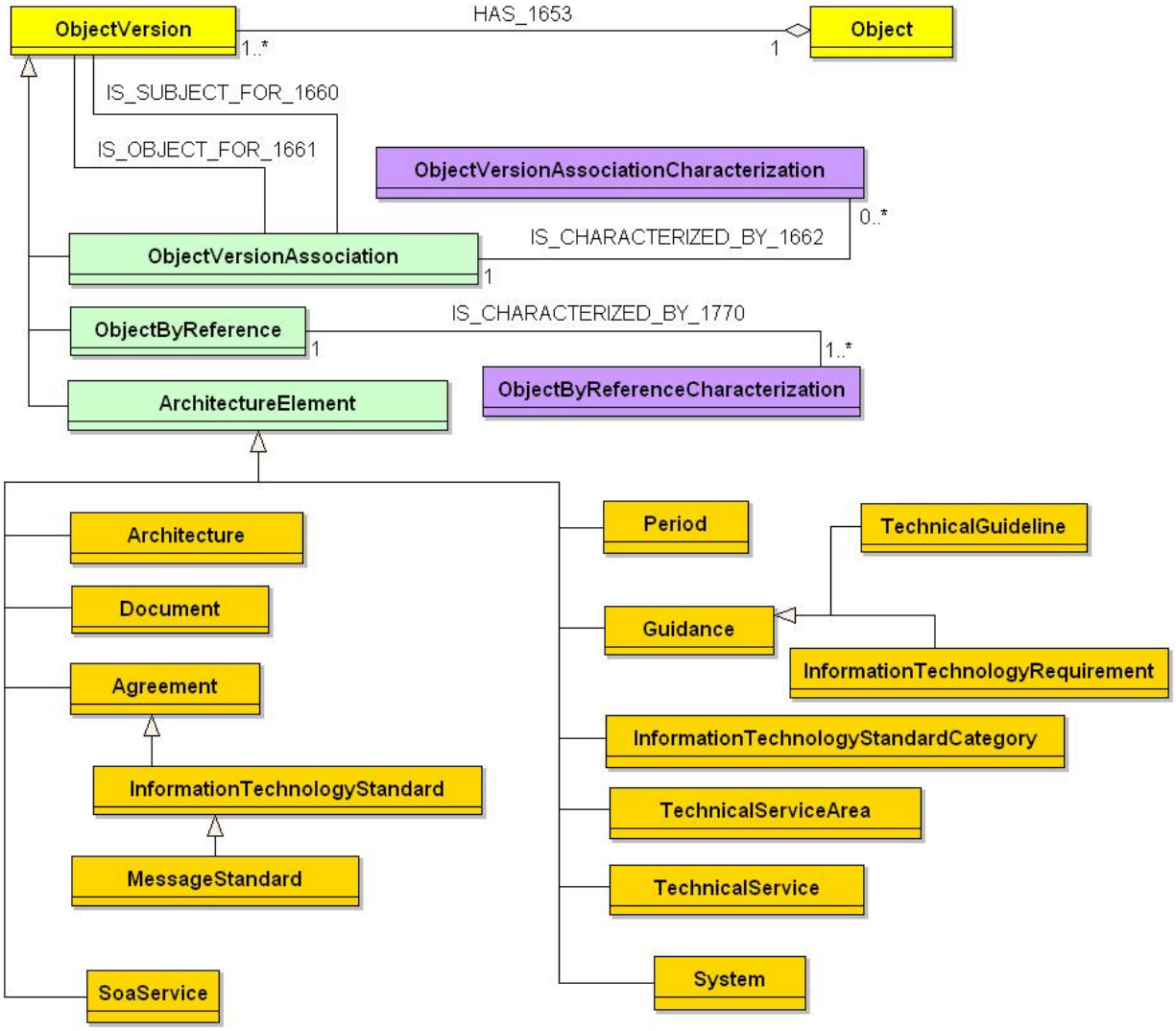


**Figure 6-2: CADM Diagram for TV-1**

### 6.1.5.1 TV-1 – Data Element Definitions

**TV-1 Information Space**

Agreement†
Architecture†
Document†
Guidance†
InformationTechnologyRequirement†
InformationTechnologyStandard†
MessageStandard†
Period†
SoaService†
System†
TechnicalGuideline†
TechnicalService†
TechnicalServiceArea†
**InformationTechnologyStandardCategory**

†) The descriptions of these elements have been provided in the preceding sections

**Table 6-4** describes the architecture data elements for TV-1.

**Table 6-4: Data Element Definitions for TV-1**[37]

| Data Elements | Attributes | Definition |
|---|---|---|
| **InformationTechnology StandardCategory** | | |
| | acronymText | The text that provides the common abbreviation used to represent a specific InformationTechnologyStandardCategory. |
| | hierarchyIdentifierText | The text that identifies the relation of the information-technology-standard-category to all other instances of InformationTechnologyStandardCategory. |

| Relationships | | |
|---|---|---|
| **Parent** | **Verb Phrase** | **Child** |
| InformationTechnologyStandard Category | applies to | InformationTechnologyStandard |
| InformationTechnologyStandard Category | is related to | InformationTechnologyStandard Category |
| TechnicalService | applies to | InformationTechnologyStandard Category |

(All previous relationships for the listed entities that comprise the information space of TV-1 should be considered part of the specification for this product, as well as those for the entities modeled via ObjectByReference and ObjectVersionAssociation. For the latter, see Volume III)

37 As noted earlier, data elements marked with an asterisk (*) should be included by the architecture development team, if the product is chosen for development as part of an integrated architecture effort.

## 6.2 TECHNICAL STANDARDS FORECAST (TV-2)

### 6.2.1 TV-2 – Product Description

**Product Definition**. The TV-2 contains expected changes in technology-related standards and conventions, which are documented in the TV-1 product. The forecast for evolutionary changes in the standards should be correlated against the time periods as mentioned in the SV-8 and SV-9 products.

**Product Purpose**. One of the prime purposes of this product is to identify critical technology standards, their fragility, and the impact of these standards on the future development and maintainability of the architecture and its constituent elements.

**Product Detailed Description**. TV-2 lists emerging or evolving technology standards relevant to the systems covered by the architecture. It contains predictions about the availability of emerging standards, and relates these predictions to the Systems and Services View elements and the time periods that are listed in the SV-8 and SV-9.

The specific time periods selected (e.g., 6-month, 12-month, 18-month intervals) and the standards being tracked should be coordinated with architecture transition plans (see SV-8). That is, insertion of new technological capabilities and upgrading of existing systems may depend on, or be driven by, the availability of new standards and products incorporating those standards. The forecast specifies potential standards and thus impacts current architectures and influences the development of transition and objective (i.e., target) architectures. The forecast should be tailored to focus on standards areas that are related to the purpose for which a given architecture is being described and should identify potential standards that will affect the architecture. If interface standards are an integral part of the technologies important to the evolution of a given architecture, then it may be convenient to combine TV-2 with SV-9. For other projects, it may be convenient to combine all the standards information into one document, combining TV-2 with TV-1.

TV-2 delineates the standards that will potentially impact the relevant system elements (from SV-1, SV-2, SV-4, SV-6, and OV-7) and relates them to the time periods that are listed in the SV-8 and SV-9. A system's evolution, specified in SV-8, may be tied to a future standard listed in TV-2. A timed technology forecast from SV-9 is related to a TV-2 standards forecast in the following manner: a certain technology may be dependent on a TV-2 standard (i.e., a standard listed in TV-2 may not be adopted until a certain technology becomes available). This is how a prediction on the adoption of a future standard, as applicable to systems elements from SV-1, SV-2, SV-4, SV-6, and OV-7, may be related to standards listed in TV-1 through the SV-9. A template for TV-2 is not shown in this section. The same template (see Table 6-2) shown in TV-1 may be used to describe TV-2.

### 6.2.2 UML Representation

There is no equivalent to this product in UML.

### 6.2.3 Net-Centric Guidance for TV-2

Since the purpose of the TV-2 is to identify critical technology standards, their fragility, and the impact of these standards on the future development and maintainability of the architecture and its constituent elements, it would subsequently include any required services or other

technologies that support NCO. Accordingly, the TV-2 is well suited to document technical standards forecasting attributes in the NCE. The NCOW RM TTV has addressed emerging standards for periods greater than five years and may be referenced in a net-centric architecture.

### 6.2.4 CADM Support for TV-2

**Figure** 6-3 provides a high-level diagram from the CADM showing key entities that are used to store architecture data for TV-2 in a CADM-conformant database.

TV-2 is represented as an instance of Document with its attribute ArchitectureProductTypeCode = TECHNICAL-STANDARD-FORECAST. This allows the specification of Name, Timeframe, etc., for this DoDAF product. In CADM v1.5, a TV-2 can be linked to instances of TechnicalService, Period, and InformationTechnologyStandard to further define the contents of the architecture product.

Standards are separately specified in a subtype hierarchy for Agreement. These include InformationTechnologyStandard and ReferenceModel. Subtypes of InformationTechnology Standard can be further specialized as MessageStandard. In addition the attribute categoryCode in InformationTechnologyStandard can be set to PROTOCOL-STANDARD, DATA-MODEL-STANDARD, and DATA-STANDARD to represent other kinds of technical standards comprised in a TV-2. Linkage via ObjectVersionAssociation to instances of Document may be used to specify constraints, issues, impacts, or recommendations.

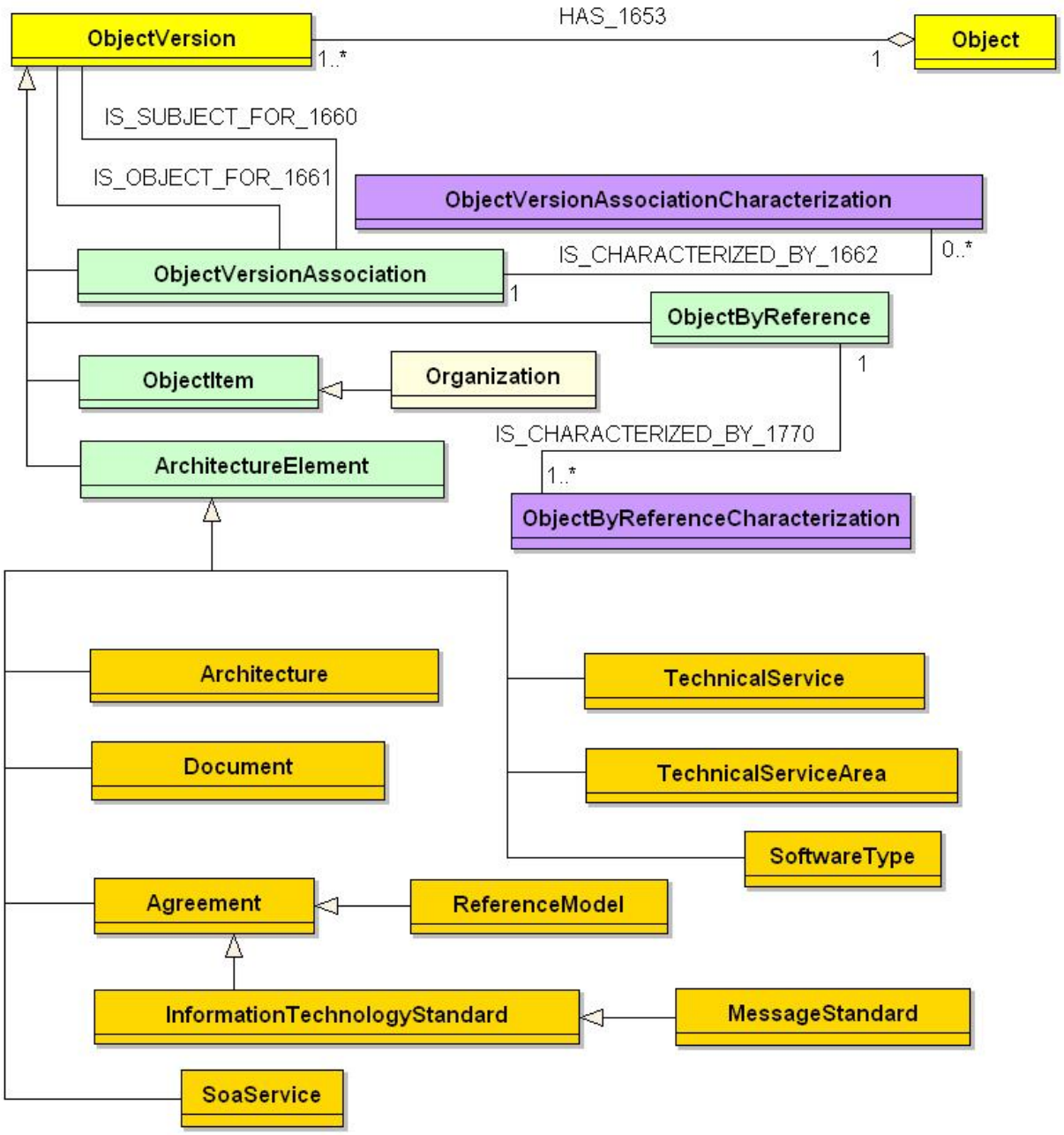


**Figure 6-3: CADM Diagram for TV-2**

#### 6.2.4.1 TV-2 – Data Element Definitions

## TV-2 Information Space

**Agreement**[†]
**Architecture**[†]
**Document**[†]
**InformationTechnologyStandard**[†]
**MessageStandard**[†]
**Organization**[†]
**ReferenceModel**[†]
**SoaService**[†]
**SoftwareType**[†]
**TechnicalService**[†]
**TechnicalServiceArea**[†]

[†] The descriptions of these elements have been provided in the preceding sections

# 7 FRAMEWORK CROSS PRODUCT DATA ELEMENT RELATIONSHIPS

## 7.1 OVERVIEW

The three views (OV, SV, and TV) of the DoDAF provide different areas of emphasis into a single, integrated architecture, including defined work processes and supporting IT. The logical linkages among the architecture data elements underlying the products and the views serve to ensure that the single architecture so described can actually be built and operated. In particular, these linkages ensure that the architecture remains mutually consistent. The linkages provide traceability from view to view, from product to product within a view, and across views that ensures:

- Integration of systems within a family of systems (FoS) or SoS
- Alignment of IT functionality to mission and operational needs
- Relationships between current and future systems to current and future standards
- Integration of services within a service family

This section discusses these linkages by summarizing the major relationships among the various DoDAF products.

## 7.2 ARCHITECTURE DATA ELEMENT RELATIONSHIPS ACROSS THREE VIEWS

**Figure 7-1** summarizes major relationships among the OV, SV, and TV architecture products. Major architecture data element relationships (belonging to these products) include:

- Operational nodes in the OV-2 map to operational activities of the OV-5, which are conducted by these operational nodes.
- Needlines in the OV-2 map to information exchanges in the OV-3, which detail the information exchanges between these operational nodes.
- OV-3 is constructed from system data elements described in the OV-7.
- The OV-6a contains structural and validity rules constraining the OV-5.
- The OV-6a also contains structural and validity rules constraining the OV-7.
- The SV-10a contains structural and validity rules constraining SV-4.
- Operational nodes in the OV-2 map to the systems in SV-1, which support these operational nodes by providing automated support.
- Needlines in the OV-2 map to interfaces in the SV-1, which represent an automated needline.
- Interfaces in a SV-1 map to system data elements exchanged in the SV-6, which in turn map to system data flows in the SV-4.
- System functions in a SV-4 map to the systems in SV-1, which execute these functions.
- System functions in a SV-4 implement automated portions of the operational activities in an OV-5. The Operational Activity to SV-5 documents this relationship.
- System data exchanges of the SV-6 map to the information exchanges of the OV-3. System data exchanges constitute the automated portions of the operational information exchanges.
- SV-11 implements and details the elements of the OV-7.

- The TV-1 documents standards that constrain the SV-1, the SV-2, the SV-4, the SV-6, the OV-7, and the SV-11.
- The SV-8 documents system/service evolution timelines and milestones that have corresponding time periods associated with timed technology forecasts in the SV-9 and timed standard forecasts in TV-2.

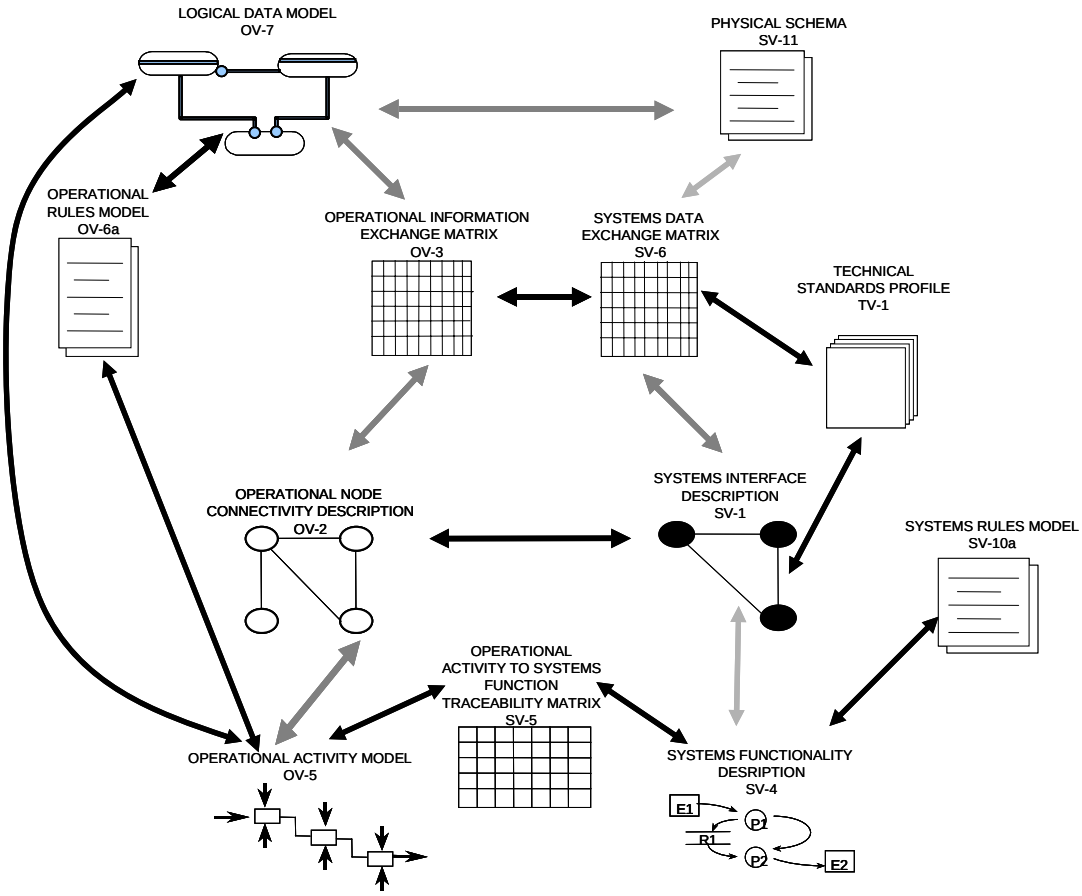


**Figure 7-1: Major Product Relationships**

## 7.3 OPERATIONAL VIEW ARCHITECTURE DATA ELEMENT RELATIONSHIPS

**Figure 7-2** covers relationships among products describing operations in the architecture's OV. Some relationships that are illustrated in Figure 7-2 may not be listed below, because they have already been stated in section 7.2. Figure 7-2 summarizes the following major architecture data element relationships:

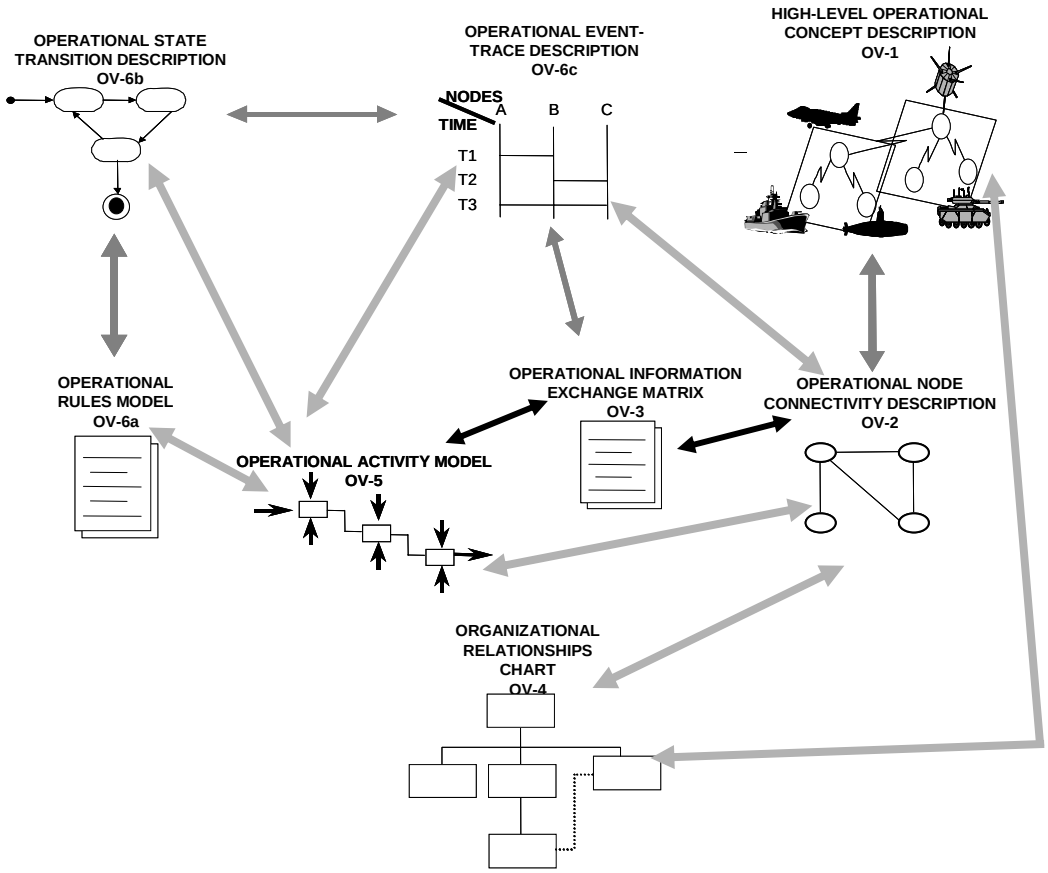


**Figure 7-2: Operational View Product Relationships**

- Organizations in the OV-1 should match those in the OV-2 and annotations identifying responsible operational nodes in the OV-5.
- Operational nodes in the OV-2 match the lifelines of the OV-6c.
- Organizations in the OV-4 map to the operational nodes in the OV-2.
- Information elements of the OV3 map to the inputs and outputs (I/Os) that belong to activities of the OV-5 conducted across two or more operational nodes of the OV-2.
- Events in the OV-6b map to events in the OV-6c.
- State transitions in the OV-6b and events in the OV6-c should be consistent with activities in the OV-5.
- Dynamic rules in the OV-6a may constrain state transitions in the OV-6b or decision points in the OV-5.
- Events in the OV-6b and the OV-6c map to triggering events in the OV-3.

## 7.4 SYSTEMS VIEW ARCHITECTURE DATA ELEMENT RELATIONSHIPS

**Figure 7-3** summarizes relationships among products of the SV. Major architecture data element relationships include:

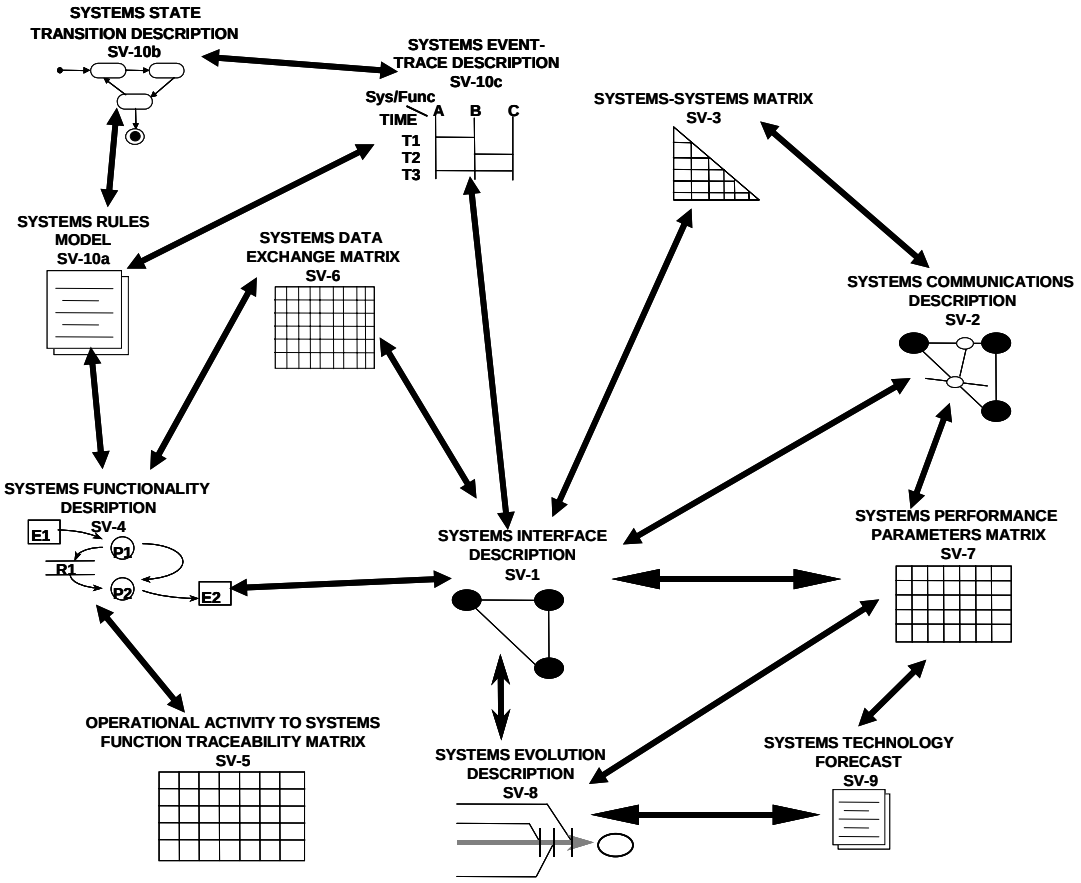


**Figure 7-3: Systems View Product Relationships**

- Interfaces in a SV-1 map to system data exchanges in the SV-6.
- System data input or output by system functions in the SV-4 map to system data elements of the SV-6.
- Interfaces in the SV-3, communications links in the SV-2, and some performance requirements in SV-7 map to interfaces in the SV-1.
- The SV-8 phases interface requirements and implementation in the SV-1.
- The SV-8 phases the applicability of performance requirements in the SV-7 and the availability of new products and technologies in the SV-9.
- Rules in the SV-10a constrain transitions in the SV-10b, events in SV-10c, and functions in the SV-4.
- Events in the SV-10b map to events in the SV-10c.
- Lifelines in the SV-10c map to systems in the SV-1 and system functions in the SV-4.

System Elements that Map to Standards illustrates the systems products (and associated systems elements) that have technical standards current (TV-1) or forecast (TV-2) associated with them. These architecture data elements **Figure 7-4** include:

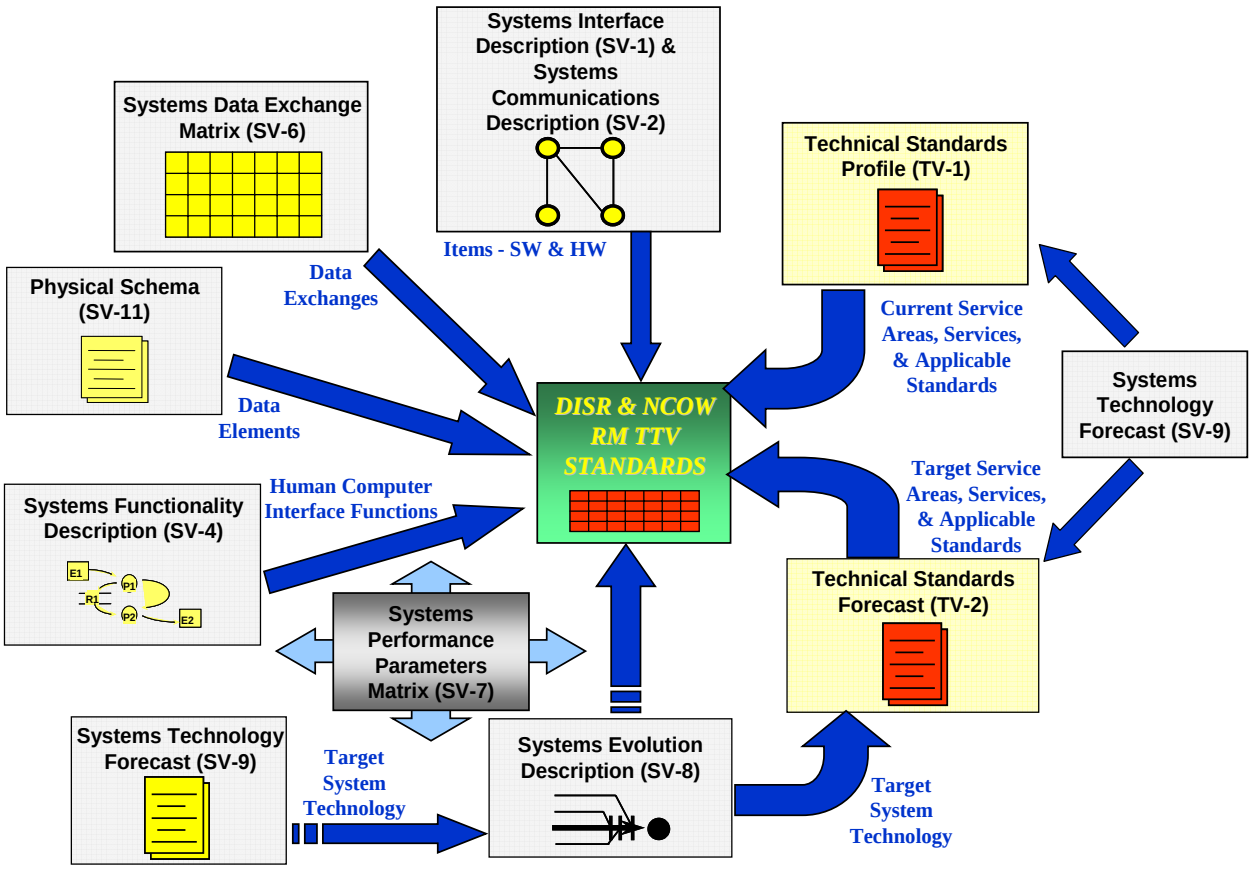


**Figure 7-4: Detail of Systems Elements that are Associated with Standards**

- Systems and system hardware/software items (hardware and software) from the SV-1.
- Communications links, communications paths, communications networks, and communications systems from the SV-2.
- System functions from the SV-4.
- System data elements from the SV-6.
- Evolving systems from the SV-8.
- Data modeling techniques used in the OV-7 and the SV-11.
- Timed technology forecasts in SV-9.

## 7.5 SUMMARY OF ARCHITECTURE DATA ELEMENT RELATIONSHIPS

**Table 7-1** details these relationships and others among the products in the Framework. The table lists every product in the LINK column and, in the TO column, every product to which the LINK product is related; thus, each entry is repeated twice.

**Table 7-1: Detailed Architecture Data Element Relationships**

| LINK | TO… | BY: |
|---|---|---|
| OV-1 | | |
| | OV-2 | Organizations, organization types, and/or human roles, depicted in OV-1 should be traceable to operational nodes in OV-2; relationships in OV-1 should trace to needlines in OV-2. |
| OV-2 | | |
| | OV-1 | Organizations, organization types, and/or human roles, depicted in OV-1 should be traceable to operational nodes in OV-2; relationships in OV-1 should trace to needlines in OV-2. |
| | OV-3 | A needline in OV-2 maps to one or more information exchanges in OV-3. |
| | OV-4 | Organizations, organization types, and/or human roles in an OV-4 may map to one or more operational nodes in an OV-2, indicating that the node represents the organization. |
| | OV-5 | The activities annotating an operational node in an OV-2 map to the activities described in an OV-5. Similarly, OV-5 should document the operational nodes that participate in each operational activity. |
| | OV-6c | Lifelines in OV-6c should map to operational nodes in OV-2. |
| | SV-1 | Operational node in an OV-2 may be supported by one or more systems in SV-1 (indicating that the operational node owns/uses the system). A needline in OV-2 may map to one or more interfaces in SV-1, and an interface in SV-1 maps to one or more needlines in OV-2. |
| OV-3 | | |
| | OV-2 | A needline in OV-2 maps to one or more information exchanges in OV-3. |
| | OV-5 | An information exchange in OV-3 should map to one or more information flows (an external Input, an external output, or an output from one operational activity mapped to an input to another) in OV-5, if OV-5 decomposes to a level that permits such a mapping. Above that level of decomposition, a single information flow in an OV-5 may map to more than one information exchange (or none, if the information flow does not cross node boundaries). |
| | OV-6b | Events in OV-6b map to triggering events in OV-3. |
| | OV-6c | Events in OV-6c map to triggering events in OV-3. |
| | OV-7 | An information element in OV-3 should be constructed of entities in OV-7. |
| | SV-6 | If any part of an information element in OV-3 originates from or flows to an operational activity that is to be automated, then that Information element should map to one or more system data elements in SV-6. |
| OV-4 | | |
| | OV-2 | Organizations, organization types, and/or human roles in an OV-4 may map to one or more operational nodes in an OV-2, indicating that the node represents the organization. |
| OV-5 | | |
| | OV-2 | The activities annotating an operational node in an OV-2 map to the activities described in an OV-5. Similarly, OV-5 should document the operational nodes that participate in each operational activity. |
| | OV-3 | An information exchange in an OV-3 should map to one or more information flows (an external input, an external output, or an output from one operational activity mapped to an input to another) in OV-5, if OV-5 decomposes to a level that permits such a mapping. Above that level of decomposition, a single information flow in OV-5 may map to more than one information exchange (or none, if the information flow does not cross node boundaries). |
| | OV-6a | A rule may define conditions that constrain the execution an operational activity in a specific way, or constrain the organization or human role authorized to execute an operational activity. |
| | OV-6b | Actions in OV-6b map to operational activities in OV-5. |
| | OV-6c | Events in OV-6c map to inputs and outputs of operational activities. |
| | SV-5 | Operational activities in SV-5 match operational activities in OV-5. |
| OV-6a | | |
| | OV-5 | A rule may define conditions that constrain the execution an operational activity in a specific way, or constrain the organization or human role authorized to execute an operational activity. |
| | OV-6b | A rule may define guard conditions for an action in OV-6b. |
| | OV-7 | The rules in OV-6a may reference the elements of OV-7 to constrain their structure and validity. |
| OV-6b | | |
| | OV-3 | Events in OV-6b map to triggering events in OV-3. |
| | OV-5 | Actions in OV-6b map to operational activities in OV-5. |
| | OV-6a | A rule may define guard conditions for an action in OV-6b. |
| | OV-6c | Events associated with transitions in OV-6b map to events of OV-6c. |
| OV-6c | | |
| | OV-2 | Lifelines in OV-6c should map to operational nodes in OV-2. |
| | OV-3 | Events in OV-6c map to triggering events in OV-3. |
| | OV-5 | Events in OV-6c map to inputs and outputs of operational activities. |

| LINK | TO… | BY: |
|---|---|---|
| | OV-6b | Events associated with transitions in OV-6b map to events of OV-6c. |
| | SV-5 | A capability associated with a specific sequence in OV-6c matches a capability in SV-5. |
| OV-7 | | |
| | OV-3 | An information element in OV-3 should be constructed of entities in OV-7. |
| | OV-6a | The rules in OV-6a may reference the elements of OV-7 to constrain their structure and validity. |
| | TV-1 | Technical standards in TV-1 apply to modeling techniques in OV-7. |
| SV-1 | | |
| | OV-2 | Operational node in OV-2 may be supported by one or more systems in SV-1 (indicating that the operational node owns/uses the system). A needline in OV-2 may map to one or more interfaces in an SV-1, and an interface in SV-1 maps to one or more needlines in OV-2. |
| | SV-2 | An interface in SV-1 is implemented by communications link(s) or communications network(s) in SV-2. |
| | SV-3 | One entry in SV-3 matrix represents one interface in SV-1. |
| | SV-4 | SV-4 defines system functions that are executed by systems defined in SV-1. |
| | SV-5 | Systems in SV-1 match systems in SV-5. |
| | SV-6 | Each system data element appearing in a system data exchange is graphically depicted by one of the Interfaces in SV-1; an interface supports one or more system data exchanges. |
| | SV-7 | The performance parameters of SV-7 apply to systems, subsystems, and system hardware/software items of SV-1. |
| | SV-8 | The systems, subsystems, and system hardware/software items of SV-8 should match the corresponding elements in SV-1. |
| | SV-9 | Timed technology forecasts in SV-9 impact systems, subsystems, and system hardware/software items of SV-1. |
| | TV-1 | Technical standards in TV-1 apply to and sometimes constrain systems, subsystems, and system hardware/software items in SV-1. |
| | TV-2 | Timed standard forecasts in TV-2 impact systems, subsystems and system hardware/software items in SV-1. |
| SV-2 | | |
| | SV-1 | An interface in SV-1 is implemented by communications link(s) or communications network(s) in SV-2. |
| | SV-7 | Performance parameters of SV-7 that deal with communications systems, communications links, and communications networks should map to the corresponding elements in SV-2. |
| | SV-8 | If a grouping link references communications items, they should appear in SV-2. |
| | SV-9 | Timed technology forecasts in SV-9 impact communications systems, communications links, and communications networks in SV-2. |
| | TV-1 | Technical standards in TV-1 apply to and sometimes constrain communications systems, communications links, and communications networks in SV-2. |
| | TV-2 | Timed standard forecasts in TV-2 impact communications systems, communications links, and communications networks in SV-2. |
| SV-3 | | |
| | SV-1 | One entry in SV-3 matrix represents one interface in SV-1. |
| SV-4 | | |
| | SV-1 | SV-4 defines system functions that are executed by systems defined in SV-1. |
| | SV-5 | System functions in SV-4 should map one-to-one to system functions in SV-5. |
| | SV-6 | System data flows in SV-4 should map to system data elements appearing in system data exchanges of SV-6. |
| | SV-8 | If SV-8 identifies system functions to be implemented in each phase of a system development, they should match the system functions in SV-4. |
| | SV-10a | If system rules in SV-10a deal with system behavior, they should reference system functions in SV-4. |
| | SV-10b | System functions in SV-4 may be associated with either states or state transitions in SV-10b. |
| | SV-10c | Events in SV-10c map to system data flows in SV-4. |
| | TV-1 | Technical standards from TV-1 apply to system functions in SV-4. |
| | TV-2 | Timed standard forecasts in TV-2 impact system functions in SV-4. |
| SV-5 | | |
| | OV-5 | Operational activities in SV-5 match operational activities in OV-5. |
| | OV-6c | A capability associated with a specific sequence in OV-6c matches a capability in SV-5. |
| | SV-1 | Systems in SV-1 match systems in SV-5. |
| | SV-4 | System functions in SV-4 should map one-to-one to system functions in SV-5. |
| SV-6 | | |
| | OV-3 | If any part of an information element in OV-3 originates from or flows to an operational activity that is to be automated, then that information element should map to one or more system data elements in SV-6. |
| | SV-1 | Each system data element appearing in a system data exchange is graphically depicted by one of the interfaces in SV-1; an interface supports one or more system data exchanges. |
| | SV-4 | System data flows in SV-4 should map to system data elements appearing in system data exchanges of SV-6. |
| | SV-7 | Performance parameters in SV-7 that deal with interface performance and system data exchange |

| LINK | TO… | BY: |
|---|---|---|
| | | capacity requirements should trace to system data exchanges in SV-6. |
| | SV-10b | Events in SV-10b map to triggering events in SV-6. |
| | SV-10c | Events in SV-10c map to triggering events in SV-6. |
| | TV-1 | Technical standards in TV-1 apply to and sometimes constrain system data elements in SV-6. |
| | TV-2 | Timed standard forecasts in TV-2 impact system data elements in SV-6. |
| SV-7 | | |
| | SV-1 | The performance parameters of SV-7 apply to systems, subsystems, and system hardware/software items of SV-1. |
| | SV-2 | Performance parameters of SV-7 that deal with communications systems, communications links, and communications networks should map to the corresponding elements in SV-2. |
| | SV-6 | Performance parameters in SV-7 that deal with interface performance and system data exchange capacity requirements should trace to system data exchanges in SV-6. |
| | SV-8 | If required performance ranges defined in SV-7 are associated with an overall system evolution or migration plan defined in SV-8, then the time periods in SV-7 should correspond to the milestones in SV-8. |
| | SV-9 | If the future performance expectations (goals) defined in SV-7 are based on expected technology improvements, then the performance parameters and their time periods in SV-7 should be coordinated with the timed technology forecasts defined in SV-9. |
| SV-8 | | |
| | SV-1 | The systems, subsystems, and system hardware/software items of SV-8 should match the corresponding elements in SV-1. |
| | SV-2 | If a grouping link references communications items, they should appear in SV-2. |
| | SV-4 | If SV-8 identifies system functions to be implemented in each phase of a system development, they should match the system functions in SV-4. |
| | SV-7 | If required performance ranges defined in SV-7 are associated with an overall system evolution or migration plan defined in SV-8, then the time periods in SV-7 should correspond to the milestones in SV-8. |
| | SV-9 | The time periods associated with timelines and milestones in SV-8 should be coordinated with time periods associated with timed technology forecasts in SV-9. |
| | TV-1 | Technical standards in TV-1 constrain evolving systems, subsystems, and system hardware/software items of SV-8. |
| SV-9 | | |
| | SV-1 | Timed technology forecasts in SV-9 impact systems, subsystems, and system hardware/software items of SV-1. |
| | SV-2 | Timed technology forecasts in SV-9 impact communications systems, communications links, and communications networks in SV-2. |
| | SV-7 | If the future performance expectations (goals) defined in SV-7 are based on expected technology improvements, then the performance parameters and their time periods in SV-7 should be coordinated with the timed technology forecasts defined in SV-9. |
| | SV-8 | The time periods associated with timelines and milestones in SV-8 should be coordinated with time periods associated with timed technology forecasts in SV-9. |
| | TV-1 | Timed technology forecasts in SV-9 may force standards in TV-1 to move to its next version. |
| | TV-2 | Timed standard forecasts in TV-2 may depend on timed technology forecasts in SV-9 becoming available. |
| SV-10a | | |
| | SV-4 | If system rules in SV-10a deal with system behavior, they should reference system functions in SV-4. |
| | SV-10b | A rule may define guard conditions for an action in SV-10b. |
| SV-10b | | |
| | SV-4 | System functions in SV-4 may be associated with either states or state transitions in SV-10b. |
| | SV-6 | Events in SV-10b map to triggering events in SV-6. |
| | SV-10a | A rule may define guard conditions for an action in SV-10b. |
| | SV-10c | Events associated with transitions in SV-10b map to events of SV-10c. |
| SV-10c | | |
| | SV-4 | Events in SV-10c map to system data flows in SV-4. |
| | SV-6 | Events in SV-10c map to triggering events in SV-6. |
| | SV-10b | Events associated with transitions in SV-10b map to events of SV-10c. |
| SV-11 | | |
| | TV-1 | Technical standards in TV-1 apply to modeling techniques in SV-11. |
| TV-1 | | |
| | OV-7 | Technical standards in TV-1 apply to modeling techniques in OV-7. |
| | SV-1 | Technical standards in TV-1 apply to and sometimes constrain systems, subsystems, and system hardware/software items in SV-1. |
| | SV-2 | Technical standards in TV-1 apply to and sometimes constrain communications systems, communications links, and communications networks in SV-2. |
| | SV-4 | Technical standards from TV-1 apply to system functions in SV-4. |

| LINK | TO… | BY: |
|---|---|---|
| | SV-6 | Technical standards in TV-1 apply to and sometimes constrain system data elements in SV-6. |
| | SV-8 | Technical standards in TV-1 constrain evolving systems, subsystems, and system hardware/software items of SV-8. |
| | SV-9 | Timed technology forecasts in SV-9 may force a standard in TV-1 to move to its next version. |
| | SV-11 | Technical standards in TV-1 apply to modeling techniques in SV-11. |
| TV-2 | | |
| | SV-1 | Timed standard forecasts in TV-2 impact systems, subsystems and system hardware/software items in SV-1. |
| | SV-2 | Timed standard forecasts in TV-2 impact communications systems, communications links, and communications networks in SV-2. |
| | SV-4 | Timed standard forecasts in TV-2 impact system functions in SV-4. |
| | SV-6 | Timed standard forecasts in TV-2 impact system data elements in SV-6. |
| | SV-9 | Timed standard forecasts in TV-2 may depend on timed technology forecasts in SV-9 becoming available. |

## ANNEX A
## GLOSSARY

# A

| | |
|---|---|
| A&T | Acquisition and Technology |
| ACL | Access Control List |
| AoA | Analysis of Alternatives |
| API | Application Program Interface |
| ASD(C3I) | Assistant Secretary of Defense for Command, Control, Communications, and Intelligence |
| ASD(NII) | Assistant Secretary of Defense for Networks and Information Integration |
| AV | All-Views |
| AWG | Architecture Working Group |

# B

| | |
|---|---|
| BRM | Business Reference Model |

# C

| | |
|---|---|
| C2 | Command and Control |
| C3 | Command, Control, and Communications |
| C3 | Command, Control, and Consultation (NATO usage) |
| C3I | Command, Control, Communications, and Intelligence |
| C4I | Command, Control, Communications, Computers, and Intelligence |
| C4ISP | Command, Control, Communications, Computers, and Intelligence Support Plan |
| C4ISR | Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance |
| CADM | Core Architecture Data Model |
| CDD | Capability Development Document |
| CED | Capability Evolution Description |
| CES | Core Enterprise Services |
| CIO | Chief Information Officer |
| CJCS | Chairman Joint Chiefs of Staff |
| CJCSI | Chairman of the Joint Chiefs of Staff Instruction |
| CJCSM | Chairman of the Joint Chiefs of Staff Manual |
| COE | Common Operating Environment |
| COI | Communities of Interest |
| CONOPS | Concept of Operations |
| COTS | Commercial Off-the-Shelf |
| CPD | Capability Production Document |
| CPN | Colored PetriNet |

| | |
|---|---|
| CRD | Capstone Requirements Document |
| C/S/As | Commands, Services, and Agencies |

# D

| | |
|---|---|
| DARS | DoD Architecture Repository System |
| DBMS | Database Management System |
| DDA | DoD Data Architecture |
| DDDS | DoD Data Dictionary System |
| DDL | Data Definition Language |
| DII | Defense Information Infrastructure |
| DFD | Data Flow Diagram |
| DIAD | Department of the Navy Integrated Architecture Database |
| DISR | DoD Information Technology Standards Registry |
| DoD | Department of Defense |
| DoDAF | DoD Architecture Framework |
| DoDD | DoD Directive |
| DoDI | DoD Instruction |
| DON CIO | Department of the Navy Chief Information Officer |
| DOTLPF | Doctrine, Organization, Training, Leadership & education, Personnel, and Facilities |
| DOTMLPF | Doctrine, Organization, Training, Materiel, Leadership & education, Personnel, and Facilities |

# E

| | |
|---|---|
| EIE | Enterprise Information Environment |
| EIEMA | Enterprise Information Environment Mission Area |
| ER | Entity-Relationship |
| ERD | Entity Relationship Diagram |

# F

| | |
|---|---|
| FAA | Functional Area Analysis |
| FEA | Federal Enterprise Architecture |
| FIPS | Federal Information Processing Standard |
| FNA | Functional Needs Analysis |
| FOC | Full Operational Capability |
| FoS | Family of Systems |
| FSA | Functional Solution Analysis |

# G

| | |
|---|---|
| GCCS | Global Command and Control System |
| GIG | Global Information Grid |

| | |
|---|---|
| GUI | Graphical User Interface |

## H

| | |
|---|---|
| HCI | Human Computer Interface |
| HR | Human Resources |

## I

| | |
|---|---|
| ICOM | Input, Control, Output, and Mechanism |
| IDEF0 | Integrated Definition for Activity Modeling |
| IDEF1X | Integrated Definition for Data Modeling |
| IER | Information Exchange Requirement |
| I/O | Input and Output |
| IOC | Initial Operational Capability |
| ISP | Information Support Plan |
| IT | Information Technology |
| ITF | Integration Task Force |
| ITMRA | Information Technology Management Reform Act |

## J

| | |
|---|---|
| JCIDS | Joint Capabilities Integration and Development System |
| JCS | Joint Chiefs of Staff |
| JMA | Joint Mission Area |
| JROC | Joint Requirements Oversight Council |
| JTF | Joint Task Force |
| JWICS | Joint Worldwide Intelligence Communications System |

## K

| | |
|---|---|
| KI | Key Interface |
| KIP | Key Interface Profile |
| KPP | Key Performance Parameters |

## L

| | |
|---|---|
| LAN | Local Area Network |

## M

| | |
|---|---|
| METL | Mission Essential Task List |
| MOE | Measure of Effectiveness |
| MOO | Measuares of Operational Outcomes |
| MOP | Measure of Performance |
| M&S | Modeling and Simulation |
| MTOE | Modified Table of Organization and Establishment |

## N

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|---|---|
| NATO | North Atlantic Treaty Organization |
| NCE | Net-Centric Environment |
| NCO | Net-Centric Operations |
| NCOW | Net-Centric Operations and Warfare |
| NIPRNET | Non-Secure Internet Protocol Router Network |
| NSS | National Security Systems |

## O

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|---|---|
| OASD | Office of the Assistant Secretary of Defense |
| OCL | Object Constraint Language |
| OMB | Office of Management and Budget |
| OMG | Object Management Group |
| OO | Object-Oriented |
| OPLAN | Operational Plan |
| OSD | Office of the Secretary of Defense |
| OSI | Open Systems Interconnection |
| OV | Operational View |

## P

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| PM | Program Manager |
| PPBE | Planning, Programming, Budgeting, and Execution |
| PRM | Performance Reference Model |

## S

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|---|---|
| SA | Structured Analysis |
| SDEM | Systems Data Exchange Matrix |
| SIPRNET | Secret Internet Protocol Router Network |
| SQL | Structured Query Language |
| SOA | Service Oriented Architecture |
| SoS | System of Systems |
| SRM | Service Component Reference Model |
| SSL | Secure Sockets Layer |
| SST | Service Specification Template |
| SV | Systems and Services View |

## T

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|---|---|
| TOE | Tables of Organization and Establishment |
| TTP | Tactics, Techniques, and Procedures |

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| TPPU | Task, Post, Process, and Use |
| TRM | Technical Reference Model |
| TV | Technical Standards View |

## U

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|---|---|
| UJTL | Universal Joint Task List |
| UML | Unified Modeling Language |
| UOB | Unit of Behavior |
| USD(A&T) | Under Secretary of Defense for Acquisition and Technology |

## V

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|---|---|
| VPN | Virtual Private Network |

## W

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| WAN | Wide Area Network |

## X

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| XML | Extensible Markup Language |

## ANNEX B
## DICTIONARY OF TERMS

The terms included in this Annex are used in some restrictive or special sense. Certain terms are not defined (e.g., event, function) because they have been left as primitives, and the ordinary dictionary usage should be assumed. Where the source for a definition is known, the reference has been provided in parentheses following the definition. Terms that are being used by both the DoD Architecture Framework (DoDAF) and the C4ISR Core Architecture Data Model (CADM) are marked with an asterisk.

**All definitions shared between the Framework and CADM documents are denoted with an asterisk (*).**

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| Analysis of Alternatives | The evaluation of the performance, operational effectiveness, operational suitability and estimated costs of alternative systems to meet a mission capability. The AoA assesses the advantages and disadvantages of alternatives being considered to satisfy capabilities, including the sensitivity of each alternative to possible changes in key assumptions or variables. The AoA is one of the key inputs to defining the system capabilities in the capability development document. (CJCSI 3170.01E, 11 MAY 2005) |
| Analysis of Materiel Approaches | The JCIDS analysis to determine the best materiel approach or combination of approaches to provide the desired capability or capabilities. Though the AMA is similar to an AoA, it occurs earlier in the analytical process. Subsequent to approval of an ICD, which may lead to a potential ACAT I/IA program, Director Program Analysis & Evaluation provides specific guidance to refine this initial AMA into an AoA. (CJCSI 3170.01E, 11 MAY 2005) |
| Architecture Data Element | One of the data elements that make up the Framework products. Also referred to as architecture data type. (DoDAF) |
| Attribute | A quantitative or qualitative characteristic of an element or its actions. (CJCSI 3170.01E, 11 MAY 2005) |
| Capability | The ability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. It is defined by an operational user and expressed in broad operational terms in the format of a joint or initial capabilities document or a joint doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) change recommendation. In the case of materiel proposals, the definition will progressively evolve to DOTMLPF performance attributes identified in the capability development document and the capability production document. (CJCSI 3170.01E, 11 MAY 2005) |
| Capability Development Document | A document that captures the information necessary to develop a proposed program(s), normally using an evolutionary acquisition strategy. The CDD outlines an affordable increment of militarily useful, logistically supportable and technically mature capability. (CJCSI 3170.01E, 11 MAY 2005) |
| Capability Gaps | The inability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. The gap may be the result of no existing capability or lack of proficiency or sufficiency in existing capability. (CJCSI 3170.01E, 11 MAY 2005) |

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| Capability Increment | A useful and supportable operational capability that can be effectively developed, produced or acquired, deployed and sustained. Each increment of capability will have its own set of threshold and objective values set by the user. Spiral development is an instance of an incremental development strategy where the end state is not known. Technology is spiraled to maturity and injected into the delivery of an increment of capability. (CJCSI 3170.01E, 11 MAY 2005) |
| Capability Production Document | A document that addresses the production elements specific to a single increment of an acquisition program. (CJCSI 3170.01E, 11 MAY 2005) |
| Capstone Requirements Document | A document that contains capability-based requirements that facilitates the development of CDDs and CPDs by providing a common framework and operational concept to guide their development. (CJCSI 3170.01E, 11 MAY 2005) |
| Communications Medium* | A means of data transmission. |
| Communities of Interest | Collaborative group of users who must exchange information in pursuit of their shared goals, interests, missions, or business processes and who therefore must have shared vocabulary for the information they exchange. (DoD Net-Centric Data Strategy (9 May 2003)) |
| Core Enterprise Services | A collection of networked capabilities that enable DoD service providers. The CESs provide and manage the underlying capabilities to deliver content and value to end users (Global Information Core Enterprise Services Strategy Vision 1.1a (9 July 2003) |
| Data | A representation of individual facts, concepts, or instructions in a manner suitable for communication, interpretation, or processing by humans or by automatic means. (IEEE 610.12) |
| Data Model | A representation of the data elements pertinent to an architecture, often including the relationships among the elements and their attributes or characteristics. (DoDAF) |
| Data-Entity* | The representation of a set of people, objects, places, events or ideas that share the same characteristic relationships. (DDDS 4362 (A)) |
| Defense Acquisition System | The management process by which the Department of Defense provides effective, affordable, and timely systems to the users. (DoDD 5000.1) |
| Doctrine | Fundamental principles that guide the employment of DoD personnel in coordinated action toward a common objective. Though neither policy nor strategy, joint doctrine serves to make US policy and strategy effective in the application of DoD power. Joint doctrine is based on extant capabilities. Joint doctrine is authoritative guidance and will be followed except when, in the judgment of the leadership, exceptional circumstances dictate otherwise. (Modified from CJCSI 5120.02) |
| DoD Component | The DoD Components consist of the OSD, the Military Departments, the Chairman of the Joint Chiefs of Staff, the combatant commands, the Office of the Inspector General of the Department of Defense, the Defense agencies, the DoD field activities, and all other organizational entities within the Department of Defense. (DoDD 8100.01) |
| Enterprise Information | The common, integrated information computing and communications |

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| Environment | environment of the GIG. The EIE is composed of GIG assets that operate as, provide transport for and/or assure local area networks, campus area networks, tactical operational and strategic networks, metropolitan area networks, and wide area networks (WAN). The EIE includes computing infrastructure for the automatic acquisition, storage, manipulation, management, control, and display of data or information, with a primary emphasis on DoD enterprise hardware, software operating systems, and hardware/software support that enable the GIG enterprise. The EIE also includes a common set of enterprise services, called Core Enterprise Services, which provide awareness of, access to, and delivery of information on the GIG. (DoDD 8115.01, 10 October 2005) |
| Family of Systems | A set or arrangement of independent systems that can be arranged or interconnected in various ways to provide different capabilities. (DoDD 4630.5) |
| Format | The arrangement, order, or layout of data/information. (Derived from IEEE 610.5) |
| Functional Area* | A major area of related activity (e.g., Ballistic Missile Defense, Logistics, or C2 support). (DDDS 4198 (A)) |
| Information | The refinement of data through known conventions and context for purposes of imparting knowledge. |
| Information Element | Information that is passed from one operational node to another. Associated with an information element are such performance attributes as timeliness, quality, and quantity values. (DoDAF) |
| Information Exchange | The collection of information elements and their performance attributes such as timeliness, quality, and quantity values. (DoDAF) |
| Information Exchange Requirement* | A requirement for information that is exchanged between nodes. |
| Information Technology | Any equipment, or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency. This includes equipment used by a DoD Component directly, or used by a contractor under a contract with the Component, which (i) requires the use of such equipment, or (ii) requires the use, to a significant extent, of such equipment in the performance of a service or the furnishing of a product. The term "IT" also includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources. Notwithstanding the above, the term "IT" does not include any equipment that is acquired by a Federal contractor incidental to a Federal contract. The term "IT" includes National Security Systems (NSS). (DoDD 4630.5) |
| Initial Capabilities Document | Documents the need for a materiel approach, or an approach that is a combination of materiel and non-materiel, to satisfy specific capability gap(s). It defines the capability gap(s) in terms of the functional area, the relevant range of military operations, desired effects, time and doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) and policy implications and constraints. The ICD summarizes the results of the DOTMLPF and policy analysis and the |

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| | DOTMLPF approaches (materiel and non-materiel) that may deliver the required capability. The outcome of an ICD could be one or more joint DCRs or capability development documents. (CJCSI 3170.01E, 11 MAY 2005) |
| Integrated Architecture | An architecture consisting of multiple views or perspectives (Operational View, Systems View, and Technical Standards View) that facilitates integration and promotes interoperability across family of systems and system of systems and compatibility among related architectures (DoDD 4630.5)<br>An architecture description that has integrated Operational, Systems, and Technical Standards Views with common points of reference linking the Operational View and the Systems View and also linking the Systems View and the Technical Standards View. An architecture description is defined to be an *integrated architecture* when products and their constituent architecture data elements are developed such that architecture data elements defined in one view are the same (i.e., same names, definitions, and values) as architecture data elements referenced in another view. (DoDAF) |
| Interoperability | The ability of systems, units, or forces to provide data, information, materiel, and services to and accept the same from other systems, units, or forces and to use the data, information, materiel, and services so exchanged to enable them to operate effectively together. IT and NSS interoperability includes both the technical exchange of information and the end-to-end operational effectiveness of that exchange of information, as required, for mission accomplishment. (DoDD 4630.5) |
| Joint Capabilities Integrated Development System | Policy and procedures that support the Chairman of the Joint Chiefs of Staff and the Joint Requirements Oversight Council in identifying, assessing, and prioritizing joint military capability needs. (CJCSI 3170.01E, 11 MAY 2005) |
| Key Performance Parameters | Those attributes or characteristics of a system that are considered critical or essential to the development of an effective military capability and those attributes that make a significant contribution to the key characteristics as defined in the Joint Operations Concepts. KPPs are validated by the Joint Requirements Oversight Council (JROC) for JROC Interest documents, and by the DOD component for Joint Integration or Independent documents. Capability development and capability production document KPPs are included verbatim in the acquisition program baseline. (CJCSI 3170.01E, 11 MAY 2005) |
| Link | A representation of the physical realization of connectivity between systems nodes. |
| Measure of Effectiveness | Measures designed to correspond to accomplishment of mission objectives and achievement of desired effects. (CJCSI 3170.01E, 11 MAY 2005) |
| Measure of Performance | A criterion used to assess friendly actions that is tied to measuring task accomplishment. (JP1-02) |
| Mission Area* | The general class to which an operational mission belongs. (DDDS 2305(A))<br>Note: Within a class, the missions have common objectives. |
| Mission* | An objective together with the purpose of the intended action. (Extension of DDDS 1(A))<br>Note: Multiple tasks accomplish a mission. (Space and Naval Warfare Systems Command) |

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| Needline* | A requirement that is the logical expression of the need to transfer information among nodes. |
| Net-Centric Environment | A framework for full human and technical connectivity and interoperability that allows all DOD users and mission partners to share the information they need, when they need it, in a form they can understand and act on with confidence, and protects information from those who should not have it. ("Net-Centric Environment - Joint Functional Concept" document (v1.0) from April 2005.) |
| Net-Centricity | An information superiority-enabled concept of operations that generates increased combat power by networking sensors, decision-makers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization. In essence, (net-centricity) translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace (Alberts, David S., Garstka, John J., and Stein, Frederick P., Network Centric Warfare: Developing and Leveraging Information Superiority, 2nd Edition (Revised), 1999, CCRP Publication Series) |
| Net-Centric Operations | The exploitation of the human and technical networking of all elements of an appropriately trained joint force by fully integrating collective capabilities, awareness, knowledge, experience, and superior decision making to achieve a high level of agility and effectiveness in dispersed, decentralized, dynamic and uncertain operational environments. ("Net-Centric Environment - Joint Functional Concept" document (v1.0) from April 2005.) |
| Net-Centric Warfare | An information superiority oriented concept of operations that generates increased combat power by networking sensors, decisionmakers, and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of selfsynchronization. (Network Centric Warfare) A sub-set of Net-Centric Operations, see above. ("Net-Centric Environment – Joint Functional Concept", v1.0, 7 April 2005.) |
| Network* | The joining of two or more nodes for a specific purpose. |
| Node* | A representation of an element of architecture that produces, consumes, or processes data. |
| National Security Systems | Telecommunications and information systems operated by the Department of Defense – the functions, operation, or use of which (1) involves intelligence activities, (2) involves cryptologic activities related to national security, (3) involves the command and control of military forces, (4) involves equipment that is an integral part of a weapon or weapons systems, or (5) is critical to the direct fulfillment of military or intelligence missions. Subsection (5) in the preceding sentence does not include procurement of automatic data processing equipment or services to be used for routine administrative and business applications (including payroll, finance, logistics, and personnel management applications). (DoDD 4630.5) |
| Operational Activity Model | A representation of the actions performed in conducting the business of an enterprise. The model is usually hierarchically decomposed into its actions, and usually portrays the flow of information (and sometimes physical objects) between the actions. The activity model portrays operational actions |

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| | not hardware/software system functions. (DoDAF) |
| Operational Activity | An activity is an action performed in conducting the business of an enterprise. It is a general term that does not imply a placement in a hierarchy (e.g., it could be a process or a task as defined in other documents and it could be at any level of the hierarchy of the OV-5). It is used to portray operational actions not hardware/software system functions. (DoDAF) |
| Operational Node | A node that performs a role or mission. (DoDAF) |
| Organization* | An administrative structure with a mission. (DDDS 345 (A)) |
| Planning, Programming, Budgeting, and Execution Process | The primary resource allocation process of the DoD. One of three major decision support systems for defense acquisition, PPBE is a systematic process that guides DoD's strategy development, identification of needs for military capabilities, program planning, resource estimation and allocation, acquisition, and other decision processes. |
| Platform* | A physical structure that hosts systems or system hardware or software items. |
| Process | A group of logically related activities required to execute a specific task or group of tasks. (Army Systems Architecture Framework) Note: Multiple activities make up a process. (Space and Naval Warfare Systems Command) |
| Report | The DoDAF defines a report to be architecture data elements from one or more products combined with additional information. Reports provide a different way of looking at architecture data. |
| Requirement* | A need or demand. (DDDS 12451/1 (D)) |
| Role | A function or position. (Webster's) |
| Rule | Statement that defines or constrains some aspect of the enterprise. |
| Service | A distinct part of the functionality that is provided by a system on one side of an interface to a system on the other side of an interface to include those capabilities to execute a business or mission process or exchange information among both machine and human users via standard interfaces and specifications. (Derived from IEEE 1003.0) |
| Service Consumer | An entity which seeks to satisfy a particular need through the use capabilities offered by means of a service. (OASIS RM for SOA) |
| Service Family | A grouping of independent services that can be arranged or interconnected in various ways to provide different capabilities |
| Service Functionality Provider | An organization that provides a service. |
| Service Implementation | A category of information captured within the service specification that describes how to access the service |
| Service Information | A category of information captured within the service specification that describes the functionality and purpose of the service |
| Service Interface | A category of information captured within the service specification that describes how to interact with the service |
| Service Oriented Architecture | Service Oriented Architecture is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable |

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| | preconditions and expectations. (OASIS RM for SOA) |
| Service Provider | A capability offered by means of a service offered by a Service Functionality Provider. |
| Service Registry | Is a platform neutral, net-work based directory that stores information about services and is searchable based on the descriptive metadata defined in the service specification |
| Service Specification | The set of descriptive metadata that provides a consistent way to describe the use, composition, and implementation of a service to service providers, users, developers, and managers |
| System | Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions. (DoDAF) |
| System Data Element | A basic unit of data having a meaning and distinct units and values. (Derived from 8320.1)<br>The architecture data element or type that stores data from the architecture domain (i.e., it has a value) that is produced or consumed by a system function and that has system data exchange attributes as specified in the Systems Data Exchange Matrix. (DoDAF) |
| System Data Exchange | The collection of System Data Elements and their performance attributes such as timeliness, quality, and quantity values. (DoDAF) |
| System Function* | A data transform that supports the automation of activities or information elements exchange. (DoDAF) |
| Systems Node | A node with the identification and allocation of resources (e.g., platforms, units, facilities, and locations) required to implement specific roles and missions. (DoDAF) |
| System of Systems | A set or arrangement of independent systems that are related or connected to provide a given capability. The loss of any part of the system will degrade the performance or capabilities of the whole. (DoDD 4630.5) |
| Task | An action or activity (derived from an analysis of the mission and concept of operations) assigned to an individual or organization to provide a capability. (UJTL, CJCSM 3500.04D, 2005) |
| Universal Reference Resources | Reference models and information standards that serve as sources for guidelines and attributes that must be consulted while building architecture products. (DoDAF) |

## ANNEX C
## DICTIONARY OF UML TERMS

The terms included here are UML terms. They convey some restrictive or special sense in this section. The sources for these definitions are [Booch, 1999] and [Rumbaugh, 1999].

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| Abstract Class | A class that cannot be directly instantiated. Contrast: concrete class. |
| Abstraction | 1. The act of identifying the essential characteristics of a thing that distinguish it from all other kinds of things. Abstraction involves looking for similarities across sets of things by focusing on their essential common characteristics. An abstraction always involves the perspective and purpose of the viewer; different purposes result in different abstractions for the same things. All modeling involves abstraction, often at many levels for various purposes.<br>2. A kind of dependency that relates two elements that represent the same concept at different abstraction levels. |
| Action | The specification of an executable statement that forms an abstraction of a computational procedure. An action typically results in a change in the state of the system and can be realized by sending a message to an object or modifying a link or a value of an attribute. |
| Action Sequence | An expression that resolves to a sequence of actions. |
| Action State | A state that represents the execution of an atomic action, typically the invocation of an operation. |
| Activation | The execution of an action. |
| Active Class | A class whose instances are active objects. See: active object. |
| Active Object | An object that owns a thread and can initiate control activity. An instance of active class. See: active class, thread. |
| Activity Graph | A special case of a state machine that is used to model processes involving one or more classifiers. Contrast: statechart diagram. |
| Actor [Class] | A coherent set of roles that users of use cases play when interacting with these use cases. An actor has one role for each use case with which it communicates. |
| Actual Parameter | Synonym: argument. |
| Adornments | Textual or graphical items that are added to an element's basic notation and are used to visualize details from the element's specification. (one of two annotation mechanisms in UML) |
| Aggregate [Class] | A class that represents the whole in an aggregation (whole-part) relationship. See: aggregation. |
| Aggregation | A special form of association that specifies a whole-part relationship between the aggregate (whole) and a component part. See: composition. |
| Annotation Mechanisms | Annotations of existing items in a UML diagram. The two annotation mechanisms are specifications and adornments. |
| Architecture | The organizational structure and associated behavior of a system. An architecture can be recursively decomposed into parts that interact through interfaces, |

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| | relationships that connect parts, and constraints for assembling parts. Parts that interact through interfaces include classes, components, and subsystems. |
| Artifact | A piece of information that is used or produced by a software development process, such as an external document or a work product. An artifact can be a model, description, or software. |
| Association | The semantic relationship between two or more classifiers that involves connections among their instances. |
| Attribute | An attribute is a named property of a class that describes a range of values that instances of the property may hold. |
| Building Blocks | There are three kinds of building blocks in UML: things, relationships, and diagrams. |
| Class | A description of a set of objects that share the same attributes, operations, methods, relationships, and semantics. A class may use a set of interfaces to specify collections of operations it provides to its environment. See: interface. |
| Class Diagram | A diagram that shows a collection of declarative (static) model elements such as classes, types, and their contents and relationships. |
| Collaboration | The specification of how an operation or classifier, such as a use case, is realized by a set of classifiers and associations playing specific roles used in a specific way. The collaboration defines an interaction. See: interaction. |
| Collaboration Diagram | A diagram that shows interactions organized around the structure of a model, using either classifiers and associations or instances and links. Unlike a sequence diagram, a collaboration diagram shows the relationships among the instances. Sequence diagrams and collaboration diagrams express similar information, but show it in different ways. See: sequence diagram. |
| Component | A modular, deployable, and replaceable part of a system that encapsulates implementation and exposes a set of interfaces. A component is typically specified by one or more classifiers (e.g., implementation classes) that reside on it, and may be implemented by one or more artifacts (e.g., binary, executable, or script files). Contrast: artifact. |
| Component Diagram | A diagram that shows the organizations and dependencies among components. |
| Concrete Class | A class that can be directly instantiated. Contrast: abstract class. |
| Constraint | A semantic condition or restriction. Certain constraints are predefined in the UML; others may be user defined. Constraints are one of three extensibility mechanisms in UML. See: tagged value, stereotype. |
| Container | 1. An instance that exists to contain other instances and that provides operations to access or iterate over its contents (e.g., arrays, lists, sets). 2. A component that exists to contain other components. |
| Containment Hierarchy | A namespace hierarchy consisting of model elements and the containment relationships that exist between them. A containment hierarchy forms a graph. |
| Context | A view of a set of related modeling elements for a particular purpose, such as specifying an operation. |
| Dependency | A relationship between two modeling elements, in which a change to one modeling element (the independent element) will affect the other modeling element (the |

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| | dependent element). |
| Deployment Diagram | A diagram that shows the configuration of run-time processing nodes and the components, processes, and objects that live on them. Components represent run-time manifestations of code units. See: component diagrams. |
| Derivation | A relationship between an element and another element that can be computed from it. Derivation is modeled as a stereotype of an abstraction dependency with the keyword Derive. |
| Derived Element | A [sic] element that can be computed from other elements and is included for clarity or for design purposes even though it adds no semantic information. |
| Diagram | A graphical presentation of a collection of model elements, most often rendered as a connected graph of arcs (relationships) and vertices (other model elements). UML supports the following diagrams: class diagram, object diagram, use case diagram, sequence diagram, collaboration diagram, state diagram, activity diagram, component diagram, and deployment diagram. |
| Effect | Specifies an optional procedure to be performed when the transition fires. |
| Element | An atomic constituent of a model. |
| Entry action | An action executed upon entering a state in a state machine regardless of the transition taken to reach that state. |
| Event | The specification of a significant occurrence that has a location in time and space. In the context of state diagrams, an event is an occurrence that can trigger a transition. |
| Exit Action | An action executed upon exiting a state in a state machine regardless of the transition taken to exit that state. |
| Extend | A relationship from an extension use case to a base use case, specifying how the behavior defined for the extension use case augments (subject to conditions specified in the extension) the behavior defined for the base use case. The behavior is inserted at the location defined by the extension point in the base use case. The base use case does not depend on performing the behavior of the extension use case. See: extension point, include. |
| Guard | A Boolean predicate that provides a fine-grained control over the firing of the transition. It must be true for the transition to be fired. It is evaluated at the time the Event is dispatched. There can be at most one guard per transition. |
| Generalizable Element | A model element that may participate in a generalization relationship. See: generalization. |
| Generalization | A taxonomic relationship between a more general element and a more specific element. The more specific element is fully consistent with the more general element and contains additional information. An instance of the more specific element may be used where the more general element is allowed. See: inheritance. |
| Inheritance | The mechanism by which more specific elements incorporate structure and behavior of more general elements related by behavior. See: generalization. |
| Instance | An individual entity with its own identity and value. |
| Interaction | A specification of how stimuli are sent between instances to perform a specific task. The interaction is defined in the context of a collaboration. See: collaboration. |
| Interaction Diagram | A generic term that applies to several types of diagrams that emphasize object interactions. These include collaboration diagrams and sequence diagrams. |
| Interface | A named set of operations that characterize the behavior of an element. |
| Link | A semantic connection among a tuple of objects. An instance of an association. See: association. |
| Link End | An instance of an association end. See: association end. |

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| Message | A specification of the conveyance of information from one instance to another, with the expectation that activity will ensue. A message may specify the raising of a signal or the call of an operation. |
| Model | A semantically complete abstraction of a system. |
| Node | A node is a classifier that represents a run-time computational resource, which generally has at least a memory and often processing capability. Run-time objects and components may reside on nodes. |
| Notes | Notes may contain any combination of text or graphics. A note that renders a comment has no semantic impact; it does not alter the meaning of the model to which it is attached. Notes are used to specify things like requirements, observations, reviews, and explanations, in addition to rendering constraints. |
| Object | An entity with a well-defined boundary and identity that encapsulates state and behavior. State is represented by attributes and relationships; behavior is represented by operations, methods, and state machines. An object is an instance of a class. See: class, instance. |
| Object Diagram | A diagram that encompasses objects and their relationships at a point in time. An object diagram may be considered a special case of a class diagram or a collaboration diagram. See: class diagram, collaboration diagram. |
| Operations | An operation is the implementation of a service that can be requested from any object of the class to affect behavior. |
| Package | A package is a general-purpose mechanism for organizing elements into groups. Graphically, a package is rendered as a tabbed folder. |
| Postcondition | A constraint that must be true at the completion of an operation. |
| Precondition | A constraint that must be true when an operation is invoked. |
| Realization | The relationship between a specification and its implementation; an indication of the inheritance of behavior without the inheritance of structure. |
| Refinement | A relationship that represents a fuller specification of something that has already been specified at a certain level of detail. For example, a design class is a refinement of an analysis class. |
| Relationship | A semantic connection among model elements. Examples of relationships include associations and generalizations. |
| Relationships | There are four kinds of relationships in the UML: Dependency, Association, Generalization, Realization. |
| Sequence Diagram | A diagram that shows object interactions arranged in time sequence. In particular, it shows the objects participating in the interaction and the sequence of messages exchanged. Unlike a collaboration diagram, a sequence diagram includes time sequences but does not include object relationships. A sequence diagram can exist in a generic form (describes all possible scenarios) and in an instance form (describes one actual scenario). Sequence diagrams and collaboration diagrams express similar information, but show it in different ways. See: collaboration diagram. |
| Signal | The specification of an asynchronous stimulus communicated between instances. Signals may have parameters. |
| Specification | A declarative description of what something is or does. Contrast: implementation (one of two Annotation mechanisms in UML). |
| Source | Designates the originating state vertex (state or pseudostate) of the transition. |
| State | A condition or situation during the life of an object during which it satisfies some condition, performs some activity, or waits for some Event. Contrast: state [OMA]. |
| State Machine | A behavior that specifies the sequences of states that an object or an interaction goes through during its life in response to Events, together with its responses and actions. |

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| Statechart Diagram | A diagram that shows a state machine. See: state machine. |
| Stereotype | A new type of modeling element that extends the semantics of the metamodel. Stereotypes must be based on certain existing types or classes in the metamodel. Stereotypes may extend the semantics, but not the structure of pre-existing types and classes. Certain stereotypes are predefined in the UML, others may be user defined. Stereotypes are one of three extensibility mechanisms in UML. See: constraint, tagged value. |
| Stimulus | The passing of information from one instance to another, such as raising a signal or invoking an operation. The receipt of a signal is normally considered an Event. See: message. |
| Swimlane | A partition on an activity diagram for organizing the responsibilities for actions. Swimlanes typically correspond to organizational units in a business model. See: partition. |
| Tagged Values | Everything in the UML has its own set of properties: classes have names, attributes, and operations, and so on. With stereotypes, you can add new things to the UML; with tagged values, you can add new properties. |
| Target | Designates the target state vertex that is reached when the transition is taken. |
| Things | The abstractions that are first-class citizens in a model; relationships tie these things together; diagrams group interesting collections of things.<br>There are four kinds of things in the UML: structural things, behavioral things, grouping things, and annotational things. |
| Thread [of Control] | A single path of execution through a program, a dynamic model, or some other representation of control flow. Also, a stereotype for the implementation of an active object as lightweight process. See process. |
| Time Event | An event that denotes the time elapsed since the current state was entered. See: event. |
| Time Expression | An expression that resolves to an absolute or relative value of time. |
| Trace | A dependency that indicates a historical or process relationship between two elements that represent the same concept without specific rules for deriving one from the other. |
| Transient Object | An object that exists only during the execution of the process or thread that created it. |
| Transition | A relationship between two states indicating that an object in the first state will perform certain specified actions and enter the second state when a specified Event occurs and specified conditions are satisfied. On such a change of state, the transition is said to fire. |
| Trigger | Specifies the event that fires the transition. There can be at most one trigger per transition. |
| Type | A stereotyped class that specifies a domain of objects together with the operations applicable to the objects, without defining the physical implementation of those objects. A type may not contain any methods, maintain its own thread of control, or be nested. However, it may have attributes and associations. Although an object may have at most one implementation class, it may conform to multiple different types. See also: implementation class Contrast: interface. |
| Use Case [Class] | The specification of a sequence of actions, including variants, that a system (or other entity) can perform, interacting with actors of the system. See: use case instances. |
| Use Case Diagram | A diagram that shows the relationships among actors and use cases within a system. |

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| Use Case Instance | The performance of a sequence of actions being specified in a use case. An instance of a use case. See: use case class. |
| Use Case Model | A model that describes a system's functional requirements in terms of use cases. |

## ANNEX D
## CADM KEY ENTITY DEFINITIONS

Source: DoD Data Dictionary System (DDDS).

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| ACTION | (325/1) (A) AN ACTIVITY. |
| ACTION-VERB | (11373/1) (A) A FUNCTION TO BE PERFORMED. |
| ACTIVITY-MODEL-INFORMATION-ELEMENT-ROLE | (4182/2) (A) THE ROLE ASSIGNED TO AN INFORMATION-ELEMENT FOR A PROCESS-ACTIVITY IN A SPECIFIC ACTIVITY-MODEL. |
| ACTIVITY-MODEL-THREAD | (20160/1) (A) A PATH IN AN ACTIVITY-MODEL CONSISTING OF SEQUENTIAL INFORMATION FLOWS FROM ONE PROCESS-ACTIVITY TO ANOTHER. |
| AGREEMENT | (332/1) (A) AN ARRANGEMENT BETWEEN PARTIES. |
| ANTENNA-TYPE | (6542/2) (A) THE CLASSIFICATION OF A DEVICE FOR THE COLLECTION OR RADIATION OF ELECTROMAGNETIC SIGNALS. |
| ARCHITECTURE | (19524/1) (A) THE STRUCTURE OF COMPONENTS, THEIR RELATIONSHIPS, AND THE PRINCIPLES AND GUIDELINES GOVERNING THEIR DESIGN AND EVOLUTION OVER TIME. |
| ARCHITECTURE-CHANGE-PROPOSAL-REVIEW | (22443/1) (A) THE CHARACTERIZATION OF A CONFIGURATION MANAGEMENT ACTIVITY FOR CHANGES TO ARCHITECTURE. |
| ARCHITECTURE-ORGANIZATION | (19546/1) (A) THE RELATION OF AN ARCHITECTURE TO A SPECIFIC ORGANIZATION. |
| AUTOMATED-INFORMATION-SYSTEM | (8020/1) (A) AN INTEGRATED SET OF COMPONENTS USED TO ELECTRONICALLY MANAGE DATA. |
| BATTLEFIELD-FUNCTIONAL-AREA-PROPONENT | (19563/1) (A) A DISCRETE AREA OF RESPONSIBILITY READILY IDENTIFIABLE BY FUNCTION PERFORMED WHICH CONTRIBUTES DIRECTLY TO BATTLEFIELD MANAGEMENT. |
| BUSINESS-SUBFUNCTION | (22594/1) (A) THE LOWER-LEVEL SET OF FUNCTIONS PERFORMED BY THE FEDERAL GOVERNMENT FOR A SPECIFIC LINE-OF-BUSINESS. |
| CAPABILITY | (333/1) (A) AN ABILITY TO ACHIEVE AN OBJECTIVE. |
| COMMUNICATION-CIRCUIT | (19575/1) (A) A PATH USED FOR TRANSMITTING DATA. |
| COMMUNICATION-CIRCUIT-TYPE | (19576/1) (A) A KIND OF PATH USED FOR TRANSMITTING DATA. |
| COMMUNICATION-LINK-TYPE | (19579/1) (A) A GENERIC KIND OF COMMUNICATION-LINK. |
| COMMUNICATION-MEANS | (19580/1) (A) A PHYSICAL OR ELECTROMAGNETIC INSTANTIATION OF TELECOMMUNICATIONS. |
| COMMUNICATION-MEDIUM | (19582/1) (A) A MODE OF DATA TRANSMISSION. |
| COMMUNICATION-SPACE-USE-CLASS | (19585/1) (A) THE SPECIFICATION OF CATEGORIES OF UTILIZATION OF SPACE FOR TELECOMMUNICATION IN BUILDINGS AND OTHER FACILITIES. |
| COST-BASIS | (19590/1) (A) THE SPECIFICATION USED TO DETERMINE AN UNDERLYING EXPENSE. |
| COUNTRY | (39/1) (A) A NATION OF THE WORLD. |

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| DATA-ITEM-TYPE | (19595/1) (A) A KIND OF DATA-ITEM. |
| DECISION-MILESTONE | (20170/1) (A) A DECISION POINT THAT SEPARATES THE PHASES OF A DIRECTED, FUNDED EFFORT THAT IS DESIGNED TO PROVIDE A NEW OR IMPROVED MATERIAL CAPABILITY IN RESPONSE TO A VALIDATED NEED. |
| DEFENSE-OCCUPATIONAL-SPECIALTY-CROSS-REFERENCE | (22526/1) ® THE RELATIONSHIP OF THE DEPARTMENT OF DEFENSE OCCUPATIONAL CONVERSIONS TO SERVICE-SPECIFIC OCCUPATIONAL SPECIALTIES. |
| DEPLOYMENT-LOCATION-TYPE | (19596/1) (A) THE CHARACTERIZATION OF A KIND OF GENERIC PLACE FOR DEPLOYED OPERATIONS. |
| DOCUMENT | (119/1) (A) RECORDED INFORMATION REGARDLESS OF PHYSICAL FORM. |
| EVENT | (49/1) (A) A SIGNIFICANT OCCURRENCE. |
| EVENT-NODE-CROSS-LINK | (19978/1) (A) THE SPECIFICATION OF HOW A SPECIFIC EVENT FOR A SPECIFIC ORIGINATOR NODE TEMPORALLY RELATES TO ANOTHER TERMINATOR NODE SUBJECT TO A CONSTRAINT. |
| EVENT-TYPE | (12341/1) (A) A CATEGORY OF EVENT. |
| EXCHANGE-RELATIONSHIP-TYPE | (19608/1) (A) THE SPECIFICATION OF A CLASS OF PAIRING FOR INFORMATION EXCHANGE. |
| FACILITY | (334/1) (A) REAL PROPERTY, HAVING A SPECIFIED USE THAT IS BUILT OR MAINTAINED BY PEOPLE. |
| FACILITY-CLASS | (5742/1) (A) THE HIGHEST LEVEL OF REAL PROPERTY CLASSIFICATION BY THE DEPARTMENT OF DEFENSE. |
| FACILITY-IMPROVEMENT-ACTIVITY | (19541/1) (A) A PROCESS TO IMPROVE CAPABILITIES FOR A SPECIFIC FACILITY. |
| FACILITY-TYPE | (50/1) (A) A SPECIFIC KIND OF FACILITY. |
| FEATURE | (4134/2) (A) A SET OF CHARACTERISTICS, STRUCTURES, OR OTHER ENTITIES THAT ARE OF MILITARY SIGNIFICANCE. |
| FUNCTIONAL-AREA | (4198/2) (A) A MAJOR AREA OF RELATED ACTIVITY. |
| FUNCTIONAL-PROCESS-FUNCTION | (22044/1) (A) A GENERAL CLASS OF ACTIVITY IN A SPECIFIC FUNCTIONAL-AREA. |
| GUIDANCE | (336/4) (A) A STATEMENT OF DIRECTION RECEIVED FROM A HIGHER ECHELON. |
| HAND-RECEIPT | (21353/1) (A) THE SPECIFICATION OF TRANSFER OF PROPERTY RESPONSIBILITY. |
| ICON-CATALOG | (19625/1) (A) A DIRECTORY OF IMAGES DEPICTED IN GRAPHICAL PRESENTATION SOFTWARE. |
| ICON-DATA-CATEGORY | (22294/1) (A) A CLASSIFICATION OF ELEMENTS OF INFORMATION THAT APPLY TO ICONS WITHIN AN ICON-CATALOG. |
| ICON-DATA-REQUIREMENT | (22295/1) (A) THE SPECIFICATION OF WHETHER AN ASSOCIATED ELEMENT OF INFORMATION IS MANDATORY FOR A SPECIFIC ICON. |
| IDENTIFICATION-FRIEND-FOE | (17031/1) (A) THE RECOGNIZED HOSTILITY CHARACTERIZATION OF A BATTLEFIELD OBJECT. |
| IMPLEMENTATION-TIME-FRAME | (19731/1) (A) THE SPECIFICATION OF A GENERAL CHRONOLOGICAL PERIOD FOR THE INSTANTIATION OF A |

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| | CONCEPT, SYSTEM, OR CAPABILITY. |
| INFLATION-FACTOR | (19732/1) (A) ADJUSTMENTS TO COSTS THAT DEPEND ON FISCAL YEAR. |
| INFORMATION-ASSET | (4246/3) (A) AN INFORMATION RESOURCE. |
| INFORMATION-ELEMENT | (4199/2) (A) A FORMALIZED REPRESENTATION OF DATA SUBJECT TO A FUNCTIONAL PROCESS. |
| INFORMATION-TECHNOLOGY-REGISTRATION | (20501/1) (A) THE IDENTIFICATION OF A MISSION-CRITICAL/MISSION-ESSENTIAL INFORMATION TECHNOLOGY SYSTEM OR OTHER ASSET. |
| INFORMATION-TECHNOLOGY-STANDARD-CATEGORY | (20513/1) (A) A CLASSIFICATION OF INFORMATION-TECHNOLOGY-STANDARD. |
| INTERNAL-DATA-MODEL-TYPE | (9289/2) (A) A CLASSIFICATION OF AN INTERNAL-DATA-MODEL. |
| INTERNET-ADDRESS | (19762/1) (A) THE SPECIFICATION OF A VALUE OR RANGE OF VALUES CONSTITUTING THE LABEL FOR A NODE ON THE INTERNET. |
| INTEROPERABILITY-DOCUMENT-TYPE | (22390/1) (A) A KIND OF DOCUMENT THAT FOCUSES ON PROPERTIES WHICH ENABLE SYSTEM INTEROPERATION. |
| LANGUAGE | (2228/1) (A) A MEANS OF COMMUNICATION BASED ON A FORMALIZED SYSTEM OF SOUNDS AND/OR SYMBOLS. |
| LINE-OF-BUSINESS | (22593/1) (A) THE TOP-LEVEL SET OF FUNCTIONS PERFORMED BY THE FEDERAL GOVERNMENT. |
| LOCATION | (343/2) (A) A SPECIFIC PLACE. |
| MATERIEL | (337/1) (A) AN OBJECT OF INTEREST THAT IS NON-HUMAN, MOBILE, AND PHYSICAL. |
| MATERIEL-ITEM | (787/1) (A) A CHARACTERIZATION OF A MATERIEL ASSET. |
| MEASURE-UNIT | (2482/2) (A) THE INCREMENT BY WHICH MATTER IS MEASURED. |
| MILITARY-PLATFORM | (22100/1) (A) AN OBJECT FROM WHICH OR THROUGH WHICH MILITARY TASKS CAN BE CONDUCTED. |
| MILITARY-TELECOMMUNICATION-USE | (19773/1) (A) THE CHARACTERIZATION OF SPECIFIC USE-DEPENDENT BUT FACILITY-INDEPENDENT PARAMETERS FOR ESTIMATING THE COMMUNICATIONS, WIRING, AND EQUIPMENT REQUIRED BY MILITARY OCCUPANTS OF FACILITIES. |
| MILITARY-UNIT-LEVEL | (42/2) (A) A MILITARY-UNIT ACCORDING TO A STRATUM, ECHELON, OR POINT WITHIN THE MILITARY COMMAND HIERARCHY AT WHICH CONTROL OR AUTHORITY IS CONCENTRATED. |
| MISSION | (1/3) (A) THE TASK, TOGETHER WITH THE PURPOSE, THAT CLEARLY INDICATES THE ACTION TO BE TAKEN. |
| MISSION-AREA | (2305/1) (A) THE GENERAL CLASS TO WHICH AN OPERATIONAL MISSION BELONGS. |
| MODELING-AND-SIMULATION-JUSTIFICATION | (19776/1) (A) A STATEMENT PROVIDING RATIONALE TO JUSTIFY REQUIREMENTS FROM THE POINT OF VIEW OF MODELING AND SIMULATION (M&S). |
| NETWORK | (10972/1) (A) THE SPECIFICATION FOR THE JOINING OF TWO OR MORE NODES FOR A SPECIFIC PURPOSE. |
| NETWORK- | (20591/2) (A) THE KIND OF FUNCTIONAL PROPONENT WHO |

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| CONTROLLER-TYPE | EXERCISES AUTHORITY OVER A NETWORK. |
| NETWORK-ECHELON | (22486/1) (A) THE NORMAL OPERATIONAL LEVEL SUPPORTED BY A NETWORK. |
| NETWORK-TYPE | (11570/1) (A) A SPECIFIC KIND OF NETWORK. |
| NODE | (956/1) (A) A ZERO DIMENSIONAL TOPOLOGICAL PRIMITIVE THAT DEFINES TOPOLOGICAL RELATIONSHIPS. |
| NODE-SYSTEM-ASSET-OWNERSHIP | (20009/1) (A) THE POSSESSION, IN WHOLE OR PART, OF THE OBJECTS OF VALUE ASSOCIATED TO A SPECIFIC NODE-SYSTEM. |
| NODE-SYSTEM-COST-MANAGEMENT | (20011/1) (A) THE AMOUNTS ASSOCIATED WITH VARIOUS ASPECTS OF THE MANAGEMENT OF A NODE-SYSTEM. |
| OCCUPATION | (2009/1) (A) A FIELD OF WORK. |
| OPERATIONAL-CONDITION | (19589/1) (A) A VARIABLE OF THE OPERATIONAL ENVIRONMENT OR SITUATION IN WHICH A UNIT, SYSTEM, OR INDIVIDUAL IS EXPECTED TO OPERATE THAT MAY AFFECT PERFORMANCE. |
| OPERATIONAL-DEPLOYMENT-MISSION-TYPE | (19848/1) (A) THE KIND OF HIGH-LEVEL TASKING FOR DEPLOYED OPERATIONS. |
| OPERATIONAL-DEPLOYMENT-PHASE | (19849/1) (A) A STAGE OF THE OPERATIONAL ACTIVITIES CONDUCTED FOR DEPLOYED OPERATIONS. |
| OPERATIONAL-FACILITY-ECHELON | (19853/1) (A) A SUBDIVISION OF A HEADQUARTERS (OR) A SEPARATE LEVEL OF COMMAND AS IT APPLIES TO AN OPERATIONAL-FACILITY. |
| OPERATIONAL-FACILITY-PROPONENT | (19854/2) (A) THE AGENT RESPONSIBLE FOR REQUIREMENTS DEVELOPMENT OF OPERATIONAL FACILITIES. |
| OPERATIONAL-MISSION-THREAD | (19857/1) (A) AN IDENTIFIED INFORMATION EXCHANGE SEQUENTIAL PROCEDURE TO SUPPORT TASK EXECUTION BY INFORMATION SYSTEMS AND ORGANIZATION-TYPES. |
| OPERATIONAL-ROLE | (22459/1) (A) THE SPECIFICATION OF A SET OF ABILITIES REQUIRED FOR PERFORMING ASSIGNED ACTIVITIES AND ACHIEVING AN OBJECTIVE. |
| OPERATIONAL-SCENARIO | (19860/1) (A) A CONCEPT AND SCRIPT FOR POSSIBLE EVENTS AND ACTIONS FOR MILITARY OPERATIONS. |
| ORGANIZATION | (345/1) (A) AN ADMINISTRATIVE STRUCTURE WITH A MISSION. |
| ORGANIZATION-TYPE | (892/2) (A) A CLASS OF ORGANIZATIONS. |
| PERIOD | (1321/1) (A) INTERVAL OF TIME. |
| PERSON-TYPE | (897/2) (A) A CLASS OF PERSONS. |
| POINT-OF-CONTACT | (19867/1) (A) A REFERENCE TO A POSITION, PLACE, OFFICE, OR INDIVIDUAL ROLE IDENTIFIED AS A PRIMARY SOURCE FOR OBTAINING INFORMATION. |
| POINT-OF-CONTACT-TYPE | (22039/1) (A) A KIND OF POINT-OF-CONTACT. |
| POSITION | (2112/1) (A) A SET OF ESTABLISHED DUTIES. |
| PROCESS-ACTIVITY | (4204/3) (A) THE REPRESENTATION OF A MEANS BY WHICH A PROCESS ACTS ON SOME INPUT TO PRODUCE A SPECIFIC OUTPUT. |
| PROCESS-ACTIVITY-FUNCTIONAL-PROCESS | (22043/1) (A) THE MEANS BY WHICH TO CARRY OUT A HIGH-LEVEL FUNCTION. |

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| PROCESS-STATE-VERTEX | (20025/1) (A) THE ABSTRACTION OF AN OBSERVABLE MODE OF BEHAVIOR. |
| RECORD-TRACKING | (19871/1) (A) INFORMATION REGARDING A SPECIFIC RECORD IN A TABLE OF DATA. |
| REGIONAL-COST-FACTOR | (19544/1) (A) THE EXPECTED EXPENSE MODIFICATION FOR A GEOGRAPHIC AREA THAT ACCOUNTS FOR SPECIFIC LOCAL COSTS IN RELATION TO A NATIONAL AVERAGE. |
| RELATION-TYPE | (6515/2) (A) AN ASSOCIATION BETWEEN OBJECTS THAT DEFINES AN INFORMATION ASSET. |
| ROOM-TYPE | (5605/1) (A) A KIND OF A ROOM. |
| SATELLITE | (14361/1) (A) A MAN-MADE BODY WHICH REVOLVES AROUND AN ASTROMETRIC-ELEMENT AND WHICH HAS A MOTION PRIMARILY DETERMINED BY THE FORCE OF ATTRACTION OF THAT ASTROMETRIC-ELEMENT. |
| SECURITY-ACCESS-COMPARTMENT | (16224/2) (A) THE SPECIFICATION OF AN EXCLUSION DOMAIN FOR INFORMATION RELEASED ON A FORMALLY RESTRICTED BASIS (E.G., TO PROTECT SOURCES OR POTENTIAL USE). |
| SECURITY-CLASSIFICATION | (940/2) (A) THE LEVEL ASSIGNED TO NATIONAL SECURITY INFORMATION AND MATERIAL THAT DENOTES THE DEGREE OF DAMAGE THAT ITS UNAUTHORIZED DISCLOSURE WOULD CAUSE TO NATIONAL DEFENSE OR FOREIGN RELATIONS OF THE UNITED STATES AND THE DEGREE OF PROTECTION REQUIRED. |
| SKILL | (2226/1) (A) AN ABILITY. |
| SOFTWARE-LICENSE | (1856/1) (A) THE STIPULATION(S) (AND LEGAL TERMS) BY WHICH THE SOFTWARE MAY BE USED. |
| SOFTWARE-SERIES | (18977/1) (A) A SET OF SOFTWARE KNOWN BY A SINGLE NAME, BUT COMPRISED OF ONE OR MORE VERSIONS DEVELOPED OVER TIME. |
| SYSTEM | (326/1) (A) AN ORGANIZED ASSEMBLY OF INTERACTIVE COMPONENTS AND PROCEDURES FORMING A UNIT. |
| SYSTEM-DETAIL-NODE-TYPE | (22391/1) (A) A KIND OF REPRESENTATION OR DEPICTION APPLICABLE TO SYSTEMS. |
| SYSTEM-PROPONENT | (22392/1) (A) AN AGENT RESPONSIBLE FOR RESEARCH, DEVELOPMENT, TEST, OR EVALUATION OF SYSTEMS. |
| SYSTEM-STATUS-TYPE | (22098/1) (A) THE SPECIFICATION OF A KIND OF DEVELOPMENT OR TRANSITION OF ONE OR MORE SYSTEMS. |
| SYSTEM-TYPE | (9083/2) (A) A SPECIFIC KIND OF SYSTEM. |
| SYSTEM-USAGE | (22396/1) (A) THE SPECIFICATION OF EMPLOYMENT FOR WHICH SYSTEMS ARE CREATED. |
| TASK | (290/2) (A) A DIRECTED ACTIVITY. |
| TECHNICAL-INTERFACE | (21694/1) (A) A GENERIC CONNECTION BETWEEN TWO ELEMENTS THAT IMPLEMENT INFORMATION TECHNOLOGY IN WHICH INFORMATION IS CAPABLE OF BEING TRANSMITTED FROM THE SOURCE ELEMENT TO THE DESTINATION ELEMENT. |
| TECHNICAL-INTERFACE-TYPE | (19761/1) (A) A KIND OF GENERIC CONNECTION BETWEEN ELEMENTS THAT IMPLEMENT INFORMATION TECHNOLOGY. |
| TECHNICAL-SERVICE | (19676/1) (A) A DISTINCT PART OF THE SPECIALIZED |

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| | FUNCTIONALITY THAT IS PROVIDED A SYSTEM ELEMENT ON ONE SIDE OF AN INTERFACE TO A SYSTEM ELEMENT ON THE OTHER SIDE OF AN INTERFACE. |
| TECHNICAL-SERVICE-AREA | (19677/2) (A) A FIELD OF SPECIALIZED FUNCTIONALITY, USUALLY SPECIFIED BY A REFERENCE-MODEL TO DEFINE INTERFACES. |
| TECHNOLOGY | (8936/1) (A) THE APPLICATION OF SCIENCE TO MEET ONE OR MORE OBJECTIVES. |
| TELEPHONE-ADDRESS | (1938/1) (A) AN ELECTRONIC ADDRESS THAT SUPPORTS COMMUNICATION VIA TELEPHONIC MEDIA. |
| TRANSITION-PROCESS | (20082/1) (A) THE DESCRIPTION OF A METHOD FOR RELATING A “SOURCE” PROCESS-STATE-VERTEX TO A “TARGET” PROCESS-STATE-VERTEX. |
| UNIFORMED-SERVICE-ORGANIZATION-COMPONENT-TYPE | (2726/2) (A) A SPECIFIC KIND OF SUBDIVISION OF A UNIFORMED-SERVICE-ORGANIZATION. |

Note: 115 entities are listed in this table. Source: DoD CADM Baseline v1.0 (18 June 2003).

# ANNEX E
# REFERENCES


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