OOI CYBERINFRASTRUCTURE
NSF OCEAN OBSERVATORIES INITIATIVE

OOI – CyberInfrastructure

Architecture & Design

Overview and Summary Information

AV-1 PDR CANDIDATE

November 2007

NSF JOI Joint Oceanographic Institutions UCSD

Document owner: OOI CI Design Team

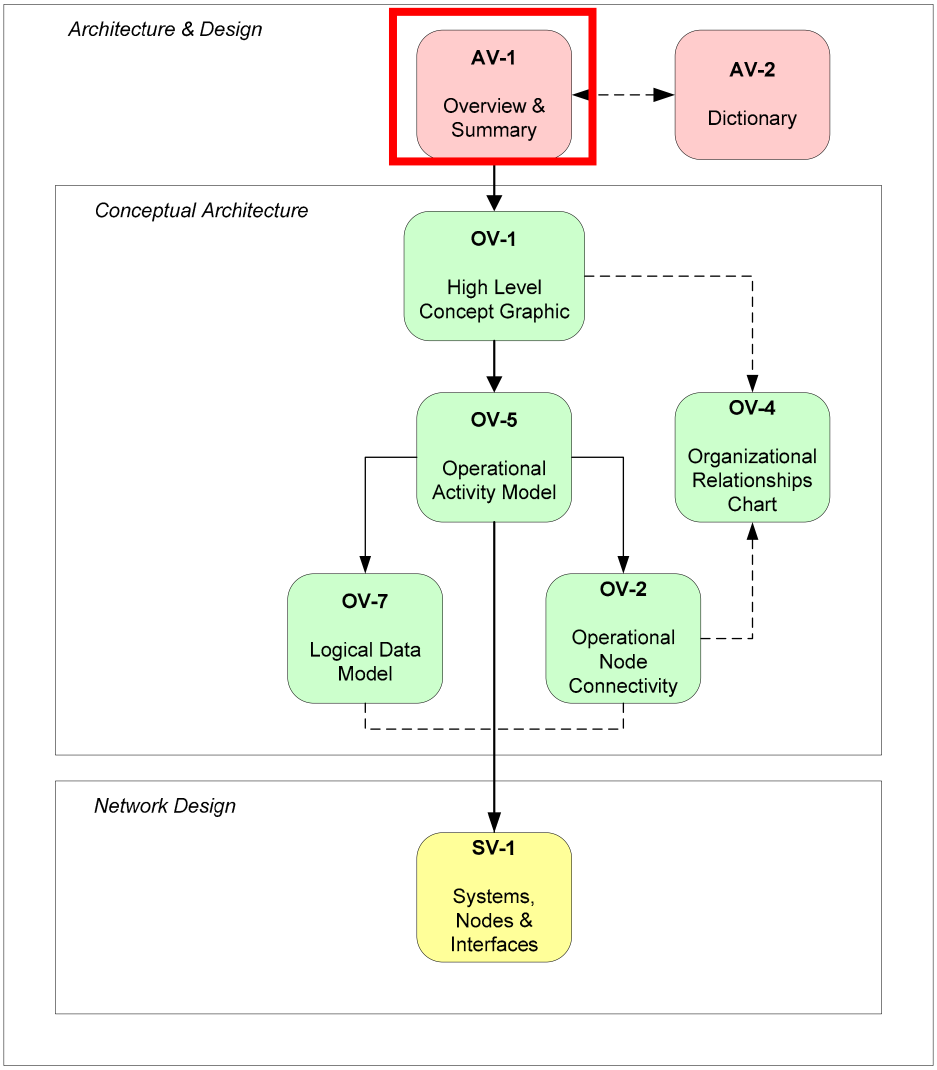
Document History

Date	Version	By	Description of Changes
2006-03-09	0.1	John Graybeal	Initial draft
2006-05-28	1.0	Alan Chave	Final draft
2006-05-30	1.1	Alan Chave	Initial release
2006-07-26	1.2	Alan Chave	Final release
2007-08-03	2.0	CI ADT	Conceptual Architecture Update Initial Draft. Reframed, updated architecture scope, replaced ORION with OOI
2007-08-15	2.1	CI ADT	Addressed review comments, added CI scope
2007-10-04	2.2	CI ADT	PDR Candidate
2007-11-12	2.3	CI ADT	Aligned with OV-2, OV4, OV-7

Preamble

The set of documents named AV*, OV*, SV*, TV* are all part of the OOI CyberInfrastructure Architecture & Design (CIAD), in the structure prescribed by the DoDAF (Department of Defense Architecture Framework). Each document has a designated title, an identifier (such as AV-1) and covers a specific topic in a self-contained way. Document AV-1 provides further explanations and a summary. A glossary of the terms used in these documents and their context can be found in AV-2.

The figure below suggests an intuitive reading flow through the provided documents. Other documents will be added to the figure as they emerge during the design of the CI (for the complete set of documents see AV-1). The thick arrow suggests a reading order through the core documents (AV-1, OV-1, OV-5 and SV-1). The red rectangle highlights the current document.



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Architecture & Design
Overview and Summary Information (AV-1)

1 Introduction

1.1 Product Overview

The Overview and Summary Information 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 (adapted from [DoDAF-vII 2007]).

1.2 Product Purpose and Description

The AV-1 product comprises a textual executive summary of the OOI CI architecture, serving as a planning guide in the initial phases of architecture development. It documents the following activities:

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 required to develop the architecture.

Scope Identifies the views and products that have been developed and the temporal nature of the architecture. Scope also identifies the organizations that fall within the scope of the architecture.

Purpose and Viewpoint Explains the need for the architecture, what it should demonstrate, the types of analyses that will be applied to it, who is expected to perform the analyses, what decisions are expected to be made on the basis of analyses, who is expected to make those decisions, and what actions are expected to result.

Context Describes the setting in which the architecture exists. It includes such things as mission, doctrine, relevant goals and vision statements, concepts of operation, use scenarios, information assurance context, 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 (adapted from [DoDAF-vII 2007]).

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2 Architecture Project Identification

2.1 Name

This architecture is targeting the CyberInfrastructure (CI) part of the Ocean Observatories Initiative (OOI) program, resulting in the CyberInfrastructure Architecture Design (CIAD).

It is based on the Conceptual Architecture Design (CAD), carried out by the OOI Conceptual Architecture Design Team (CADT), a subcommittee of the OOI CI Committee.

2.2 Architect

This project is carried out by the OOI CI Architecture Design Team (CIADT), a subteam of the CI Implementing Organization (CIIO). The OOI CI System Architect is Ingolf Krueger (UCSD).

2.3 Organization Developing the Architecture

This architecture is being developed by the OOI CI Implementing Organization (CIIO) on behalf of the OOI Program Office, which is hosted and overseen by the Joint Oceanographic Institutions (JOI), a subdivision of the Consortium for Ocean Leadership (COL).

2.4 Assumptions and Constraints

The OOI CIAD description is a living document that depends on input from various stakeholders, and in particular the OOI Observatory Steering Committee and its subcommittees. The stakeholders list is comprised of individuals or organizations that would serve as excellent sources to identify specific requirements or features to be implemented in the OOI CI.

- OOI community:
    1. Ocean scientists directly involved with observatory experiments.
    2. Ocean scientists not directly involved with observatory experiments.
    3. Ocean scientists who develop data products based on observatory data.
    4. Ocean technologists and engineers who develop instruments and platforms for use on ocean observatories.
    5. Educators who use outreach products developed by OOI.
- External community
    1. Environmental scientists directly involved with other observatory efforts (e.g., NEON, WATERS).
    2. Environmental scientists not directly involved with other observatory efforts.
    3. The public at large.
    4. The operational oceanography community, and especially the Integrated and Sustained Ocean Observing System (IOOS).
    5. The US national security authorities.

The following constraints must be considered for the entire architecture:

- The OOI CI is in service to scientific investigation, discovery and innovation, and its development must be science-driven.
- System engineering and integration activities for the OOI CI should comply with the procedures and standards supported by the International Council on System Engineering (INCOSE) (http://www.incose.org) to the greatest extent practicable.
- OOI CI system engineering and integration activities should comply with existing architectural frameworks identified within each stakeholder area of interest.
- The national security concerns of the US government must be accommodated.
- Legal requirements (e.g., Section 508, ITAR) must be accommodated.
- The hardware/software interface between the wet and dry elements of the global, coastal, and regional cabled observatories and the OOI CI must be managed throughout the design cycle.
- The Concept of Operations (ConOps) should comply with existing stakeholder policies and procedures.

In addition, the architecture and its documentation are constrained by the availability of information for subsystems that may be influenced by commercial confidentiality or other factors.

2.5 Approval Authority

The CIIO Project Manager (PM) approves documents produced by the System Architect (SA) and the System Engineer (SE). This includes the CIAD.

CIIO PM approved documents will be made available to the OOI Program Office, operated by the Joint Oceanographic Institutions (JOI), a subdivision of the Consortium for Ocean Leadership (COL).

2.6 Date Completed

The completion date for the Preliminary Architecture and Design of the CIAD is targeted for October 3, 2007.

2.7 Level of Effort and Projected and Actual Costs to Develop the Architecture

This information is available through the OOI Program Office.

3 Origin and Input Traceability

3.1 Input/Source Documents

Reference	Document	Version
CA	Conceptual Architecture	
CONOPS	Concepts of Operations	
NORIA	NORIA Technical/Management Proposal	(version of 22-Dec-06)
URD	User Requirements Document	
SRD	System Requirements Document	

3.2 History

Each document part of the architecture carries its own history information. The following table contains the major releases of the complete set of documents.

Date	State	Comment
August 2006	Concept Architecture Public Version	

4 Scope Definition

The CIAD serves the following purposes:

- Defining the CI for the NSF Ocean Observatories Initiative (OOI) and the relationships to other observatory programs, not necessarily managed by COL. This includes programs such as IOOS.
- Support the efforts of OOI to provide an overarching integration system for the three observatory elements (i.e., regional, coastal, and global) of the OOI.
- Provide a preliminary design as a decision point for the OOI about future program development
- Establish a common terminology and integrated architecture for the OOI CI
- Establish the interfaces of CI with Marine IOs
- Establish a basis for implementation of the CI subsystems that is in compliance with stakeholder requirements, as expressed by the User Requirements Document, System Requirements Document and Concepts of Operations, by

- Designing and documenting a set of information system capabilities
- Designing and documenting concrete system components and interfaces

The CIAD complies with the following guidelines:

- The use of off-the-shelf components from commercial sources or other science-oriented distributed network systems should be assessed and included where feasible.
- Establishment of a clear dividing line between the responsibilities of the "overarching" CI and those of the individual observatories
- Support for the definition of interface management between the two.

The CIAD is scoped to cover the architecture and design of the CI component of the OOI system. It does not cover the other OOI components, namely the regional, coastal and global observatories and their infrastructure components.

As an enabling system and central integration infrastructure component, the CI needs to define interfaces to the three OOI components outside of the CI, as well as to other external systems.

Furthermore, the operational activities enabled by the CI and described as part of the Operational Views of the architecture span the entire OOI system, making it appear to its users and the environment as one integrated system. The CI provides a “face” to the OOI system.

Therefore, it is strongly suggested that the CIAD clearly distinguish the operational scope of the CI, which spans most of the OOI system, from the technical scope of the CI infrastructure itself, which is significantly smaller in extent.

4.1 Views and Products Developed

The Department of Defense Architectural Framework Version 1.5 (DoDAF) was used to define the CIAD. An appendix to this document summarizes the DoDAF process. The following DODAF architectural views have been developed:

- AV-1: Overview and Summary Information (this section)
- AV-2: Integrated Dictionary
- OV-1: High-Level Operational Concept Graphic
- OV-2: Operational Node Connectivity Description
- OV-4: Organizational Relationships Chart
- OV-5: Operational Activity Model
- OV-7: Logical Data Model
- SV-1: Systems and Services Interface Descriptions

The CIAD entails the following deliverables required by the CIIO:

- The **OOI CI Conceptual Architecture** is contained in and documented as part of the Operational Views (OVs) of the CIAD.
- The **OOI CI Network Design** is contained in and documented as part of the System and Service Views (SVs).

The CIAD provides a comprehensive and integrated architecture and design view on these and potential other individual system engineering artifacts by following the principles of the DoDAF methodology and its underlying Core Architecture Data Model (CADM).

4.2 Time Frames Addressed

This product provides the preliminary architecture and design, encompassing the conceptual architecture developed by the CI CA subcommittee. It will be the basis for the detailed architecture and design that must last many decades through numerous iterations of the underlying software technologies.

4.3 Organizations Involved

The scope of the architecture includes the following organizations

- OOI Implementing Organizations
  - CI IO, consortium led by UCSD
  - Coastal/Global Scale Node IO, a consortium led by WHOI
  - Regional Scale Node IO, operated by UW
- OOI Scale Node Operators (future)

The architecture scope has associations with the following organizations:

- OOI Program Office
- National Science Foundation (NSF)
- NEPTUNE Canada
- Other observatory programs, including IOOS, NEON, WATERS and ESONET

5 Purpose and Viewpoint

5.1 Purpose and Questions to be addressed through Analysis of the Architecture

The architecture serves the goal of providing a consistent, structured, up-to-date representation of the OOI CI architecture and design, providing views for multiple groups of stakeholders. This includes operational views, as required by users and decision makers, as well as deployment and process views, required by CI implementers and subsystem architecture and design teams. The architecture also serves the goal of entraining potential participants in, and advocates for, the OOI CyberInfrastructure and its connected observatories. In particular, the potential cost savings and added value from a comprehensive CI are expressed.

5.2 From Whose Viewpoint the Architecture is developed

The architecture design was developed primarily from the viewpoint of its potential users, whether ocean scientists, instrument developers, data providers, subsystem designers, system operators, or data users and analysts.

The Operational Views capture the viewpoints of the potential users, while the System Views capture the subsystem designers and implementer viewpoints.

6 Context

6.1 Mission

In order to provide the U.S. ocean-sciences research community with access to the basic infrastructure required to make sustained, long-term and adaptive measurements in the oceans, the National Science Foundation (NSF) Ocean Sciences Division has initiated the Ocean Observatories Initiative (OOI). The OOI is the outgrowth of many years of national and international scientific planning efforts. The OOI builds upon recent technological advances and experience with existing observatories, and is underpinned by several successful pilot and testbed projects. As these efforts mature, the research-focused observatories enabled by the OOI will be networked, becoming an integral part of the proposed Integrated and Sustained Ocean Observing System (IOOS; www.ocean.us). IOOS is an operationally-focused national system, and in turn will be the enabling U.S. contribution to the international Global Ocean Observing System (GOOS; http://www.ioc-goos.org) and the Global Earth Observing System of Systems (GEOSS; www.earthobservations.org).

6.2 Doctrine, Goals, and Vision

The OOI comprises three types of interconnected observatories spanning global, regional and coastal scales. The global component addresses planetary-scale problems via a network of moored buoys linked to shore via satellite. A regional cabled observatory will 'wire' a single region in the Northeast Pacific Ocean with a high-speed optical and power grid. The coastal component of the OOI will expand existing coastal observing assets, providing extended opportunities to characterize the effects of high frequency forcing on the coastal environment. The OOI CyberInfrastructure (CI) constitutes the integrating element that links and binds the three types of marine observatories and associated sensors into a coherent system-of-systems. Indeed, it is most appropriate to view the OOI as a whole that will allow scientists and citizens to view particular phenomena irrespective of the observing elements (e.g. coastal, global, regional, ships, satellites, IOOS…) to which the observations belong.

The objective of the OOI CI is provision of a comprehensive federated system of Observatories, Laboratories, Classrooms, and Facilities that realizes the OOI Mission. The infrastructure provided to research scientists through the OOI will include the cables, buoys, deployment platforms, moorings and junction boxes required for power and two-way data communication with a wide variety of sensors at the sea surface, in the water column, and at or beneath the seafloor. The initiative also includes components such as unified project management, data dissemination and archiving and education and outreach activities essential to the long-term success of ocean observatory science. A fully operational research observatory system would be expected to meet the following goals:

- continuous observations at time scales of seconds to decades
- spatial measurements from millimeters to kilometers
- sustained operation during storms and other severe conditions
- real-time or near-real-time data as appropriate
- two-way transmission of data and remote instrument control
- power delivery to sensors between the sea surface and the seafloor
- standard plug-n-play sensor interface protocol
- autonomous underwater vehicle (AUV) dock for data download/battery recharge
- access to deployment and maintenance vehicles that satisfy the needs of specific observatories
- facilities for instrument maintenance and calibration
- a management system that makes data publicly available
- an effective education and outreach program

The vision of the OOI CI is to provide the OOI user base, beginning with the science community, access to a system that enables simple and direct use of OOI resources to accomplish their scientific objectives. This vision includes direct access to instrument data, control, and operational activities described above, and the opportunity to seamlessly collaborate with other scientists, institutions, projects, and disciplines.

The core capabilities and the principal objectives of ocean observatories are collecting real-time data, analyzing data and modeling the ocean on multiple scales and enabling adaptive experimentation within the ocean. A traditional data-centric CI, in which a central data management system ingests data and serves them to users on a query basis, is not sufficient to accomplish the range of tasks ocean scientists will engage in when the OOI is implemented. Instead, a highly distributed set of capabilities are required that facilitate:

- end-to-end data preservation and access,

- end-to-end, human-to-machine and machine-to-machine control of how data are collected and analyzed,
- direct, closed loop interaction of models with the data acquisition process,
- virtual collaborations created on demand to drive data-model coupling and share ocean observatory resources (e.g., instruments, networks, computing, storage and workflows),
- end-to-end preservation of the ocean observatory process and its outcomes, and
- automation of the planning and prosecution of observational programs.

In addition to these features, the CI must provide the background messaging, governance and service frameworks that facilitate interaction in a shared environment, similar to the role of the operating system on a computer.

The OOI system construction will occur during the confluence of several significant technology innovations in web and distributed processing: semantic webs, social networks, Grid computing, sensor networks, service-oriented architectures (SOA), event-driven architectures, policy-based security and machine virtualization. Each offers different capabilities, and each may increase the scope and reliability of the OOI system while lowering its complexity and cost. The challenge to building the CI at this time of convergence is finding an appropriate integration architecture and roadmap to deliver a functioning system as early as possible, while maintaining the ability to refine and extend operating characteristics as technology evolves.

6.3 Rules, Criteria, and Conventions Followed

The conceptual architecture has been developed according to the guidelines in the DOD Architecture Framework (DoDAF; see appendix). Funding for the development and operation of the CI has followed NSF conventions and regulations. All government standards applicable to the CI (for example, metadata standards) therefore apply.

Certain data streams, data products and processes may fall under the jurisdiction of national security organizations. So far, there do not appear to be any direct architectural adjustments required to meet the requirements of such entities.

6.4 Linkages to Other Architectures

No direct linkages to other architectures are mandated at this time. However, several other environmental observatories and initiatives (e.g., NEON and WATERS) have created or are creating standards and interfaces that should be integrated with the OOI architecture. This task is in the domain of the CI IO with guidance from the OOI Program Office

7 Tools and File Formats Used

Tools used to develop the architecture include:

- Microsoft Word (word processing)
- Microsoft Visio, OmniGraffle, Adobe Illustrator (drawing)
- FreeMind (outlining)
- Adobe Acrobat (creating PDF-formatted files)
- Microsoft Excel (spreadsheet)
- Telelogic DOORS for requirements (setup in progress)
- Telelogic System Architect for DoDAF (setup in progress)

8 Findings

The findings are contained in the views and documents submitted to the OOI Program Office.

9 Appendix: DoDAF Architecture Views and Products

The Department of Defense (DoD) Architecture Framework (DoDAF), Version 1.5, defines a common approach for DoD architecture description development, presentation, and integration for both operations and processes.

The selection of products from DoDAF is compatible with other standards such as the Rational Unified Process (RUP) architecture framework and the Federal Enterprise Architecture (FEA). To illustrate this, we provide a mapping from DoDAF products to the corresponding elements and views of the RUP architecture framework at the end of this appendix.

9.1 Views and Products Developed

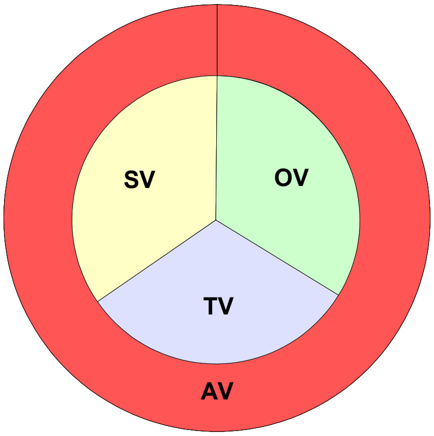

Figure 1. DoDAF views, comprising All Views (AV), - Operational Views (OV), System and Services Views (SV) and Technical Standards Views (TV)

In the following tables, a coarse overview of the content of each of the views defined by DoDAF is presented:

Table 1: Definition of DoDAF Architecture Framework Views

View	Definition
All-Views (AV)	There are some overarching aspects of an architecture that relate to all three views. These overarching aspects are captured in the All-Views (AV) products. The AV products give information pertinent to the entire architecture but do not represent a distinct view of it. AV products set the scope and context of the architecture. The scope includes the subject area and time frame. 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; relevant goals and vision statements; concepts of operations (ConOps); scenarios; and environmental conditions.
Operational View (OV)	The OV is a description of the tasks and activities, operational elements, and information exchanges required to accomplish DoD business processes. The OV contains graphical and textual products that comprise an identification of the operational nodes and elements, assigned tasks and activities, and information flows required between nodes. It defines 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.
Systems and Services View (SV)	The SV is a set of graphical and textual products that describes systems and interconnections providing for, or supporting, DoD functions, including business functions. The SV associates system resources with the OV. These system resources support the operational activities and facilitate the exchange of information among

	operational nodes.
Technical Standards View (TV)	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. The TV includes a collection of the technical standards, implementation conventions, standards options, rules, and criteria organized into profile(s) that govern systems and system elements for a given architecture.

9.2 Architecture Products

Table 2 lists the products defined by DoDAF version 1.5 together with an expected content summary. Products selected for the OOI Concept Architecture Design are indicated by a checkmark (✓) in the first column. These products were selected to represent the processing and inter-nodal levels of operation that best reflect information exchange requirements. Furthermore, the technical criteria governing the interoperable implementation and procurement of the envisioned system's capabilities based on the architecture purpose stated above are best represented by the selected products.

Table 2: Architecture Products defined in and selected from the DoD Architecture Framework for use in the OOI CI Concept Architecture

Selected	Product	Name	Summary
✓	AV-1	Overview and Summary Information	The Overview and Summary Information 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.
✓	AV-2	Integrated Dictionary	The Integrated Dictionary 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.
✓	OV-1	High Level Operational Concept Graphic	The High- Level Operational Concept Graphic describes a mission 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.
✓	OV-2	Operational Node Connectivity Description	The Operational Node Connectivity Description 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.
	OV-3	Operational	The Operational Information Exchange Matrix details in-

		Information Exchange Matrix	formation exchanges and identifies "who exchanges what information, with whom, why the information is necessary, and how the information exchange must occur". There isn't 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.
✓	OV-4	Organizational Relationships Chart	The Organizational Relationships Chart 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 architecture.
✓	OV-5	Operational Activity Model	The Operational Activity Model describes the operations that are normally conducted in the course of achieving a mission or a business goal. 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 (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.
	OV-6a	Operational Rule Model	The Operational Rules Model specifies operational or business rules that are constraints on an enterprise, a mission, operation, business or architecture.
	OV-6b	Operational State Transition Description	The Operational State Transition Description 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.
	OV-6c	Operational Event Trace Description	The Operational Event-Trace Description 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.
✓	OV-7	Logical Data Model	The Logical Data Model describes the structure of an architecture domain's system data types and the structural business process rules (defined in the architecture's Operational View) that govern the system data. It provides a definition of architecture domain data types, their attributes or characteristics, and their interrelationships.
✓	SV-1	Systems Interface Description	The Systems Interface Description depicts systems nodes and the systems resident at these nodes to support organization/human roles represented by operational nodes of the Operational Node Connectivity Description (OV-2). SV-1 also identifies the interfaces between systems and system nodes.
	SV-2	Systems Communication	The Systems Communications Description depicts pertinent information about communications systems, communica-

		Description	tions links, and communications networks. SV-2 documents the kinds of communications media that support the systems and implement 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.
	SV-3	Systems-Systems Matrix	The Systems-Systems Matrix provides detail on the interface characteristics described in SV-1 for the architecture, arranged in a matrix form.
	SV-4	Systems Functionalities Description	The Systems Functionality Description documents system functional hierarchies and system functions, and the system data flows between them. Although there is a correlation between Operational Activity Model (OV-5) or business-process hierarchies and the system functional hierarchy of SV-4, it need not be a one-to-one mapping, hence, the need for the Operational Activity to Systems Function Traceability Matrix (SV-5), which provides that mapping.
	SV-5	Operational Activities to System Functionalities Traceability Matrix	Operational Activity to Systems Function Traceability Matrix is a specification of the relationships between the set of operational activities applicable to architecture and the set of system functions applicable to that architecture.
	SV-6	Systems Data Exchange Matrix	The Systems Data Exchange Matrix 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.
	SV-7	Systems Performance Parameters Matrix	The Systems Performance Parameters Matrix 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.
	SV-8	Systems Evolution Description	The Systems Evolution Description 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.
	SV-9	Systems Technology Forecasts	The Systems Technology Forecast defines the underlying current and expected supporting technologies. It is not expected to include predictions of technologies as with a crystal ball. 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.
	SV-10a	Systems Rules	Systems rules are constraints on architecture, on a system(s),

		Model	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 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.
	SV-10b	Systems State Transitions Description	The Systems State Transition Description 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.
	SV-10c	Systems Event-Trace Description	The Systems Event-Trace Description 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 View may reflect system-specific aspects or refinements of critical sequences of events described in the Operational View.
	SV-11	Physical Schema	The Physical Schema product 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.
	TV-1	Technical Standards Profile	The Technical Standards Profile collects the various systems standards rules that implement and sometimes constrain the choices that can be made in the design and implementation of architecture.
	TV-2	Technical Standards Forecast	The Technical Standards Forecast 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.

For readers more familiar with the RUP architecture framework, we provide a mapping from the DoDAF products to the elements/views of the RUP architecture framework as follows:

RUP Architecture Element/View	DoDAF Architecture Product
Supplementary Information	AV-1, AV-2, SV-9, SV-10a, TV-1, TV-2
Logical View	OV-1, OV-2, OV-3, OV-4, OV-5, OV-6, OV-7
Deployment View	SV-1, SV-2, SV-3, SV-4, SV-5, SV-6, SV-10b, SV-10c
Process View	SV-2, SV-7, SV-10b, SV-10c
Implementation View	SV-8, SV-11
Use Cases	OV-5, OV-6 (ConOps)

From this mapping, a RUP-style architecture document can easily be constructed starting from the selected DoDAF products. A similar mapping exists from DoDAF products to the FEA.
Figure 2 presents a reading map of the complete set of DoDAF documents. Note that only the solid lined boxes represent products delivered for PDR. The thick lines suggest the reading order of the documents.

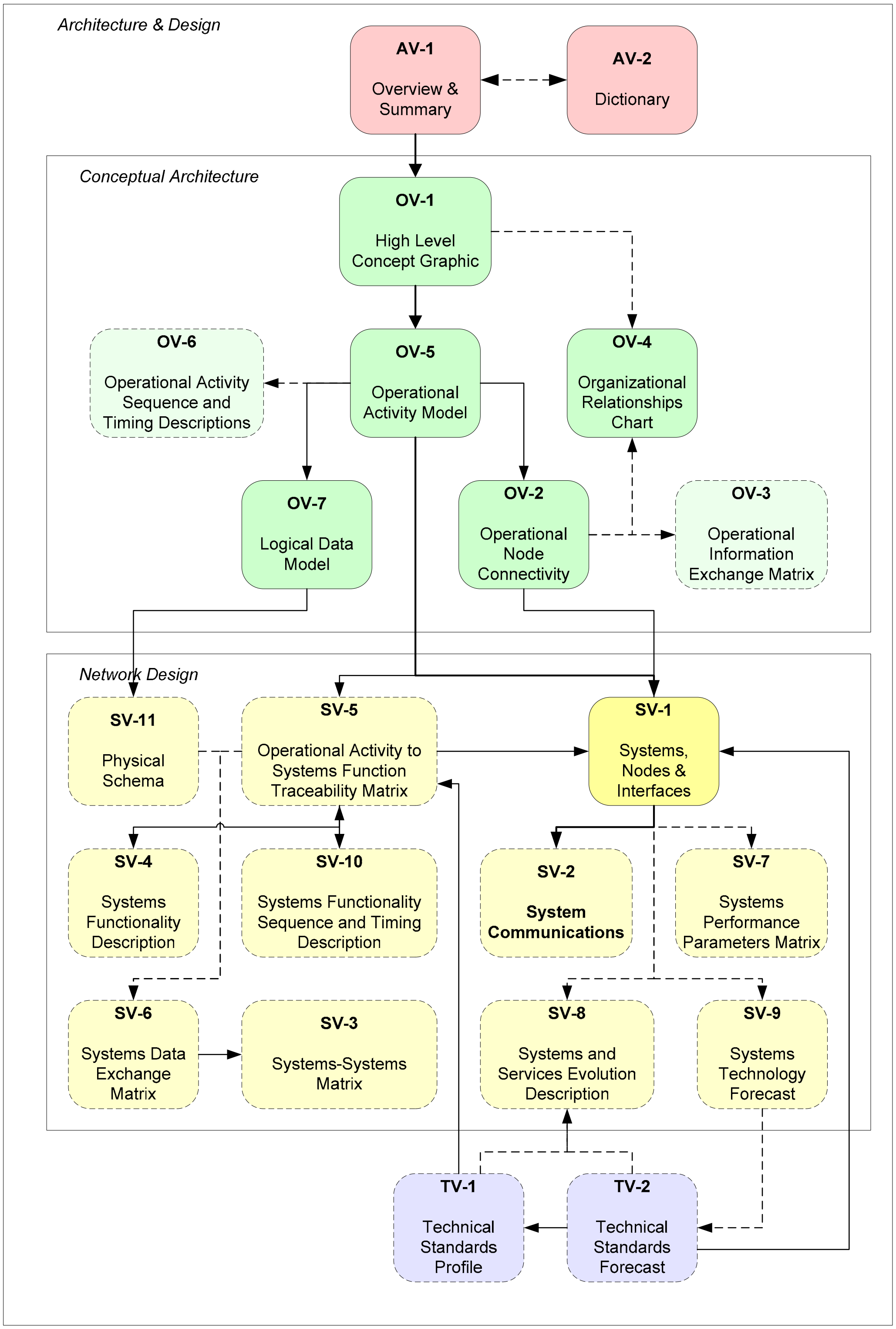

Figure 2. DoDAF documents map