Architectural Frameworks: Defining the Contents of Architectural Descriptions

David E. Emery

The MITRE Corporation
1820 Dolley Madison Blvd, MS W538 McLean, VA 22102-3481 USA
emery@mitre.org, +1 703 883 7606 v, +1 703 883 6143 fax

Abstract. This paper describes experiences with several architectural frameworks. An “architectural framework” specifies what is included in the description of an architecture, independent of the specific system being described. The three frameworks are the U.S. DoD C4ISR Architecture Framework, the associated Core Architecture Data Model and the emerging IEEE Recommended Practice on Architecture Description. From these experiences, we speculate on the further evolution of architecture frameworks and architectural descriptions.

1 Introduction

The term “architecture” means many things to many people. Initially, there was no ‘formal’ definition of the term. Users of the term relied instead on intuition and the analogy with other disciplines, such as structural architecture and landscape architecture. Within the last two years, though, there have been many attempts to add structure and rigor to the notion of ‘architecture’, resulting in several different approaches to defining what constitutes an architecture. These attempts have defined “architecture” by defining how to -describe- architectures.

These examples give us a notion of an abstract “architecture” with many possible “architectural descriptions”, where the contents of an architectural description (the concrete representation of the architecture) is established by an “architectural framework”. Thus an “architectural framework” is a specification of how to describe architectures, rather than the definition of a specific architecture.

This paper relates the author’s experience with several different architectural frameworks. There are many architectural frameworks and approaches in the literature; we concentrate here on those that are used to describe the systems aspects of software-intensive systems, rather than the more specific notion of “software architectures.” (A survey of architectural frameworks can be found in [9]). Architectural frameworks are important, since the value of architecture comes as a communications medium, and a common “language” (as defined by an architectural framework) is needed to compare architectures.
1.1 Characterizing Architecture Frameworks

An architectural framework tells the user how to describe an architecture. The framework may imply a methodology, but the intent of the framework is to establish the contents of a (conforming) description of an architecture. Generally, a framework consists of a definition of “architecture” and related terms and concepts, along with the definition of one or more “views”, or representations. The architecture is described by a set of these views, where each view conforms to the requirements of the framework. Some frameworks may place additional requirements on the set of views (e.g. cross-view consistency rules).

2 DoD C4ISR Architecture Framework Document

This section discusses the U.S. Department of Defense Command, Control Communications and Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Architecture Framework document. [16]

2.1 The C4ISR Architecture Framework

The C4ISR Architecture Framework was developed in response to U.S. Department of Defense need for a coordinated approach for developing, integrating and using Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems. Operation Desert Storm showed both strengths and weaknesses in combining systems developed by each military service into an integrated system for the Commander in Chief. One of the most notable examples from Desert Storm is that the Navy and Air Force were reduced to exchanging air tasking information on floppy disks, rather than through any interactive or automated process.

The Framework document prescribes that architectural descriptions will be oriented around three views, with a series of products for each view. These views are

- Operational View: tasks and activities, operational elements and information flows required to accomplish or support a military operation. (Often abbreviated “OA”)
- Systems View: descriptions, including graphics, of systems and interconnections providing for, or supporting, warfighting functions. (Often abbreviated “SA”)
- Technical View: minimal set of rules governing the arrangement, interaction and interdependence of system parts or elements, whose purpose is to ensure that a conformant system satisfies a specified set of requirements. (Often abbreviated “TA”)

For each of the three views, the Framework document specifies a set of “products”. A “product” is a document that contains information relating to some aspect of the architecture. Products are classified as “Essential” or “Supporting”, with Essential products containing the minimum information needed to