A Methodology for Development of Enterprise Architecture of PPDR Organisations

W. Müller, F. Reinert

Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB

76131 Karlsruhe, Fraunhoferstraße 1

GERMANY

Abstract - *The growing number of events affecting public safety and security (PS&S) on a regional scale with potential to grow up to large scale cross border disasters puts an increased pressure on agencies and organization responsible for PS&S. In order to respond timely and in an adequate manner to such events Public Protection and Disaster Relief (PPDR) organisations need to cooperate, align their procedures and activities, share the needed information and be interoperable.*

This paper provides an approach to tackle the above mentioned aspects by defining an Enterprise Architecture (EA) of the organisation and based on this EA define the respective System Architectures. We propose a methodology for the development of EA for PPDR organisations. Our methodology refines architectural artefacts of the OSSAF approach and introduces a lightweight architecture development model relying on capability based planning as the organisational top level approach.

Keywords: *Architecture framework, Public Protection & Disaster Relief, NAF, OSSAF*

1 Introduction

Public Protection and Disaster Relief (PPDR) organisations are confronted with a growing number of events affecting public safety and security. Since these events either expand from a local to a regional and to an international scale or are from beginning affecting multiple countries the pressure on PPDR organisations to be able to cooperate in order to respond timely and adequately to such events increases as well. The need of cooperation demands for aligned procedures and interoperable systems which allows timely information sharing and synchronization of activities. This in turn requires that PPDR organizations come with an Enterprise Architecture on which the respective System Architectures are building. The Open Safety & Security Architecture Framework (OSSAF) provides a framework and approach to coordinate the perspectives of different types of stakeholders within a PS&S organisation. It aims at bridging the silos in the chain of commands and on leveraging interoperability between PPDR organisations. Our work is based on OSSAF and provides the methodology to describe the OSSAF perspectives and views with the adequate models.

2 Related work

The goal of Enterprise Architecture design is to describe the decomposition of an enterprise into manageable parts, the definition of those parts, and the orchestration of the interactions between those parts. Although standards like TOGAF and Zachman have developed, however, there is no common agreement which architecture layers, which artifact types and which dependencies constitute the essence of enterprise architecture.

[7] defines seven architectural layers and a model for interfacing enterprise architectures with other corporate architectures and models. They provide use cases of mappings of corporate architectures to their enterprise architecture layers for companies from the financial and mining sector.

A layered model is also proposed by [10]. The authors propose four layers to model the Enterprise Architecture: A Strategy Layer, an Organizational Layer, an Application Layer, and a Software Component Layer. For each of the layers a meta-model is provided. The modeling concepts were developed for sales and distribution processes in retail banking.

MEMO [11] is a model for enterprise modeling that is based on an extendable set of special purpose modeling languages, e.g. for describing corporate strategies, business processes, resources or information. The languages are defined in meta-models which in turn are specified through a common meta-metamodel. The focus of MEMO is on the definition of these languages and the needed meta-models for their definition.

The Four-Domain-Architecture [8] divides the enterprise into four domains and tailors an architecture model for each. The four domains are Process domain, Information / Knowledge domain, Infrastructure domain, Organization domain. Typical elements for each domain are also provided. The authors also provide proposals how to populate the cells of the Zachman framework with architectural elements.

The Handbook on Enterprise Architecture [9] provides methods, tools and examples of how to architect an enterprise through considering all life cycle aspects of Enterprise Entities in the light of the Generalized Enterprise Reference Architecture and Methodology (GERAM) framework.

None of the papers addressing Enterprise Architectures covers the special needs of PPDR organizations with their need on timely cooperation, alignment of procedures, and interoperability needs across different organizations.

3 Approach

3.1 Enterprise Architecture Frameworks

Supporting the development of dedicated enterprise architecture is the task of Enterprise Architecture Frameworks (EAF). According to [3] more than 50 published frameworks for EA exists, for example ADS, AGATE, EAF, GERAM, MODAF, PERA, TISAF, E2AF, CIMOSA, SABASA, OBASHI, ARIS etc. to name a few. The most well known frameworks are the The Open Group Architecture Framework (TOGAF) [1], Zachman Architecture Framework (ZAF) [4] and the NATO Architecture Framework (NAF) [5].

In general EA frameworks have different characteristics concerning intension and content. Some provide a methodology, others provide templates and meta-models, some provide governance aspects, others also provide tool support and some provide combinations of parts or all of them. The intensions covered range from management support through Government & Agencies, Military, Interoperability and Manufacturing-specific to pure technically oriented frameworks.

3.2 Open Safety & Security Architecture Framework (OSSAF)

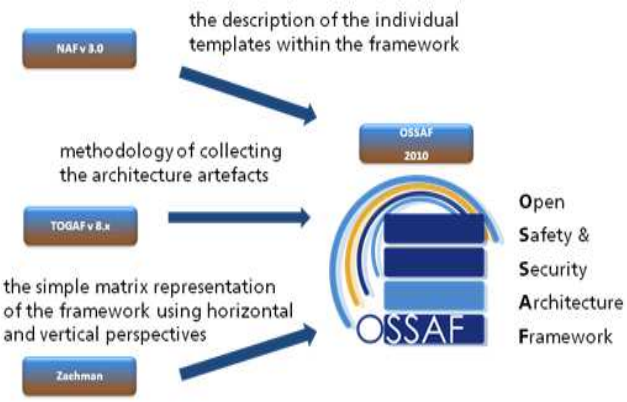
For PPDR organizations, [2] proposes the Open Safety & Security Architecture Framework (OSSAF). The framework incorporates concepts of several mature enterprise architecture frameworks such as the Zachman Architecture Framework (ZAF), the TOGAF framework and the NATO Architecture Framework (NAF) [5]. Reusing fundamental concepts provides a sound founding to OSSAF. There is also an explicit statement within the whitepaper, that a mapping between OSSAF and other existing frameworks is possible. Nevertheless OSSAF builds mainly on (see Figure 1):

1. The methodology of collecting information and artifacts contributing to the architecture from TOGAF.

2. The two dimensional matrix representation of the framework for structuring the different perspectives from Zachman.

The OSSAF whitepaper [2] also mentions that the NAF meta-model and views may be used where suitable for describing the content of the different perspectives, but does not provide details on the application of the NAF views.

Figure 1: Inputs to OSSAF



OSSAF proposes a total of four perspectives and a total of twenty views. In general it depends on the intention of the architecture under development which views are actually instantiated. In other words the views can be tailored to the specific needs of the architecture under consideration.

3.3 EA development methodology for PPDR organizations

The proposed methodology for the development of enterprise architecture of PPDR organizations follows a pragmatic approach, looking at an “enterprise” as the joint undertaking of one or more organizations with PS&S responsibilities that operate across a distributed and often complex environment. This understanding states, that we see an enterprise in this context as nonprofit-oriented organizations or complex structures of organizations (inter-organizational aspect of enterprise definition) such as national PPDR organizations, for example national police or fire-fighter organizations.

We see the enablement of PPDR organizations regarding their agility, interoperability and mutual networking as an evolutionary course of action based on a planned and predictable process which has to deal with highly complex issues. In computer science the divide and conquer principle is often used to handle complex problems. We refer to this principle to support the evolutionary process in order to deal with chunks of smaller complexity. These chunks with reduced complexity are the Capabilities. One can understand a Capability according to [1] as:

”An ability that an organization, person, or system possesses. Capabilities are typically expressed in general and high-level terms and typically require a combination of organization, people, processes, and technology to achieve.

For example, marketing, customer contact, or outbound telemarketing."

The introduction of Capabilities as main planning items leads to the approach of capability based planning. This is of course not a new approach. It is applied for years in the context of the NATO in order to provide interoperability across the whole spectrum of system solutions required for overall portfolio of the NATO enterprise putting extra attention on interoperability from technical up to the semantic level.

As a side note, there may arise some confusion on capabilities in relationship to requirements. In contrast to a capability, a requirement must be understood as a singular documented physical and functional need that identifies a necessary attribute, characteristic, or quality of a system to have value and utility to a customer, organization, internal user, or other stakeholder [6].

Seeing capability based planning as the overarching guideline, our actual approach for the development of an EA proposes scenarios as main input. Preceding to the definition and development of scenarios the first step in the development approach is the definition of Visions and Goals in order to depict an overall strategy including the winning of supporters for the overall architecting approach.

Keeping visions and goals in mind the next step is the development of representative scenarios. One can see the scenario development as the first concrete step towards enterprise architecture and being crucial for our proposed methodology. Therefore this step requires a very close cooperation with operational end-users. The development is an iterative and interactive process with a successive refinement of operational procedures, and requirements. Scenarios derived include as-is scenarios and also to-be scenarios or a mixture of both of them. The to-be scenarios are particular important to identify lacks in capabilities. Since the scenarios are developed in close cooperation with end-users, it is assumed that they reflect user's needs in a sufficient manner. In case of encountering deficits while designing the architecture in that the scenarios don't provide enough input to the development of the perspectives/views the OSSAF Engagement Questionnaire will be used to obtain the required information. This questionnaire is already defined in OSSAF. The further steps include:

- Define scope and principles of the architecture (for example require to use the SOA paradigm for the architecture, kind of architecture e.g. Reference architecture or Target architecture to be developed)
- Refer to or define/adapt a common modeling vocabulary (further addressed in 3.3 Definition of the Modeling Vocabulary)
- Define stakeholders addressed
- Tailor the architecture perspectives and views (architecture artifacts) according to the kind of architecture addressed.
- Map architecture artifacts to the corresponding stakeholders
- Analyze Scenarios/Use Cases on operational Capabilities required. This is a creative process and one has to align actual capabilities with further capabilities addressed in order to identify possible lacks of capabilities. As a starting point serve the six top-level capabilities of OSSAF in order to classify further capabilities derived.
- Analyze Scenarios/Use Cases on functional and non-functional requirements
- Derive Capability taxonomy und dependencies (capability based planning concept)
- Identify and analyze operational Context including: Nodes conducting (operational) Activities, Players, Activities, Information flows, Processes and Constraints (e.g. operational rules))
- Identify Services (operational as well as technical services) and Systems in order to support the capabilities, operational requirements and information exchange needs. Take existing technical Standards and Service catalogues under consideration. That means, re-use existing solutions first before developing new ones, being normally not that mature.
- Design Services (including communication services) and Systems (including communication systems) as well as their interactions (logical definitions of systems and services) and derive conceptual information models form the operational information exchange requirements.
- Define technical implementation of Services and Systems (physical definition) and a data models corresponding to the conceptual information model
- Define the standards that have to be considered or describe emerging standard configurations (products) resulting from the architecture approach.
- Finally validate the architecture with operational-end users and the stakeholders. In general it shall be noticed, that the proposed method is normally conducted in several iterations after defining the scenarios itself, although it may be necessary to refine them during further architecture development.
- After the final architecture validation, develop a potential migration plan which the decision-makers responsible for the organizational enhancements may adopt.

3.4 Definition of the modeling vocabulary

Defining a common vocabulary/meta-model in order to describe the architecture, i.e. its components and relationships is a very beneficial task. It enables the description of the architecture in a consistent and coherent way. Referring to such a meta-model also supports the use of tools for architecture modeling. Since the OSSAF framework already proposes to use NAF views where suitable as templates for describing the OSSAF views and the NAF views defines a vocabulary, our approach is to use NAF as the modeling vocabulary where suitable.

"NATO Architecture Framework Metamodel (NMM) and Architecture Data Exchange Specification (ADES)" and CHAPTER 4 "Architecture Views and Subviews" in order to get a detailed insight and understanding of NAF.

Being in proposal state, OSSAF actually does not define the contents of the NAF meta-model being part of the corresponding OSSAF views. Only general hints are given. Therefore, at first, a mapping between OSSAF views and NAF views has to be established. Table 1 summarizes the first results of a general mapping of NAF views to OSSAF perspectives. Each column represents a perspective defined by

Table 1: Mapping of NAF templates to OSSAF views

OSSAF Views	OSSAF Perspectivec							
	Strategic		Operational		Functional		Technical	
	Vision & Goals	NAV-1 NCV-1	Use Case Scenarios	No proper NAF view	Systems & Services	NSOV-1 NSOV-2 NSOV-3 NSOV-4 NSOV-5 NSV-12	Solution Context	No proper NAF view
	Capability Planning	NCV-2 NCV-4	Operational Concepts	NCV-4 NCV-5 NCV-6 NOV-1	Functional Requirements	NSV-2d NSV-4 NSV-5 NSV-6 NSV-7 NSV-10a	Standards & Protocols	NTV-1
	Funding Model	No proper NAF view	Operational Nodes Model	NOV-2	Systems Connectivity Model	NSV-1 NSV-2a NSV-2b	Device Connectivity Model	NSV-2a NSV-2b NSV-2d
	Laws & Regulations	No proper NAF view	Organization Chart	NOV-4	Systems Interface Model	NSV-1 NSV-2 NSV-3	Product Specification	(NTV-1)
	Local Market Landscape	No proper NAF view	Process Model	NOV-5 NOV-6a NOV-6b NOV-6c			Product Configuration	NTV-3
			Information Exchange Model	NOV-3 NOV-7				

In general NAF provides a mature common meta-model to describe the contents of the corresponding views. Every view contains a section of the overall meta-model in order to describe view-specific contents and relations. In addition to the concepts and relationships the meta-model also defines the semantics of each of these elements [5]. The reader should refer to the NAF documentation [5], especially CHAPTER 5

the OSSAF framework. The rows represent the views per perspective, each with a specific semantics defined by OSSAF. To the right of each OSSAF perspective we refer to the corresponding NAF-views which we see suitable for representing the semantics required by OSSAF. For example to describe the "Capability Planning" view of the "Strategic" perspective it is suggested to use the NAF Capability View-2

("NCV-2") and Capability View-4 ("NCV-4") view accordingly. In order to describe the OSSAF "Operational Concepts" view of the "Operational" perspective we refer to several NAF views form the NAF Capability and Operational descriptions. These are the Capability dependencies View ("NCV-4"), the Capability to organizational deployment mapping View ("NCV-5"), the Operational activity to capability mapping View ("NCV-6") and finally form the NAF Operational description the High level operational concept description View ("NOV-1"). Another example for the suggested re-use of NAF views in order to describe the required semantics of the OSSAF is given for the "Systems Interface Model" view of the OSSAF Functional perspective. Here we refer to the NAF Systems descriptions in form of the System Interface description ("NSV-1"), the Systems communications description ("NSV-2") and the System to System matrix ("NSV-3") views defined in NAF in order to describe the corresponding OSSAF view.

As the table shows, a direct mapping between OSSAF and NAF views is not always possible ("No proper NAF view" comment at the corresponding matrix entry in the table). For example the OSSAF "Funding Model" could not directly be mapped to a corresponding NAF view. In such cases suitable representations will be proposed in a follow-on work.

4 Conclusions and further work

The proposed methodological approach provides a starting point to the development of Enterprise Architectures for PPDR organizations. Based on the Enterprise Architecture, specific System Architectures may be derived.

The proposed EA methodology will be used in the SALUS project [12] to define the Enterprise Architecture of PPDR organizations and the System Architecture of the communication network for those organizations. As the need arises it will be further refined. In addition, a tool support for modeling the different NAF views is under development. This tool captures the relevant meta-model parts of NAF as an UML-profile extension which enables modeling in an UML-style. It will be used in SALUS to support the design and development of the above mentioned architectures.

Acknowledgement: The work described in this paper was partly funded by the European Commission within the European Seventh Framework Programme under Grant Agreement 313296, SALUS - Security And InteroperabiLity in Next Generation PPDR CommUnication InfrastructureS

5 References

[1] Website TOGAF, http://www.opengroup.org/togaf/

[2] Open Safety & Security Architecture Framework (OSSAF), http://www.openssaf.org/download

[3] D. Mattes „Enterprise Architecture Frameworks Kompendium", Springer-Verlag Berlin Heidelberg, 2011

[4] Website Zachman Framework, http://zachman.com/

[5] NATO Architecture Framework Version 3, ANNEX 3 TO AC/322(SC/1-WG/1)N(2007)0004

[6] Website Wikipedia, http://en.wikipedia.org/wiki/Requirement

[7] R. Winter, R. Fischer "Essential Layers, Artifacts, and Dependencies of Enterprise Architecture", Proceedings of the 10th IEEE International Enterprise Distributed Object Computing Conference Workshops (EDOCW'06), IEEE Computer Society, 2006

[8] B. IYER, R. Gottlieb "The Four-Domain-Architecture: An approach to support enterprise architecture design", IBM Systems Journal, Vol 43, No 3, 2004, pp. 587- 597.

[9] P. Bernus, L. Nemes, G. Schmidt (Editors) „Handbook on Enterprise Architecture", Springer, 2003.

[10] Ch. Braun, R. Winter "A Comprehensive Enterprise Architecture Metamodel and Its Implementation Using a Metamodeling Platform", In: Desel, J., Frank, U. (Eds.): Enterprise Modelling and Information Systems Architectures, Proc. of the Workshop in Klagenfurt, GI-Edition Lecture Notes (LNI), Klagenfurt, 24.10.2005, Gesellschaft für Informatik, Bonn, P-75, 2005, pp. 64-79.

[11] U. Frank, "Multi-Perspective Enterprise Modeling (MEMO) - Conceptual Framework and Modeling Languages", Proceedings of the Hawaii International Conference on System Sciences (HICSS-35), 2002, p. 3021ff.

[12] SALUS: Security and interoperability in next generation PPDR communication infrastructures. http://www.sec-salus.eu/