

Development of Enterprise Architecture of PPDR Organisations

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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) organizations need to cooperate, align their procedures and activities, share the needed information and be interoperable.*

The paper at hands provides an approach to tackle the above mentioned aspects by defining an Enterprise Architecture (EA) of the PPDR organization and based on this EA define the respective System Architectures. Based on a methodology which refines architectural artefacts of the OSSAF by using NAF views, a tooling for a lightweight architecture development model is presented.

Keywords: *Enterprise Architecture, 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. In [1] a methodology was presented, which based on the Open Safety & Security Architecture Framework (OSSAF) framework [2]

and provided the modeling vocabulary for describing a PPDR Enterprise Architecture.

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.

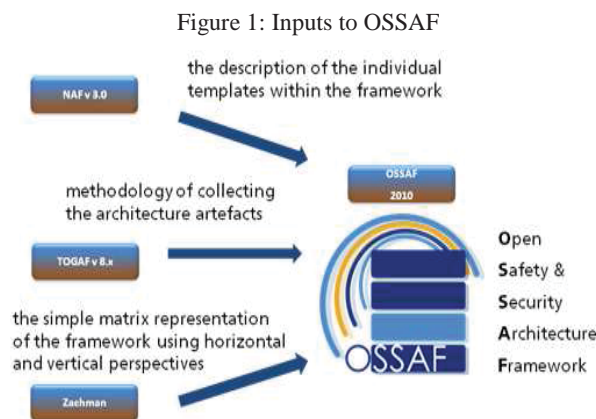
3 EA development approach

3.1 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) [3], the TOGAF framework and the NATO Architecture Framework (NAF) [5] (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.



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.

3.2 EA development methodology for PPDR organizations

The methodology proposed in [1] 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. In this context an enterprise is seen as a nonprofit-oriented organization or complex structures of organizations (inter-organizational aspect of enterprise definition) such as national PPDR organizations, for example national police or fire-fighter organizations.

To handle the task of developing an Enterprise Architecture for PPDR organizations, [1] used the approach of capability based planning. 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.”

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

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, [1] used NAF as the modeling vocabulary for describing the OSSAF perspectives and views where suitable.

Table 1 summarizes the general mapping of NAF views to OSSAF perspectives as defined in [1]. Each column represents a perspective defined by 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 the corresponding NAF-views are mentioned which are seen 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 several NAF views form the NAF Capability and Operational descriptions may be used. 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. For describing this OSSAF view the NAF Systems descriptions are proposed, especially the System Interface description (“NSV-1”), the Systems communications description (“NSV-2”) and the System to System matrix (“NSV-3”) view.

The NAF views are modeled with the different elements of the Unified Modeling Language (UML).

The proposed EA methodology is 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. However, in order to provide an effective usability of the methodology, it was necessary to provide a profile for assigning UML stereotypes and diagrams to the NAF views.

Table 1: Mapping of NAF templates to OSSAF views

| OSSAF Perspective | | | | | | | | |
|--|------------------------|--------------------|----------------------------|-------------------------------------|----------------------------|--|---------------------------|----------------------------|
| Strategic | | Operational | | Functional | | Technical | | |
| O S S A F V i e w s | 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 | | | | |
| | | | | | | | | |

3.3 Tailoring NAF views for PPDR Enterprise Architecture development

The section at hand provides a simplified overview on the core concepts and their relationships as defined in the meta-model of the NATO Architecture Framework (NAF) in order to be used for PPDR EA development.

Figure 2 provides an extract from the overall model used for the development of the PPDR EA. Especially the strategic and operational perspectives of the OSSAF model are depicted. However, for reasons of readability, not all relations, attributes, constraints, and cardinalities are shown.

The model shows that an Enterprise Vision specifies an Enterprise Goal and a Capability contributes to the Enterprise

Vision. A Capability is dependent on another Capability, decomposes into one or more other Capabilities and has one or more Assigned Properties. An operational Node has a Capability and conducts an Operational Activity. An operational Node has a need to exchange information with another operational Node, which is modeled via a Needline which bundles one or more Information Exchanges.

An operational Node is realized by a Resource, either by an Organizational Resource or by a Functional Resource. An Organizational Resource is responsible for an Operational Activity.

The Functional Resource Capability Configuration provides a specific Capability and is delivered via a Configuration Delivery action by a Project Milestone.

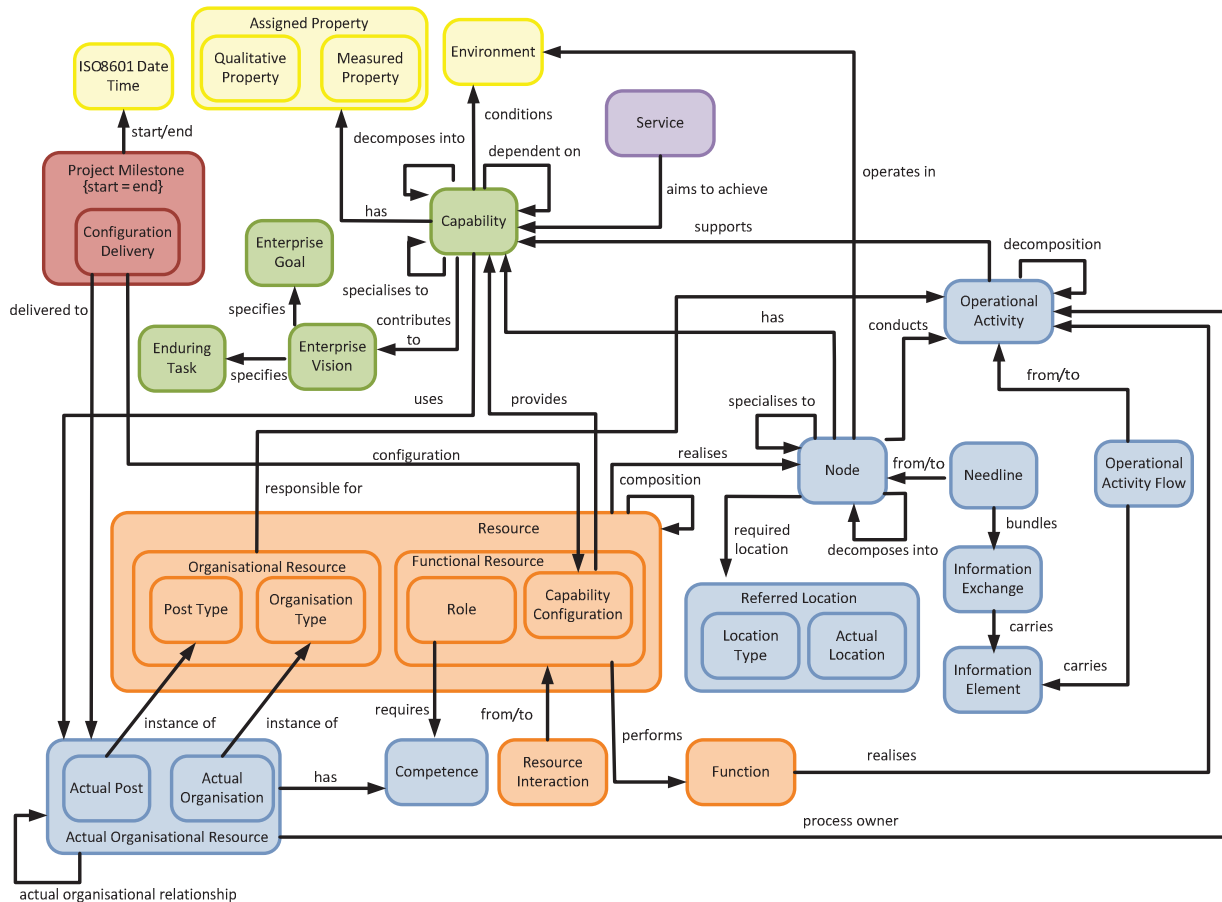
A similar extract from the overall model could be produced also for the Functional and Technical perspectives of OSSAF.

A detailed meta-model description as well as the description of the semantics of each concept and relationship can be found in [5]. It is not replicated here.

The complete profile was produced with the tool Enterprise Architect by SPARX Systems and is based on the MODAF Metamodel 1.2.004 [13].

The MODAF Metamodel was adapted to the needs of EA development for PPDR organizations and extended where needed. An example of such an extension is the multiple inheritance of the model element Node (UML Stereotype Node) from the UML elements “UML class” and “UML part”. This was done in order to re-use the same model element instance across different UML diagrams (e. g. class diagrams and composition diagrams).

Figure 2: NAF Model elements according to the strategic and operational scope



Views - Contents and Representation

According to the approach of describing OSSAF views via suitable NAF-views, the contents of the dedicated NAF-views used in designing the PPDR EA are described. The description contains the model elements captured in the corresponding view (that is actually a section of the overall model), proposes a suitable representation (i.e. graphical, textual etc.) and may give hints in order to support the development of the view under consideration. This is done in a way agnostic to any tool, but refers to UML modeling concepts where suitable.

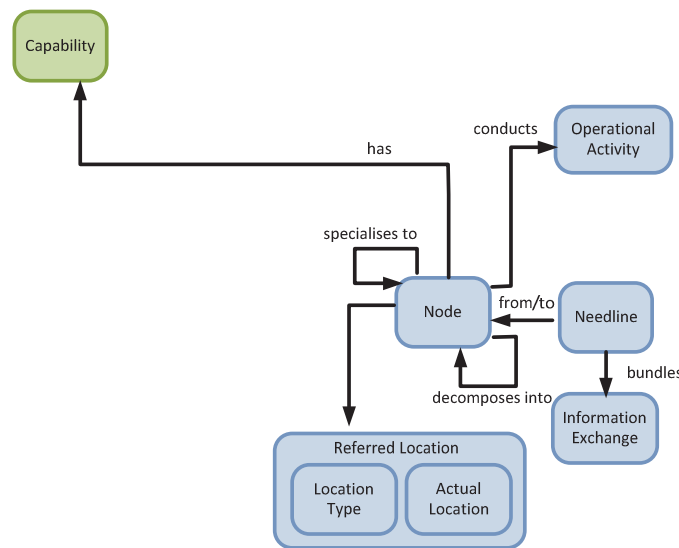
An example of such a description is provided below. It shows how the connectivity between operational nodes and their linkage to capabilities has to be described using the NAF view NOV-2, NATO Operational View, Operational Node Connectivity Description.

NOV-2, Operational Node Connectivity Description

Type of Representation: graphical; diagram which is based on the UML Composite Structure diagram enriched with textual annotations. Needlines describe information flows between nodes (see Hints)

Model elements to be considered: see Figure 3

Figure 3: NAF View NOV-2, Operational Node Connectivity Description



Hint: Node and Needline are recommended, the other elements are optional.

Hint: Depending on the complexity, there may exist several instances of a NOV-2 diagram/table, for example in order to represent nodes with different levels of abstraction (specialisations).

Hint: Exchanges can be annotated (textual) in order to show flows of materiel, energy, or people between nodes as these exchanges are not needlines and therefore do not appear in an NOV-3 view.

Hint: A single Needline represents one-to-many information exchanges (information elements and their attributes).

4 Conclusions and further work

An approach for developing Enterprise Architectures for PPDR organizations was presented. The approach is based on the OSSAF and NAF frameworks. The OSSAF perspectives are described using NAF views. The NAF views are modeled with the different elements of the Unified Modeling Language (UML). In order to provide an effective usability of the methodology, a tool support with a profile for assigning UML stereotypes and diagrams to the NAF views was created.

Based on the Enterprise Architecture, specific System Architectures may be derived.

The proposed EA methodology is 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.

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