DISASTER

Data Interoperability Solution At Stakeholders Emergency Reaction
285069

EMS Core Ontology - V1 (Technical Reference)

Lead Author: Emilio Rubiera Azcona (CTIC)
With contributions from: TREE

Reviewer: Frank Wilson (VRK)

Deliverable nature:	Report (R)
Dissemination level:	Public/PU
Contractual delivery date:	M12 (January 2013)
Actual delivery date:	January 24, 2013
Version:	0.1
Total number of pages:	28
Keywords:	owl, skos, ontology, rdf, dolce, dul, wai, w3c

Abstract

This technical report contains the reference manual of the ontology EMERGEL (Emergency Elements), developed for the DISASTER project. It is a companion document to EMERGEL OWL file, for which publication we give details in the following sections. It provides details about the publication of the ontology and the methodology carried out for the design. Also, it explains the vocabulary and provides documentation about the classes and the properties of both the core and the transversal modules. In addition, a description of the extensible design is also included.

This report is an ongoing document that will be improved or modified along the implementation of not only D3.21 (EMS Core Ontology V1), but also D3.22 (EMS Core Ontology V2), D3.31 and D3.32 (Transversal and vertical modules complementary to the EMS Core Ontology, V1 & V2), corresponding to month 6, 12, 18 and 24 respectively.

Executive summary

This document describes the EMERGEL ontology developed for the DISASTER project. It is a companion document to EMERGEL OWL file published at the moment at http://purl.org/emergel and hosted by CTIC in http://vocab.ctic.es. It provides details about the publication of the ontology and the methodology carried out for the design. Also, it explains the design decisions, ontological assumptions of the vocabulary and provides documentation about the classes and the properties of both the core and the transversal modules. In addition, a description of the extensible design is also included. This report is an ongoing document that will be improved or modified along the implementation of not only D3.21 (EMS Core Ontology V1), but also D3.22 (EMS Core Ontology V2), D3.31 and D3.32 (Transversal and vertical modules complementary to the EMS Core Ontology, V1 & V2), corresponding to month 6, 12, 18 and 24 respectively.

Document Information

Project Number	285069	**Acronym**	DISASTER
Full Title	Data Interoperability Solution At Stakeholders Emergency Reaction		
Project URL	http://disaster-fp7.eu/		
Document URL	http://disaster-fp7.eu/sites/default/files/D7.21.pdf		
EU Project Officer	Jana Paskajova		

Deliverable	**Number**	D3.21	**Title**	EMS Core Ontology - V1 (Technical Reference)
Work Package	**Number**	WP3	**Title**	Ontology Design and Development

Date of Delivery	**Contractual**	M12	**Actual**	M12
Status	Version 0.1		final □	
Nature	prototype □ report ■ demonstrator □ other □			
Dissemination level	public ■ restricted □			

Authors (Partner)	Emilio Rubiera (CTIC)			
Responsible Author	**Name**	Emilio Rubiera Azcona	**E-mail**	emilio.rubiera @fundacionctic.org
	Partner	CTIC	**Phone**	+34 984 29 12 12

Abstract	This technical report contains the reference manual of the ontology EMERGEL, developed for the DISASTER project. It is a companion document to EMERGEL OWL file, for which publication we give details in the following sections. It provides details about the publication of the ontology and the methodology carried out for the design. Also, it explains the vocabulary and provides documentation about the classes and the properties of both the core and the transversal modules. In addition, a description of the extensible design is also included. This report is an ongoing document that will be improved or modified along the implementation of not only D3.21 (EMS Core Ontology V1), but also D3.22 (EMS Core Ontology V2), D3.31 and D3.32 (Transversal and vertical modules complementary to the EMS Core Ontology, V1 & V2), corresponding to month 6, 12, 18 and 24 respectively.
Keywords	owl, skos, ontology, rdf, dolce, dul, wai, w3c

Version Log			
Issue Date	**Rev. No.**	**Author**	**Change**
January 11, 2013	0.1	Emilio Rubiera Azcona et al. (CTIC)	Final version to review

Table of Contents

List of Figures

List of Tables

Abbreviations

ADMS Asset Description Metadata Schema

CAP Common Alerting Protocol

DCAT Data Catalog Vocabulary

EDXL Emergency Data Exchange Language

EMERGEL Emergency Elements

GeoSPARQL Geographic SPARQL Protocol and RDF Query Language

GML Geography Markup Language

HTTP Hypertext Transfer Protocol

IETF Internet Engineering Task Force

IRI Internationalised Resource Identifier

ISA Interoperability Solutions for Public Administrations

KML Keyhole Markup Language

OGC Open Geospatial Consortium

OWL Web Ontology Language

PURL Persistent Uniform Resource Locators

RADion Repository Asset Distribution

RDF Resource Description Framework

SLD Styled Layer Descriptor

URI Uniform Resource Identifier

W3C World Wide Web Consortium

WFS Web Feature Service

WMS Web Map Service

XML eXtensible Markup Language

Chapter 1

Introduction

This technical report contains the reference manual of the ontology EMERGEL, developed for the DISASTER project. It is a companion document to EMERGEL OWL file, for which publication we give details in the following sections. It provides details about the publication of the ontology and the methodology carried out for the design. Also, it explains the vocabulary and provides documentation about the classes and the properties of both the core and the transversal modules. In addition, a description of the extensible design is also included.

This report is an ongoing document that will be improved or modified along the implementation of not only D3.21 (EMS Core Ontology V1), but also D3.22 (EMS Core Ontology V2), D3.31 and D3.32 (Transversal and vertical modules complementary to the EMS Core Ontology, V1 & V2), corresponding to month 6, 12, 18 and 24 respectively.

EMERGEL interprets a disaster as a kind of event. Events are susceptible to cause other events, and a simple landing operation of a plane can lead to a disaster like a airplane crash in an airport. Additionally, this accident may have direct and collateral consequences (like a fire, chained explosions, a chemical accident in a neighbour industrial facility, a full airport block, etc.) so it is important to semantically capture the causality chain between the diverse events. In addition, the proper spatio-temporal contextualisation of a disaster is crucial to ensure successful information exchange among stakeholders. EMERGEL provides means to temporally describe a crisis situation in RDF. This is a critical problem as information changes over time, and in particular, with respect to space.

1.1 EMERGEL publication

The publication of any ontology usually includes the reservation of an ontology namespace, i.e., the URI that identifies the ontology. It is also necessary to host the ontology files in a public repository and associate the URI with this hosting location. The official name of the ontology has been decided by the consortium to be EMERGEL (Emergency Elements). As for the first stage of the ontology, a namespace has been registered at PURL: `http://purl.org/emergel`. The ontology is hosted by CTIC in `http://vocab.ctic.es` and will be published according to W3C best practices.

A further option has been considered to publish the ontology. Initial contacts have been arranged with the W3C consortium, in particular with the Government Linked Data Working Group[1], to draw attention from the community. In this Working Group, there is also presence from the EU JoinUp[2] initiative, a platform caring about the standardisation of open vocabularies and models, and open source software within the European Union. The first reaction has been positive, although it may take some time to formalise the relationship and agree about the publication procedure of EMERGEL. The last task is to provide human-readable documentation of the ontology to facilitate its consultation and consumption by security experts. Best practices recommend ontologies to include valuable metadata information that helps identify the elements of the ontology that can be useful for potential users. In the last years, a number of ontology documentation tools leverage that metadata to offer visualisations of this information in the form of HTML pages or other multimedia formats to the final user. We use CTICs Parrot[3] online available tool to automatically generate the end-user documentation of the EMERGEL ontology.

1.2 Methodology

The methodology followed to model the EMERGEL ontology has involved an initial definition of semantic-coverage requirements, already done in D2.40[4]. This task is complemented with the identification of existing ontologies and non-ontological domain resources that partially cover an aspect of the ontology. As a design decision, the ontology is modularised, i.e., application of ontology engineering guidelines to divide and structure the knowledge domain in meaningful segments. This step will finally produce the DISASTER ontology, composed of a core (abstract, upper-level ontology including transversal modules: space-time representation) and vertical (associated with specific domains). The W3C OWL 2 ontology language has been selected to describe the DISASTER data model.

1.2.1 Competency questions

One of the ways to determine the scope of an ontology is to chalk out a list of questions that our ontology should be able to answer. Competency questions are targets for what your ontology should be able to cover, given sufficient facts (i.e. data) in our knowledgebase. These questions serve as a test and help us to find out if the ontology contains enough information. The answers assist the ontology experts to work out the requirements for the level of detail needed or the representation of a particular area. The competency questions are just rough drawings and do not need to be exhaustive.

To capture the requisites for the core ontology a number of competency questions was conceived during the first steps of the project. They were discussed in the consortium and included in Deliverable D2.40. The current initial version of the core module of the ontology is grounded in those questions, that cover a number of wide subjects as time, space, resources, agents, etc.

[1] www.w3.org/2011/gld/
[2] http://joinup.ec.europa.eu/page/about_us
[3] http://ontorule-project.eu/parrot/parrot
[4] http://disaster-fp7.eu/sites/default/files/D2.40.pdf

1.2.2 Vertical modules development methodology

Emergency-domains (i.e., vertical modules) are being formalised collaboratively between the ontology engineers (with strong experience in OWL-based modelling) and the domain experts of the project: ANT, AIM and DBI. There is a number of non-ontological resources at national and European levels that are of EMERGEL interest. For instance, regarding crisis data representation in a given cartography, there exist different symbologies used in the European landscape. These differences pose a hindrance to interoperability in both international cross-border cooperation and national coordination of stakeholders. EMERGEL aims to incorporate these in-use schemes (taxonomies, data catalogues, cartographic symbologies, and so forth) into a common representation format, i.e., RDF, to enable the specification of semantic equivalences to drive data translation processes between IT crisis management systems.

Some options are available to specify these mappings between knowledge resources, ranging from heuristic-based semiautomatic generation to manual definition by experts. The former is more of a research topic that might not guarantee accurate results. The latter is backed by the knowledge of an expert. Moreover, these manual alignments can be validated by the experts community. Given the strong domain knowledge in the DISASTER consortium, it is reasonable to design a manual methodology to successfully involve consortium security experts in the ontology development loop.

This methodology is a 3-step workflow, defined as following: Figure 1.1 shows a particular example of a translation between a Dutch map symbology and a German map symbology:

1. **Taxonomy creation and mapping specification**. The domain expert encodes original non-ontological resources and specifies correspondences between them in the form of a table that is specially formatted for further automatic processing.

2. **Automatic generation of SKOS taxonomies and RDF mappings (EMERGEL vertical modules)**. The taxonomies and classifications are automatically encoded in SKOS/OWL. The previous correspondences are automatically extracted from the table and converted to mappings defined in a technical format, i.e., SKOS vocabulary to taxonomies alignment.

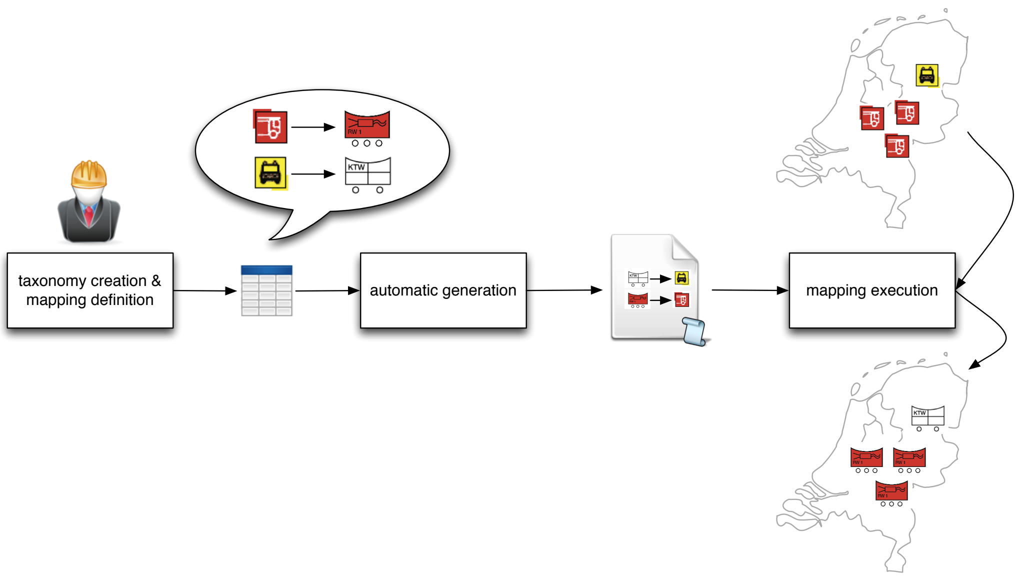
3. **Execution of mappings**. The mappings are available online as part of the EMERGEL ontology. They are used on demand by the mediation component (specified in D4.20) to perform a given data translation process.

These three steps are described in more detail in the following sections.

Taxonomy creation and equivalences specification

Despite the existing tools able to perform automatic generation of mappings, DISASTER approach is to exploit the domain knowledge of the consortium and formalise it as mappings, i.e., correspondences between two different in-use classifications or symbologies in the emergency field. The choice of tabular structures for representation of this knowledge has been made to lighten the burden of domain experts on this task, so they can focus on the work skipping their involvement in highly-technical IT knowledge management tools.

Figure 1.1: Processes involved in symbology translation applied to situational information maps for emergency responders



The initial structure of such spreadsheets has already been created so domain experts can start with the process. These spreadsheets are available as shared Google docs, so enhancing the collaboration between partners. Table 1.1 defines the content of each column.

Automatic generation of EMERGEL vertical modules

This process bridges the gap between the tabular format used to manually represent the classifications and the correspondences between them by the emergency-domain experts and the RDF-based final format. The choice of a tabular format is backed up by the broad support of translation tools available nowadays. As an example, the list gathered by csv2rdf4lod-automation team[5] has more than 50 tools identified (and this is not the only compilation available). Most of the tools that cover this conversion rely on some type of transformation language used to specify the format of the output file applied to each column of the table. This requirement suggests a small effort from our side to define what is the output format of choice for the mappings and formalise it on the tabular transformation tool language.

As an example, the following diagram exemplifies a final EMERGEL representation of a Fire Station using both the German and Dutch icon sets. Notice that apart from the iconographic divergence, the meaning is the same and symbols are interchangeable in a given spatial representation. EMERGEL recycles SKOS machinery to declare semantic equivalences (i.e., mappings). In this case, mapping is expressed by means of the `skos:exactMatch` property.

[5] `https://github.com/timrdf/csv2rdf4lod-automation/wiki/Alternative-Tabular-to-RDF-converters`

Table 1.1: Fields in the mapping definition table

Column	Contents
Concept name	The name of the concept. For instance, the ones: Ambulance, Truck, etc.
Concept ID	A code used to identify the concept in a given classification.
Description	A natural language text
Symbol URI	We are going to need a file with all the symbols compressed (all of them preferably in vector graphics). Each symbol should have a file name (with what in the future we expect to create URIs, but we are still thinking about that).
Label (German)	Alternative labels in German language for that concept. Understanding here labels as synonyms (i.e., a synset). Labels are separated with commas to easy their machine readability.
Label (Dutch)	Alternative labels in Dutch
Label (English)	Alternative labels in English
Label (Danish)	Alternative labels in Danish
Label (N language)...	Alternative labels in other language
Mappings (classification1)	A field to establish semantic equivalences between different symbologies
Mappings (classification 2)	Equivalences with another classification
Mappings (classification N)	Equivalences with another classification
Parent	This field enables capturing hierarchical relationships between concepts, for instance ambulance is a narrower concept than vehicles

EMERGEL mapping execution

The mappings between classifications are part of the EMERGEL specification, so publicly available. They provide added-value to the project as are part of the solution to resolve the heterogeneity and diversity of available schemes used within the emergency domain. These mappings will be used on-demand by the mediation component to perform data transformation processes, such as mediation between different national map symbologies. How the mappings are actually executed is covered in further detail in D4.20[6].

[6] http://disaster-fp7.eu/sites/default/files/D4.20.pdf

Chapter 2

EMERGEL upper-level design

EMERGEL uses some upper-level classes belonging to the DOLCE+DnS Ultralite (DUL) ontology. DUL is a simplification and an improvement of some parts of DOLCE Lite-Plus library[1] and of the Descriptions and Situations ontology[2]) that provides a set of upper level concepts that can be the basis for easier interoperability among many middle and lower level ontologies.

In this aspect, to model what is involved in an emergency situation, EMERGEL uses `dul:Event` and also `dul:PhysicalObject`, two classes belonging to DUL.

To model agents and roles, as it will be more specifically presented later, EMERGEL uses FOAF[3] and WAI[4]. FOAF is a vocabulary to describe people, the links between them and the things they create and doTo model people and groups EMERGEL reuses the FOAF classes `foaf:Person` and `foaf:Group`. WAI is a vocabulary aiming to extend the FOAF specification through introducing the concepts of roles and profiles. From WAI, EMERGEL takes `foaf:Role`, `foaf:Profile` and `foaf:Context`.

2.1 Disasters as events

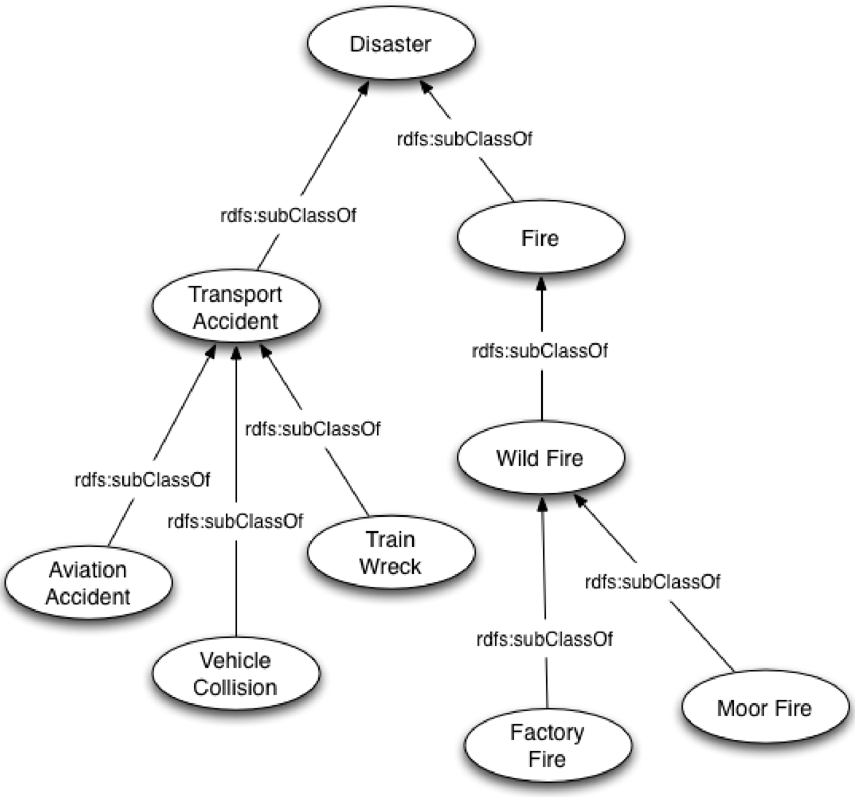
A disaster is defined as a natural, man-made or technological hazard resulting in an **event** of substantial extent causing significant physical damage or destruction, loss of life, drastic change to the environment or simply damage to property. It can affect and destroy the economic, social and cultural life of people. That kind of events stem from other events such as earthquakes, floods, catastrophic accidents, fires, or explosions. From a security point of view, disasters can be seen as the consequence of inappropriately managed risks, that are the product of a combination of both hazards and vulnerability.

EMERGEL thus interprets a disaster as a kind of event. Therefore, two upper-level classes are hierarchically introduced: `emergel:Disaster` as subclass of `dul:Event`. Furthermore, the ontology builds upon existing disaster classifications widely used in security domains, such as in-

[1] http://dolce.semanticweb.org
[2] http://www.ontologydesignpatterns.org/wiki/Ontology:DnS
[3] http://www.foaf-project.org/
[4] http://vocab.ctic.es/wai/wai.html

surance, freight transport and critical infrastructures (ports, airports, etc.), namely: NatCatSERVICE[5], more focused on natural disasters, and EM-DAT[6], more general. These classifications have been adapted and merged to fit the modelling requirements identified in the aforementioned competency questions (cf. D2.40).

Figure 2.1: Examples of emergency situations



`emergel:Disaster` has a number of subclasses dealing with wide specific emergency situations: `emergel:AviationAccident`, `emergel:ChemicalAccident`, `emergel:ComplexDisaster`, `emergel:MiscellaneousAccident`, `emergel:Fire`, etc. These are grouped thematically as shown in Figure 2.1. Note that we only present some of the classes in an illustrative way, the taxonomy is more complex and also can be completed, improvable or modified.

Events are susceptible to cause other events. A simple landing operation of a plane can lead to a disaster like a airplane crash in an airport. Additionally, this accident may have direct and collateral consequences as a fire, chained explosions, a chemical accident in a neighbour industrial facility, a full airport block, etc. To semantically capture the causality chain between the diverse events in a given disaster, the property `emergel:causes` (and a set of companion subproperties) has been added to the ontology.

[5] http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx

[6] http://www.emdat.be/database

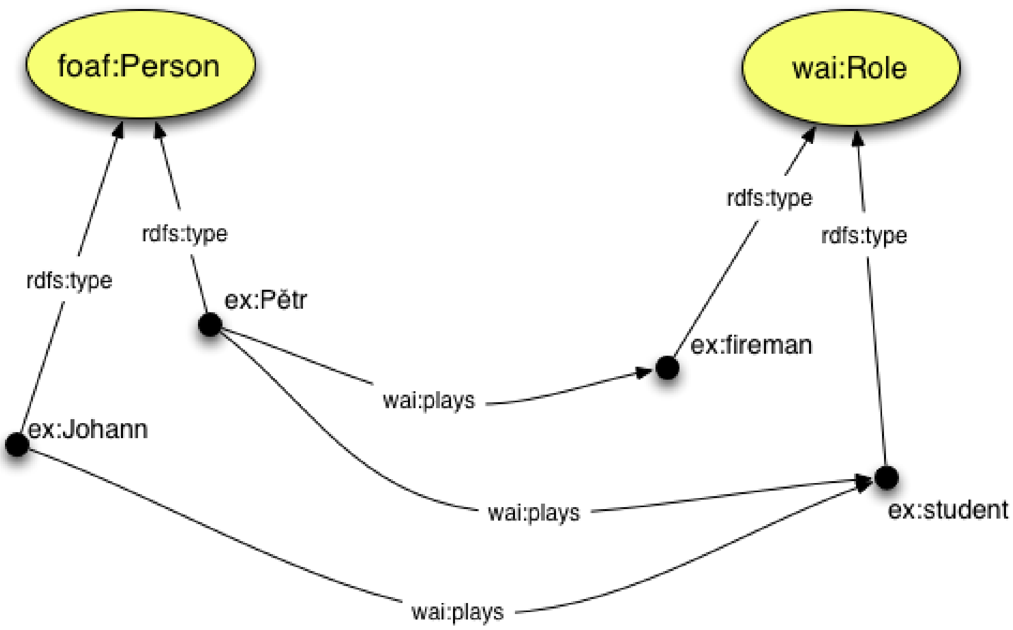
2.2 Agents, roles and profiles

Many agents (with different descriptive granularity and resolution) are involved in a crisis situation: from a rescue army brigade to the technical specifications of a fire truck. Agents are understood in a broad and generic way in order to cover beyond organisations, groups of people and individual profiles. Therefore equipment, affected buildings, casualties, etc. also fall into this agentive dimension of the ontology.

The different agents involved in an emergency situation are modelled in EMERGEL reusing the WAI[7] ontology, a vocabulary to describe roles and profiles. Using WAI we can smoothly be attach to a given person different roles and profiles: a person can be for instance a fireman or a victim depending of the context or the moment within the emergency situation.

WAI provides a class `wai:Role` and the corresponding property `wai:plays` to link up individuals and roles. This strategy was also applied by the DOLCE ontology, but with a general knowledge representation purpose. WAI instead is a specifically dedicated vocabulary to represent people and a given person can play more than one role, as shown in Figure 2.2, where a German Sorb called Pĕtr is both an engineer student and a voluntary firefighter.

Figure 2.2: People can play more than one role



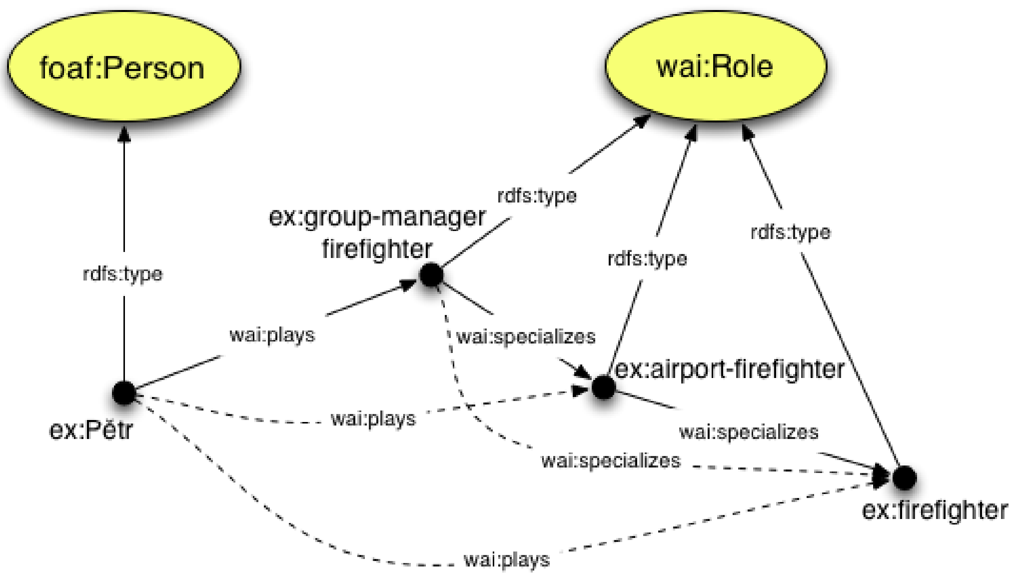
Roles can also be arranged in a hierarchy of entities in a similar way as ontology classes are organised via a subsumption relation. For instance, a fireman can be specialised into a fireman corporal, which is also specialised into a fireman corporal of Germany's fire brigade. However, roles are considered first-order individuals and therefore it is not possible to use OWL subclassification axioms. WAI introduces a primitive property `wai:specializes` able to capture these hierarchies

[7] http://vocab.ctic.es/wai/wai.html

of roles, so allowing more generic roles to be successively refined into more specific ones.

Profiles are entities capturing the dynamic and temporal aspects of roles. For instance, the full meaning of the sentence ”Pětr the fireman was a fire victim 3 hours ago” cannot be represented by a simple relation between Pětr and the role ”fireman” by means of the property `wai:specializes`. A temporal location of ”Pětr-as-victim” is needed. Profiles are introduced to cover this knowledge representation gap. Roles are not inherent to people, as they are not essential properties. Profiles (`wai:Profile` in the ontology) are a mechanism allowing to refer to people when they are actually playing a particular role, i.e. ”person-as-role”.

Figure 2.3: Hierarchies and inheritance of roles



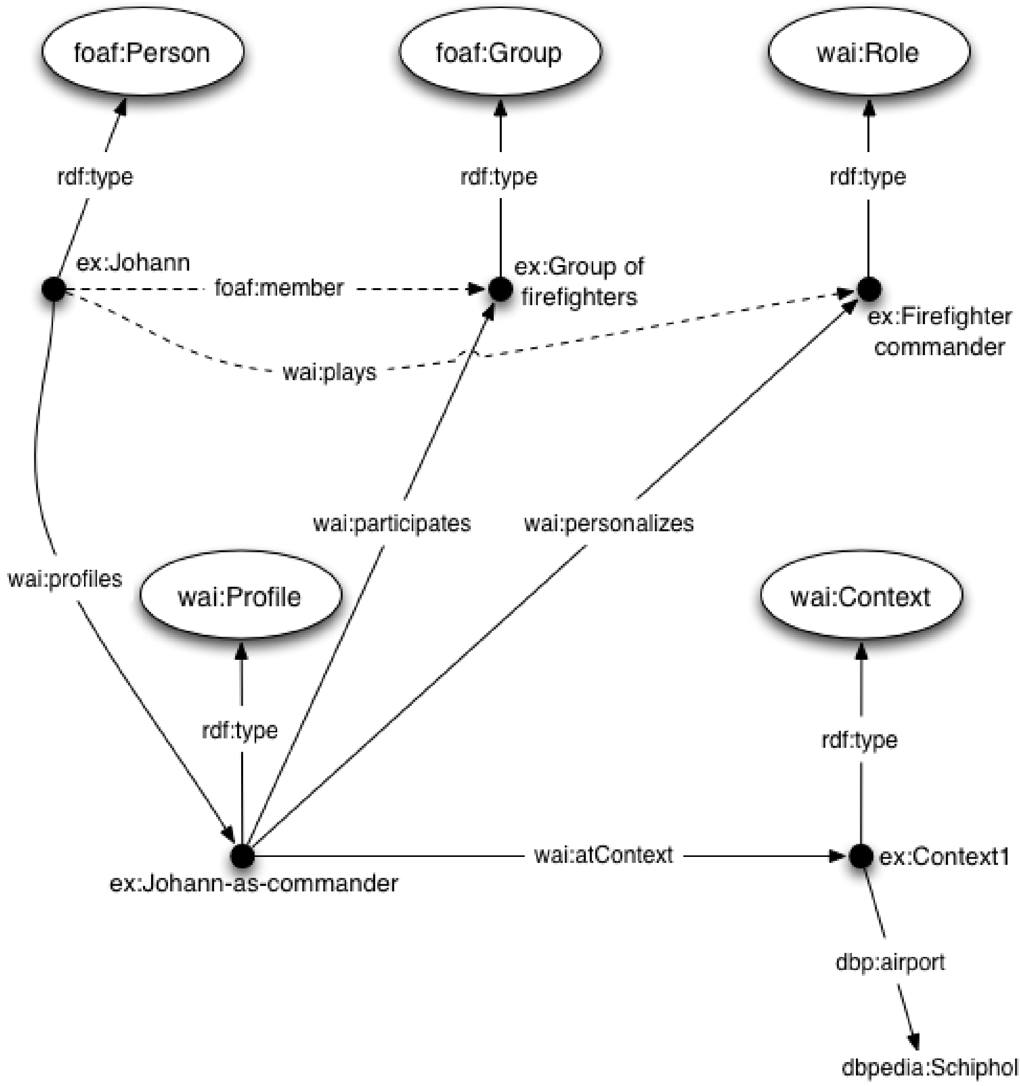
Profiles using WAI do not necessarily need to refer to a role. When contexts and groups are used to fix the interpretation coordinates of the profile, roles may be implicit. In this case, a profile is considered a ”person-at-context” or a ”person-in-group”, rather than ”person-as-role”. Nevertheless, none of the three are exclusive, but complementary. Figure 2.4 shows a WAI example where the firefighter ”Johann” is the operational leader of a group of firefighters in the given geographical context of a wildfire in the Schiphol airport.

2.3 Describing emergency situations

Apart from the events themselves and the agents participating, to properly describe emergency situations it is also mandatory to have an extensive account of physical objects involved. Under the umbrella of DUL’s superclass `wai:PhysicalObject`, EMERGEL includes buildings, facilities, and infrastructures affected, but also trucks, planes, equipment, tools, resources, etc.

In addition, time and space are the other crucial elements when describing that kind of situations. This is analysed in the following sections.

Figure 2.4: A person playing a role in a group at a given context



2.4 From geographical features to spatial geometries

Regarding spatial representation of an emergency situation, EMERGEL introduces a pristine ontological distinction between the involved conceptual layers: (1) features, (2) geometries, and (3) feature-types classifications related with cartographic visual representation (i.e., maps). This distinction eases the reconciliation between the geographical-feature description of emergency-entities and a pure geometrical representation of the space.

2.4.1 Core geographical model

A common modelling choice in geospatial science is a distinction between a Feature and a Geometry:

- A feature is an entity in the real world with some spatial extent, such as airports, monuments, hospitals, hotels, etc. A feature can have a spatial location that does not need to be precisely defined. Imagine, for instance, a lake, where a unique geographical point cannot determine its location.
- A geometry, on the other hand, is a geometric shape, such as a point, polygon or line. Geometries are used to capture a features spatial location. For instance, the Guggenheim Bilbao Museum is a geospatial feature (it is an entity with a specific location in the world), therefore it has an associated geometry that is a point with coordinates 43.268964, -2.934219 (in the WGS84 datum). The reader should note that geometries could be measured at varying resolutions, from a single point in the centre of a feature to a complex and precise measurement of a shape border.

In DISASTER, we assume that geographical information is captured by the NeoGeo Vocabulary, which provides the distinction between features and geometries by means of `spatial:Feature` and `geom:Geometry` classes. The property `geom:geometry` is used to reconcile both facets of the same geographical entity. URIs (implicitly) denoting a `geom:Geometry` might have any format based on HTTP content negotiation. NeoGeo recommends using MIME Media Type negotiation to provide access to different supported serialisations. In other words, when an HTTP request with the "Content-Type: application/vnd.google-earth.kml+xml" header field is sent, a KML representation of the feature should be received. In addition, the geographical entity is not forced to be typed as a `spatial:Feature`.

Finally, the visual aspect of maps is conformed by style guidelines. This is not a random decision, on the contrary, the styling of a map is aligned with final user visualisation requirements, i.e., the same geographic information often is presented with different styling according to the intended audience. Thus, styles usually conform to cartography style manuals or follow symbology standards to assure proper understanding. In this line, we can refer to maps as human-readable artifacts to visualise geospatial information. According to this, styles are the mechanisms to build these visualisations, selecting the properties of features that must be encoded in the map. There are different maps depending on the kind of the visualised information: geocharts, i.e., statistical data associated with spatial information presented as maps; political maps, i.e., maps that emphasise the division of territory according to governmental directives; or physical maps, i.e., maps that represent the properties of the terrain such as mountains, rivers or lakes.

The style assigns a number of visual properties to each feature. The nature of style is dual, as it assigns graphical representations to concepts. EMERGEL captures this double identity of styles by linking features to SKOS concepts, and then SKOS concepts with graphical representations. We associate a `neogeo:Feature` to a `skos:Concept` using the `dct:subject` property. Finally, concepts can be linked using the property `emergel:prefStyle` to specific `emergel:Style` instances, which are in charge of containing, or linked to, their graphical representation.

2.4.2 Classification and description of geographical objects

Every physical entity can be geographically located, so to be interpreted as spatial features. This means that current domain ontologies and vocabularies might be reused to describe features. Even if this is possible, it is not advisable from the point of view of a uniform treatment of the features. Domain ontologies and vocabularies diverge with respect to ontological assumptions and world interpretation. Moreover, besides semantic web approaches, there exist a lot of data models in the geospatial community that must be reused at some extent. Without a common structure to describe features, automatically translation is difficult and the different outputs do not guarantee compatibility. This poses a hindrance to geospatial data fusion and integration.

We propose SKOS[8] vocabulary as the underlying model to represent geospatial schemas, that are used to describe features. One of the positive effects is that we do not enter in conflict with the current description of the feature according to particular and domain ontologies.

2.4.3 Classifications and map symbols

Most of the geospatial classifications provide map symbols. These icons are used in data visualisation to understand the cartography of the map, i.e., what is the kind of feature present at a given location. Basically, each map icon represents a given type (or class) of feature. Map symbols are used from the origins of cartography and there exist a huge diversity of collections due to cultural and historical reasons. In Map symbols collections, some of them are identified and briefly presented.

Regarding SKOS and map symbols collections, the subjacent concepts and hierarchy are easily captured by this vocabulary. In case of the icons themselves, there used to be in previous versions of the SKOS specification properties to relate a given concept to some symbols expressing its same meaning by means of iconographic resources. These properties were skos:prefSymbol and `skos:altSymbol`. As they are no longer part of the vocabulary, we propose to extend SKOS with our own properties able to replicate the aim of the former.

2.5 What at when: a 4D approach

2.5.1 Introduction

A critical problem for representing a disaster (i.e., a crisis management situation) in RDF is dealing with information that changes over time, and in particular, with respect to space. For instance, the

[8] http://www.w3.org/2004/02/skos/

damaged surface in a forest fire is not the same at the beginning of the conflagration than two days after. During this time interval, many squared kilometers may have been affected. How to reflect these changes in a proper and understandable representation is the aim of this introduction.

We can summarise the problem as how do we logically account for the fact that ”same” entity appears to be ”different” at different times [Welty[9]]. In an endurantist perspective, such as the DOLCE approach, a distinction is made between endurants and perdurants. The former relate to entities that are three-dimensional, and persist through time, i.e., are always present. Physical objects, like people, buildings and animals, are typical samples of endurants. On the other hand, perdurants have temporal parts that exist during the times the entity exists.

Our approach is based on a 4D (four dimensionalism) view of the reality, sometimes called a perdurantist perspective. The basic idea is that everything in the reality, on an a universal and microscopic scale, is an event: from the birth of a newborn baby to a chair in a room. The prescription that so-called endurants are somehow different is product of our interpretation and perspective on time and space. Therefore, all entities have temporal parts and can be thought as four dimensional ”spacetime worms”. The temporal parts are the slices of the worm. There are two OWL-based initiatives in the state of the art that follow this four dimensionalism approach: the 4D Fluents ontology and the temporal extension to the OWL language tOWL.

2.5.2 Proposed formalisation

Our formalisation relies on these previous works, but putting the focus on the representation (and exchange) of data describing a crisis management situation.

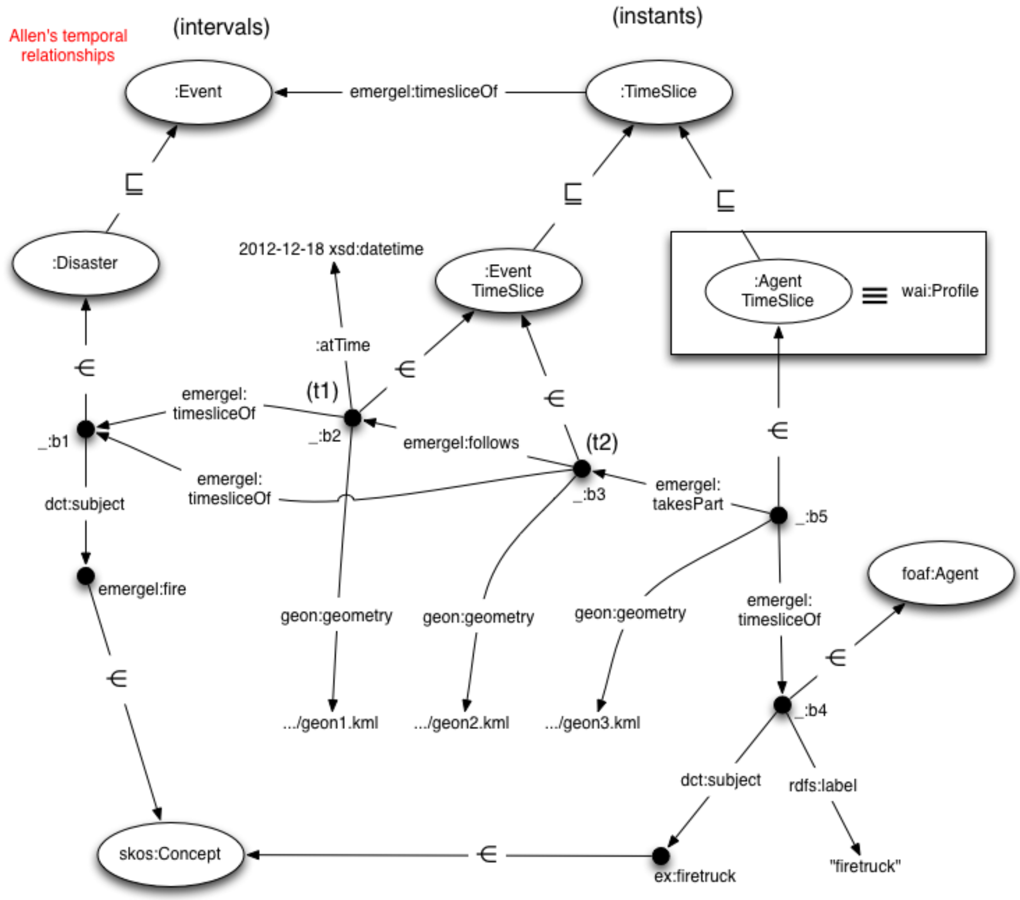
- The first step is to provide our ontology with a clear interpretation of time. To this end, a temporal infrastructure should be supplied. There are two alternatives: representing time in the form of instants and/or intervals. From our point of view, an instant-based model is preferable as they provide snapshots of a situation at a given moment. In other words, we have mindful vision of an event without considering evolution in time. This is important in order to guarantee interoperability between information systems and to come up with easily-translatable visualisations.

- However, interval-based interpretation of time does not disappear, but it is implicit in the 4D approach of the ontology, as every entity is a composition of successive temporal parts. We restrictively introduce the class `dul:Event` in the ontology, as a generic and broader concept meaning ”something that happens” and ”the occurrence of a process or a phenomenon”. Events are inherently time intervals, and so they can relate each other by means of the Allen’s temporal algebra. For instance, ”the fire started before the explosion in the factory”. Notice that even if a 4D approach is considered, Allen’s relationships only apply to what is usually understood as events in natural language.

  The ontology introduces timeslices and fluents to provide the diachronic perspective of time. Timeslices represent the temporal parts of a specic entity at given snapshots in time (i.e., instants). Fluents are properties that hold at a specic moment in time, or at a specic interval in time. In other words, uents and timeslices represent a vocabulary to capture temporal

[9] http://www.comp.leeds.ac.uk/brandon/FOIS-06/CRC/Part-5/20_fois06.pdf

Figure 2.5: First draft of time representation in EMERGEL



parts of individuals that change some property in time. You can understand a timeslice of ”an event x in time y” as an entity, which a temporal part of x that occurs in y. This entity can be name eventx@timey, which syntax does not have any semantic implication.

One of the drawbacks of this approach is the proliferation of objects in the ontology due to the creation of two timeslices each time something is changing, which, in turn, must be associated to the static individuals they represent and linked to each other by a fluent.

Chapter 3

EMERGEL vertical modules

EMERGEL has been designed to aligned with some upper-level government-ground vocabularies designed by the W3C consortium and the European JoinUP platform[1]. These vocabularies play two roles with respect to EMERGEL. On the one hand, they allow EMERGEL to incorporate into a general description framework of standardise vocabularies at the European (even international) level. On the other hand, their top-level structure enables domain-specific classifications and vocabularies (vertical modules) to be connected and integrated in the single semantic space of EMERGEL.

3.1 EMERGEL connected to semantic assets

Despite of their importance, standards are not easily discoverable on the web via search engines because metadata about them is rarely available. Navigating on the websites of the different publishers of standards is usually not productive either. That is why EMERGEL with the help of some upper-level government-ground standard vocabularies tries to make sense of the complex multi-publisher environment around standards and in particular the ones which are semantic assets such as ontologies, data models, data dictionaries, code lists, XML and RDF schemas.

A semantic asset is a specific sort of standard which imbroils highly reusable metadata and/or reference data. Typically companies and organisations use semantic assets to share information and knowledge (within themselves and with others). Semantic assets are usually very valuable and reusable elements for the development of Information Systems, in particular, as part of machine-to-machine interfaces. As enablers to interoperable information exchange, semantic assets are usually created, published and maintained by standardisation bodies. Nonetheless, ICT projects and groups of experts also create such assets. There are therefore many publishers of semantic assets with different degrees of formalism.

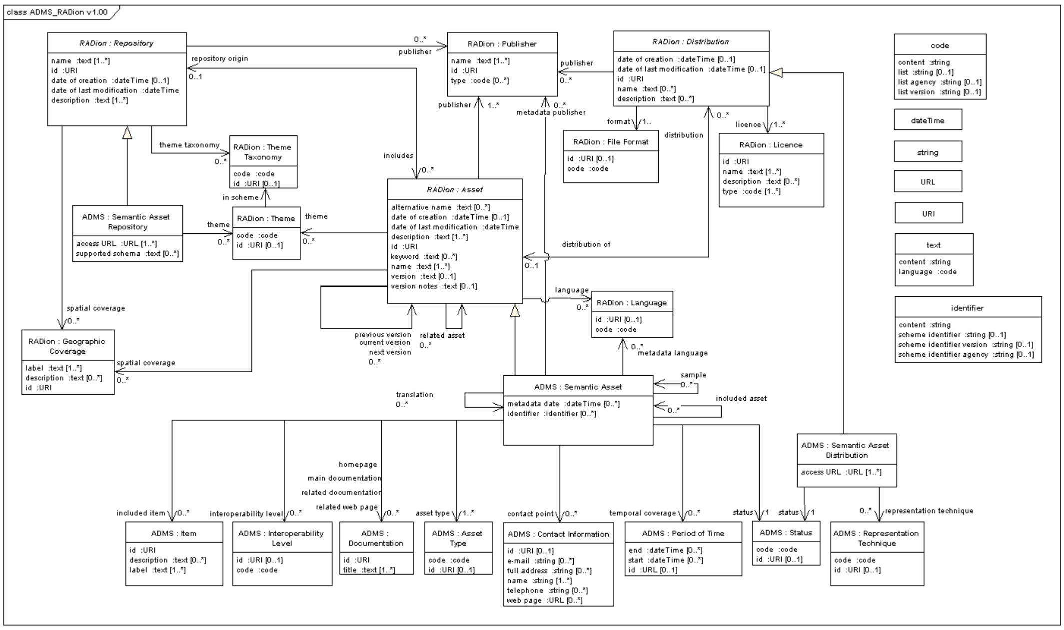
[1] https://joinup.ec.europa.eu/

ADMS and adjacent pillars

ADMS[2] is an OWL standardised metadata vocabulary created by the EU's Interoperability Solutions for European Public Administrations (ISA) Programme[3] of the European Commission to describe semantic assets, their repositories and this way help publishers of standards document what their standards are about (their name, their status, theme, version, etc) and where they can be found on the Web. ADMS descriptions can then be published on different websites while the standard itself remains on the website of its publisher (i.e. syndication of content).

ADMS embraces the multi-publisher environment and, at the same time, it provides the means for the creation of aggregated catalogues of standards and single points of access to them based on ADMS descriptions. The Commission is supposed to offer a single point of access to standards described using ADMS via its collaborative platform, Joinup. The Federation[4] service increase the visibility of standards described with ADMS on the web. This also tries to stimulate their reuse by Pan-European initiatives. In addition to ADMS, another couple of vocabularies mut be taken

Figure 3.1: UML Model of ADMS

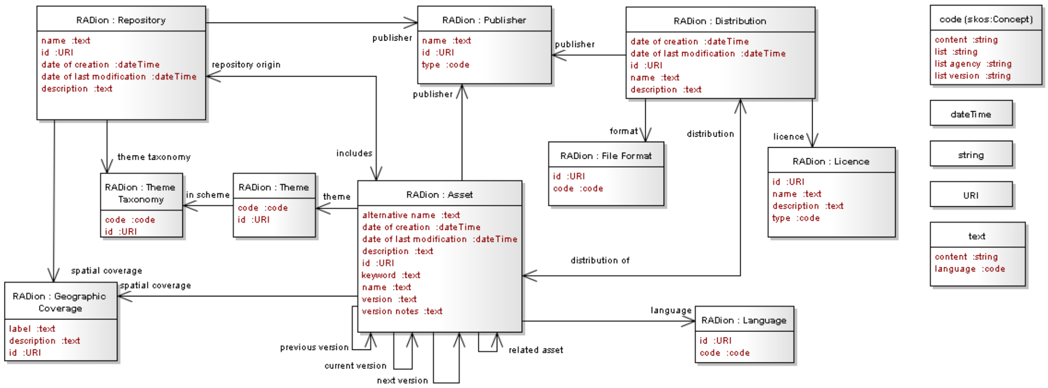


into account with respect to the fitting of EMERGEL vertical modules. As shown in Figure 3.1, ADMS builds upon RADion (Repository Asset Distribution)[5], a high-level vocabulary intended to facilitate the federation and co-operation of semantic assets repositories. It aims to act as a common layer among repositories that want to exchange data. Because the key class names in this model are Repository, Asset and Distribution, the model got the name RADion. This is shown in Figure 3.2. RADion was also developed under the European Commission's ISA Programme.

Finally, the third leg of this upper-level government-ground vocabularies is DCAT (Data Catalog

[2] http://joinup.ec.europa.eu/asset/adms/home
[3] http://ec.europa.eu/isa/
[4] https://joinup.ec.europa.eu/elibrary/document/adms-enabled-federation-semantic-asset-repositories-bro
[5] http://www.w3.org/ns/radion

Figure 3.2: RADion UML Class Diagram



Vocabulary)[6], an RDF Schema vocabulary for metadata about structured data resources, such as datasets or catalogs. By using DCAT to describe datasets in data catalogs, publishers increase discoverability and enable applications easily to consume metadata from multiple catalogs. It further enables decentralised publishing of catalogs and facilitates federated dataset search across sites. Figure 3.3 illustrates how DCAT easily connects with some of the SKOS classes used by EMERGEL, and the class `skos:ConceptScheme` is the suitable anchor to link EMERGEL with `adms:ConceptScheme` and `radion:Asset` providing that way a vertical modularity.

Future work

Further steps in this line will be worked out to fully incorporate EMERGEL to the framework of these vocabularies. As mentioned in section 1.1, initial contacts have been made with the Government Linked Data Working Group[7] to negotiate the publication of EMERGEL within W3C's hosting. This demands a fully compliance with the JoinUp platform principles, and some other pertinent vocabulary anchors from EMERGEL to these vocabularies must be defined.

It is worth noticing that EMERGEL embracing of these initiatives permits it to be a consortium-open product, leaving the door open and welcoming future third-party extensions and contributions.

[6] `http://www.w3.org/TR/vocab-dcat/`
[7] `www.w3.org/2011/gld/`

Figure 3.3: Example providing a quick overview of how dcat might be used to represent a government catalog and its datasets