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Plan for standardisation for large scale experimentation

WP 600

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FUTURE INTERNET PPP

SEVENTH FRAMEWORK PROGRAMME

Smart Agri-Food

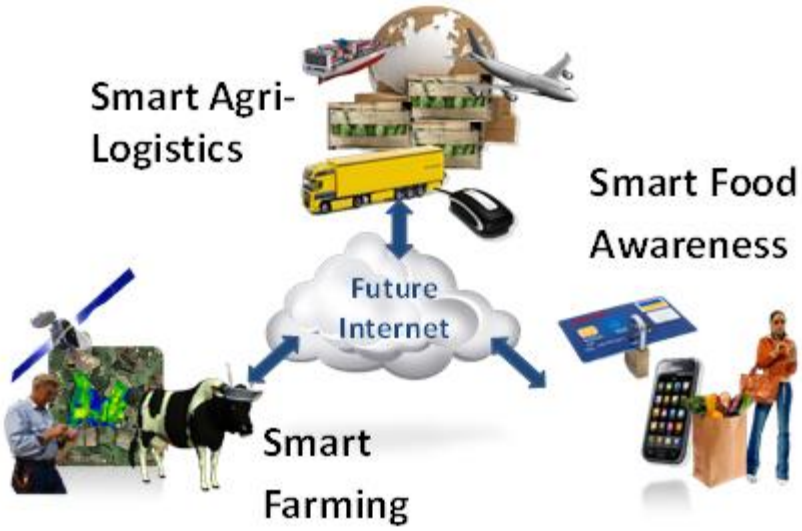
The SmartAgriFood Project

The SmartAgriFood project is funded in the scope of the Future Internet Public Private Partnership Programme (FI-PPP), as part of the 7th Framework Programme of the European Commission. The key objective is to elaborate requirements that shall be fulfilled by a "Future Internet" to drastically improve the production and delivery of safe & healthy food.

Project Summary

SmartAgriFood aims to boost application & use of Future Internet ICTs in agri-food sector by:

- Identifying and describing technical, functional and non-functional Future Internet specifications for experimentation in smart agri-food production as a whole system and in particular for smart farming, smart agri-logistics & smart food awareness,
- Identifying and developing smart agri-food-specific capabilities and conceptual prototypes, demonstrating critical technological solutions including the feasibility to further develop them in large scale experimentation and validation,
- Identifying and describing existing experimentation structures and start user community building, resulting in an implementation plan for the next phase in the framework of the FI PPP programme.



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Dissemination Level

PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Change History

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Document Summary

This document summarizes the work done for task T620 of the SmartAgriFood. All efforts towards a knowledge based agri-food industry rely on a certain level of standardisation. This document summarizes known standardisation activities that are relevant for the agri-food sector and therefore within the SmartAgriFood project. A list of known relevant standards is provided. Organisations which are active in domain specific standardisation activities are described. This document covers the results of all work packages including all pilots. In the project, existing domain-specific standards are used wherever possible. Existing gaps and overlaps in the standardisation are identified and recommendations for corrective measures are made. Finally, this document provides an action plan for standardisation activities which have to be performed during Phase 2 of the Future Internet Public Private Partnership.

Abbreviations

AEF	Agricultural Electronics Foundation
D	Deliverable
EC	European Commission
EFSA	European Food Safety Authority
EPC	Electronic Product Code
FI-PPP	Future Internet Public Private Partnership
GE	Generic Enabler
GLN	Global Location Number
GML	Geography Markup Language
GPC	Global Product Classification
GTIN	Global Trade Item Numbe
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Taskforce
ISO	International Organization for Standardisation
NGO	Non-governmental organization
OASIS	Organization for the Advancement of Structured Information Standards
RDF	Resource Description Framework
RFC	Request for Comments
RFID	Radio Frequency Identification
TBG	Trade and Business Groups
TC	Technical Committees
UN/CEFACT	United Nations Centre for TradeFacilitation and Electronic Business
UNECE	United Nations Economic Commission for Europe
UUID	Universally Unique Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
W3C	World Wide Web Consortium
XML	Extensible Markup Language

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1 Introduction

1.1 Motivation for standardisation

The agri-food sector can be described as a system of distributed networks with a large number of actors with heterogeneous interests and from different backgrounds. Analysis of statistical data in previous research work has shown that small and medium sized enterprises are prevalent in certain parts of the food chain, whereas in others large, global companies play a major role. Surveys conducted among farm management system- and tracking and tracing system providers showed that a large set of different technical tools and programming methods is in use leading to a heterogeneous landscape of systems [1]. Within this setting, however, seamless data exchange is of crucial importance for communication purposes between chain actors and control of processes within the sector to ensure efficient and sustainable production as well as food safety and security.

One of the major issues and goals within any multi-stakeholder ICT initiative in the agri-food sector therefore often is achieving interoperability at different levels. According to the Institute of Electrical and Electronics Engineers (IEEE) Standard Computer Dictionary [2], interoperability is the ability of two or more systems or components to exchange information and to use the information that has been exchanged. Although it is limited to a tractable set of applications and stakeholders within projects, interoperability can be achieved on a basis of bilateral agreements, the only way to enable uptake and implementation on a broader scale is standardisation of interfaces and data structures.

Interoperability is a basic requirement for electronic communication between systems. An optimum in support of user's processes often has stronger demands leading up to integration i.e. linking or packaging up interoperable components (systems) and data to act as a coordinated whole and satisfy an intended purpose [3, 4]. Wolfert et al. [5] described data integration as the alignment of data definitions in order to be able to share data, and the provision of technical infrastructure to enable communication between hardware components (connectivity). Based on this description and the integration framework developed by Giachetti [6], data integration can be considered at different levels: inter-enterprise and intra-enterprise level (Figure 1). The different integration types are interdependent in two ways:

1. Conditional (solid arrowed lines in Figure 1): to share data and couple applications, the physical infrastructure must be connected; to integrate applications, there must be common data definitions; for effective process coordination it must be possible to share data or to integrate applications.
2. Requiring (dotted arrowed lines in Figure 1): a starting point is the need for integrated processes which defines the requirements for data exchange and application integration; application integration implies specific requirements for data to be exchanged; data exchange and application integration both require a supporting technical infrastructure.

Integration can be divided in the four levels:

- Physical: interoperability of devices/sensors, collaborative infrastructure, broadband internet
- Data: integration of data standards, alignment of data definitions and data dictionaries, data quality and security
- Applications: choice for open standards, adoption of open web services;

- Process: business process modelling as new skill, process approach picked up in new areas

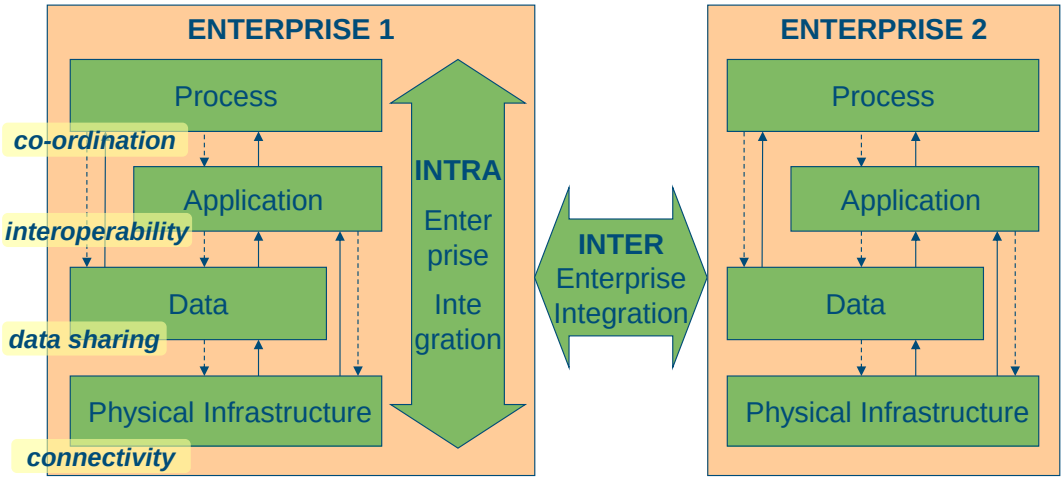

Figure 1: Integration Framework according to Giacchetti [6], adapted.

At each of these levels, standardisation serves as an important means for integration, especially, if components are to be provided by different stakeholders as can be the case in cloud services or architectures based on CAAS (Component-as-a-Service). For the analysis conducted within this document, the approach mainly focused on the Application and Data level. Section 1.2 elaborates on the scheme that is used for this. Additional benefits of standardisation arise in backwards compatibility and comparability of data from older data sets or legacy systems, if standards are published as open standards. All efforts towards a knowledge-based agri-food industry therefore rely on a certain level of standardisation.

1.2 Scope and theoretical framework of this document

This document summarizes the work done for task T620 ‘Standardisation Planning’ of the SmartAgriFood project. For each sub-use case, the standardisation needs are derived and analysed including standardisation organisations that are involved. The results are matched with feedback that comes from the collaboration with the core platform. From this result, a plan for standardisation is developed.

The goal of this document is to give a plan for future work on standards to allow for facilitated uptake of work done within the SmartAgriFood project and to derive activities for phase 2 of the FI-PPP programme. To achieve this goal, it is necessary to get a picture of the state of the art, available specifications and standardisation activities. This document therefore summarizes known standardisation activities that are relevant for the agri-food sector, classified for each sub-use case of the SmartAgriFood project. It covers the results of all work packages including all pilots. In the project, existing domain-specific standards are used wherever possible. Existing gaps and overlaps in the standardisation are identified and corrective measures are proposed.

In this context, a standard is a technical specification that is worked out by a group of independent entities with similar requirements and typically approved by an authorized organisation. Standards that are specific for the agri-food sector including the production level up to the retailer are considered (“from farm to fork”).

The term “standard” has to be distinguished from “Generic Enabler”. The term Generic Enabler (GE) refers to a technology which is developed within the Future Internet project, whereas a standard exists outside the framework of this project. The GEs might use existing generic

standards such as data formats, protocols etc. The need for further generic standardisation which might become necessary in the development process of the GEs is not discussed here. Focus here is rather on the domain-specific subsystems.

The pilot implementations used generic standards and proven technologies wherever feasible. These generic and widely used technologies are not described in this document, as knowledge on them is easily accessible and widespread. Detailed descriptions can be obtained from other sources like e. g. the respective Internet Engineering Taskforce (IETF) RFCs. However, due to the special needs of the domain, gaps might be identified with regard to functionality commonly covered by generic standards.

Puschmann and Alt [7] categorize four types of integration (cf. Wolfert et al., [5]):

- Communication Standards (technical infrastructure)
- Data Integration (syntax)
- Object Integration (semantics)
- Process Integration (pragmatics)

These four concepts can also serve as a basic draft of a layered system concerning communication and standards. With regard to the technical infrastructures, within context of the agri-food system, two core concepts play a major role and thus have to be differentiated: identification and protocols

Identification is a crucial part of an information infrastructure, as it connects the real world with the virtual one. It is a means to build up the relationships between real world object space and information space offering additional information e.g. on a certain food item, package etc. It provides the ability to relate data to each other in order to derive information. Identification serves as a key mechanism to interrelate data in distributed networks. A common mechanism and agreement on how to build identifiers – a standard – is required to ensure unique and unambiguous identification of objects within the agri-food service network. Therefore, special attention is paid within this deliverable to sketch existing standards and systems for identification used within the domain. Identification is here used as a broader term for more detailed aspects such as coding, naming, labelling and addressing. The descriptions and references should give enough information as to which aspect is actually covered in a certain standard.

The *protocol* layer within the technical infrastructure provides generic data searching, querying and updating mechanisms, building upon identification systems to address information. Common syntaxes are necessary on the level of data integration to allow for information to be encoded and decoded at the other end. As will be shown in Chapter 2, there are domain-specific protocols and syntax standards available. It was also found that most of the functionality needed can be covered by already existing, more generic standards.

Semantics refers to the meaning of data. Meaning can be conveyed through a number of ways, the simplest being human readable descriptions of data items. A number of standards that were analysed, limit their communication of semantics to that level. While this approach may be suitable to bilateral agreements or standardisation within a manageable group of stakeholders it comes quickly to its limits when it comes to large-scale communication needs or involving several groups of stakeholders with different roles within a network. Inter-standards communication is currently very poor but nevertheless needed within the agri-food sector. Formalized, machine-readable descriptions of semantics have a potential to facilitate that process. Therefore special attention was paid to existing controlled vocabularies, thesauri and ontologies that could form a basis to build semantically interoperable systems.

Process integration is a very difficult step with regard to standardisation. Standardising processes commonly leads to a very rigid framework that leaves little to no room to optimization

and innovation. Process standardisation within a large scale multi-stakeholder network is in most cases only successful if there are strong political drivers such as mandatory regulations. Standards on that level are commonly not oriented on technology but rather on work flows. They are therefore not covered in this document.

The document focuses on standards for data and information, such as the identification and coding of products, logistic messages, and technical communication. Therefore, also the following types of standards are not considered here:

- Product standards, e.g. *Codex Alimentarius* or standards on food properties (e. g. size classes in eggs and fruit)
- Regulatory and certification based standards, e.g. organic food
- Quality standards, such as quality management standards like e. g. ISO 9001 etc.

The adherence to such a standard might be included as a signal e.g. in a product label as a part of the product data backpack. Given proper use of existing information technology standards, it can safely be assumed that any requirement arising from process, quality and product standards can be covered on the information technology side and necessary data sets can be represented.

1.3 Structure and Methodology

Chapter 2 provides a collection of standards on national, European and global level. All standards are described according to a pre-defined template. Also, there has been strong interaction with the agriXchange[1] project on that topic and previous work of partners in other projects has been taken into account.

Chapter 3 gives an overview of standardisation bodies. Their relevance with regard to the agri-food sector is discussed and existing relations are outlined. This serves as a basis of whom to address within further activities.

In Chapter 0, the sub use cases are analysed. Interfaces and data structures for which standards are needed are identified, the needs are compared with the relevant existing standards, and the demand is formulated. This chapter concentrates on summarising the results of the pilot descriptions as given in deliverable D200.3, D300.3 and D400.3 and gives relations to the core platform.

Challenges and opportunities are outlined in Chapter 5. These are derived from information that was provided in the preceding chapters.

Recommendations are given in Chapter 0, focusing on a high level strategic view designed to overcome barriers and trying to leverage chances that were identified in Chapters 4 and 5.

Finally Chapter 7 gives a concrete action plan for standardisation for phase 2, focussing on next steps and tasks that are specifically relevant for the large scale experimentation of the SmartAgriFood pilots.

[1] www.agriXchange.eu

2 Existing standards used in the agri-food chain.

This chapter gives a list of standards that are relevant to the agri-food sector. They are described in further detail according to a template initially drafted in previous work and developed further by SmartAgriFood project partners and adjusted according to the needs of this project. The list is in alphabetic order, except for the standards provided by GS1 which are described in 2.35.

The fields used within the template and their meaning are:

- Name of standard
- Source (issuing organisation). In some cases, standards are officially approved by a well-known standardisation organization such as ISO or W3C, but development is carried out within another initiative more intensively. In this case, the latter is mentioned preferably where known, as this will commonly be a more efficient channel to introduce SmartAgriFood results and proposals into the respective standards.
- URL: Internet address where the standard and/or additional information is obtainable
- Sector: Classification of scope of standards according to the three SmartAgriFood sub-use cases (Smart Farming, Smart Agri-Logistics, Smart Food Awareness)
- Level: Standards are classified as referring to “Identification”, “Syntax”, “Semantics”, “Protocol” or “Metadata”. This classification system is focused on agri-food/agri-logistics needs. It splits between methods of data exchange (the protocol) and data formats. On the format side, it differentiates between syntax and semantics (structure vs. content, see also section 1.2).
- Description: Short description of standards, mostly citing information given by the issuing organisation.
- Regional Scope: indicates if scope of standard is international, or currently restricted to a certain country or a certain region.
- Language: natural languages in which description of the standard is available
- Example data set: an example data set exemplifies the format of the data, if available and feasible.
- Status (proposed, in use, etc.): indicates the state of development or use of a standard.
- Licence: refers to the availability of a standard and restrictions for its use.
- Participation: refers to the possibility for stakeholders to participate in the development of a standard. This field might be empty, meaning that this information was not available when compiling the list
- References: sources of cited information indicating where further information can be found. The references are numbered separately for each standard description.

Table 1 lists the standards and their relevance to a specific sub-use case.

Table 1 Overview of the standards that are described in this chapter and their relevance for each sub-use case

Standard	SmartFarming	SmartAgri-Logistics	SmartFood-Awareness	Chapter
ADIS-ADED	X			2.1
AGMES	X			2.2
AgroVoc	X			2.3
agroXML	X			2.4
Animal Identification	X			2.5
CPVO	X			2.6

DAPLOS	X			2.7
ebXML		X		2.8
eCert		X		2.9
Edibulb		X		2.10
EDIFACT		X		2.11
EFSA		X	X	2.12
eLab	X	X		2.13
Florecom		X		2.14
Frug I Com		X		2.15
GIEA	X			2.16
GML	X			2.17
HI-tier	X			2.18
IACS	X			2.19
INSPIRE	X			2.20
ISO 21067:2007		X		2.21
ISO 7563:1998		X	X	2.22
ISOagriNET	X			2.23
ISOBUS	X			2.24
LanguaL		X	X	2.25
Observations and Measurements	X	X		2.26
PLU Codes			X	2.27
SANDRE	X			2.28
SensorML	X	X		2.29
SSN	X	X		2.30
UNECE		X		2.31
UNSPSC		X		2.32
VBN Code		X		2.33
WCO Data Model		X		2.34
GS1 Standards		X	X	2.35

The information that is provided in this document is reflects the current situation as known to project partners. Standards continue to evolve and, while implementing pilots in more detail, additional requirements may turn up that lead to additional standards becoming relevant. Therefore, this collection does not claim for completeness. In a few cases, no complete description on a standard was available to the general public. Some fields of the template had to remain empty because information was unknown at the time writing this document. If necessary during further work, the collection can be extended. A possible place to do that is the agriXchange platform (http://www.agrixchange.eu), also providing references of standards usage within interfaces and use cases.

2.1 ADIS-ADED

2.1.1 Name of standard:

ADIS Data interchange syntax (ISO 11787)

ADED Agricultural data element dictionary (ISO 11788-1)

2.1.2 Source (issuing organisation):

Landeskontrollverband Nordrhein-Westfalen e.V. (http://www.lkv-wl.de/index.php?id=316, in German)

2.1.3 URL:

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=3247

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=19984

2.1.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Used for livestock farming; mainly pig and cattle farming, milk production, air condition

2.1.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	X	X		

2.1.6 Description

Provides the means to enable communication between on-farm process computers of stationary and mobile agricultural equipment or machinery, and management computers. Specifies an Agricultural Data Interchange Syntax (ADIS) to exchange data electronically. It implies that the syntax is not intended for real-time data exchange. [1]

Electronic data interchange between information systems in agriculture -- Agricultural data element dictionary -- Part 1: General description, Part 2: Dairy farming, Part 3: Pig farming [2]

2.1.7 Regional Scope

International;

Used for data exchange with milk control autorities in Germany

2.1.8 Language

English, German

2.1.9 Example data set

```
DH990001000000000800090000208000900003080009000040600090000624000900009080009
00012080

DN88000100800004150

VN880001 12345678

DN880002008000041500080015008000800151080008000190510080002005000800021032008
00022030......

VN880002 123456781996100119970215 352 6550412366......

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ZN
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2.1.10 Status [Proposed, In use, etc.]

ISO 11787:1995: International Standard confirmed (2010-03-30)

ISO 11788-1:1997: International Standard confirmed (2010-05-28)

2.1.11 Licence

The description of the Data Dictionary is free; the ISO documents are available for a fee.

2.1.12 Participation

ISO participation rules apply with regard to changes in the official specifications. National data dictionary variants are maintained by organizations in the respective countries. Within the german context, the Landeskontrollverband Nordrhein-Westfalen can be approached for requests on extensions.

2.1.13 References

[1] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=3247

[2] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=19984

http://www.lkv-nrw.de/index.php?id=305

Goldmann, J: ISOagriNET, Ein Handbuch für Entwickler und Entscheider, Münster 2010. (see www.bfl-online.de)

2.2 AGMES

2.2.1 Name of standard

Agricultural Metadata Element Set (AgMES)

2.2.2 Source (issuing organisation)

FAO

2.2.3 URL

http://aims.fao.org/standards/agmes

2.2.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Description of literature and other information resources in agriculture.

2.2.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
				x

2.2.6 Description

The Agricultural Metadata Element Set (AgMES) aims to encompass issues of semantic standards in the domain of agriculture with respect to description, resource discovery, interoperability and data exchange for different types of information resources [1]. AgMES as a namespace is designed to include agriculture specific extensions for terms and refinements from established standard metadata namespaces like Dublin Core, AGLS etc. Thus to be used for Document-like Information Objects, for example like publications, articles, books, web sites, papers, etc., it will have to be used in conjunction with the standard namespaces mentioned before.

- Agricultural Metadata Element Set (AGMES) V.1.1. Namespace Specification
- AgMES RDF Schema

Application profiles are defined as schemas which consist of data elements drawn from one or more namespaces, combined by implementers, and optimized for a particular local application. Application profiles that use AgMES elements are:

- AGRIS Metadata (AGRIS AP)
- Event Metadata (Ag-Events AP)
- Job Vacancy Metadata (Ag-Jobs AP)
- Learning Resources Metadata (Ag-LR AP)

- Organization Metadata (Ag-Org AP)

2.2.7 Regional Scope

International

2.2.8 Language

English, French, Spanish

2.2.9 Status [Proposed, In use, etc.]

Published

2.2.10 Licence

2.2.11 References

[1] http://aims.fao.org/standards/agmes

2.3 AgroVoc

2.3.1 Name of standard

AgroVoc

2.3.2 Source (issuing organisation)

FAO. The AGROVOC Thesaurus is owned and maintained by a community of institutions all over the world. FAO is only the curator.

2.3.3 URL

http://aims.fao.org/standards/agrovoc/about

2.3.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Multilingual thesaurus and vocabulary for agriculture.

2.3.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		X		

2.3.6 Description

The AGROVOC thesaurus by the Food and Agricultural Organization of the United Nations (FAO) is nowadays the most comprehensive multilingual thesaurus and vocabulary for agriculture. Originally, it was devised for indexing of literature, but it is increasingly used also in facilitating knowledge sharing and exchange through electronic media and machine-readable data formats. It The AGROVOC thesaurus contains more than 40 000 concepts in up to 21 languages covering topics related to food, nutrition, agriculture, fisheries, forestry, environment and other related domains [1].

The vocabulary is provided in standard RDF and SKOS and concepts are identified by URLs. Therefore, it is easy to reference these concepts or create mappings to other vocabularies. Apart from several agricultural ontology relations (for a complete list see http://aims.fao.org/website/Ontology-relationships/sub) AGROVOC uses common thesauri relationships like “broader term”, “narrower term”, “related term”.

2.3.7 Regional Scope

Global

2.3.8 Language

Multilingual

2.3.9 Example data set

Labels	Status	Scope	Created	Last modified
Coconuts (EN)	Descriptor (20)		1988-11-14	1998-11-05 09:09:00
Noix de coco (FR)	Descriptor (20)		1988-11-14	1998-11-05 09:09:00
Coco (ES)	Descriptor (20)		1988-11-14	1998-11-05 09:09:00
الهند جوز (AR)	Descriptor (20)		2002-12-12	2002-12-12 00:00:00
椰子(果) (ZH)	Descriptor (20)		2002-12-12	2002-12-12 00:00:00
Coco (PT)	Descriptor (20)		1998-08-04	1998-08-04 16:33:00
kokosové ořechy (CS)	Descriptor (20)		2003-03-27	2003-03-27 10:59:43
ココナッツ (JA)	Descriptor (20)		2005-08-09	2005-08-09 00:00:00
มะพร้าว (TH)	Descriptor (20)		2005-08-19	2005-08-19 00:00:00
kokosové orechy (SK)	Descriptor (20)		2005-12-16	2007-11-20 00:00:00
KOKOSNUSS (DE)	Descriptor (20)		1996-12-24	1998-11-05 09:09:00
kókuszdió (HU)	Descriptor (20)		2006-12-06	2006-12-06 00:00:00
Orzech kokosowy (PL)	Descriptor (20)		2006-12-19	2007-11-23 00:00:00
هل‌ی‌ن ارگ (FA)	Descriptor (20)		2007-04-20	2007-11-16 00:00:00
Noci di cocco (IT)	Descriptor (20)		2006-12-04	2007-11-16 00:00:00
кокос (орехи) (RU)	Descriptor (20)		2009-02-17	2009-02-17 12:21:39
नारीयल (HI)	Descriptor (20)		1988-11-14	2008-01-20 00:00:00
ໝາກພ້າວ (LO)	Descriptor (20)		2005-12-16	2007-11-16 00:00:00

Word Tree

BT	12873 - Nuts (EN)
RT	1714 - Coconut oil (EN)
RT	1716 - Cocos nucifera (EN)
RT	1873 - Copra (EN)
RT	34238 - Coconut water (EN)

2.3.10 Status [Proposed, In use, etc.]

Published

2.3.11 Licence

2.3.12 Participation

Within AIMS a community exists for Agrovoc, to participate and contribute to the AGROVOC thesaurus. AIMS welcomes librarians, information management specialists, software developers, researchers, students, policy makers, and others to participate.

2.3.13 References

[1] http://aims.fao.org/website/About/sub

2.4 agroXML

2.4.1 Name of standard

agroXML

2.4.2 Source (issuing organisation)

Kuratorium für Technik und Bauwesen in der Landwirtschaft e. V. (KTBL)

2.4.3 URL

www.agroxml.de

2.4.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

2.4.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	X		

2.4.6 Description

agroXML is an XML dialect for representing and describing farm work. It provides elements and XML data types for representing data on work processes on the farm including accompanying operating supplies like fertilizers, pesticides, crops and the like. It can be used within farm management information systems as a file format for documentation purposes but also within web services and interfaces between the farm and external stakeholders as a means to exchange data in a structured, standardized and easy to use way.

The main purposes of agroXML and agroRDF are:

- exchange between on-farm systems and external stakeholders
- high level documentation of farming processes
- data integration between different agricultural production branches
- semantic integration between different standards and vocabularies
- a means for standardized provision of data on operating supplies

Among its use cases are for example:

- Extensive Documentation Of Crop Growing: Demand for documentation of activities during cultivation of crops like seeding, fertilization, harvesting etc. is constantly rising. The same goes for livestock farming, where relevant events to document may include birth of animals, veterinary treatments, feeding etc. On the one hand, information like

amounts of fertilizers applied, variety used, veterinary drugs handed out etc. is requested by buyers of agricultural goods like mills or slaughterhouses. On the other hand, in certain settings, information like this may be used within web platforms or quality programs to achieve a certain marketing advantage by transparency on production processes. Whether the purpose of your application is fulfilling demands for obligatory information or voluntarily achieving transparency, agroXML is the perfect fit for that kind of use case. It provides the necessary elements to construct files or web services that provide the necessary information. As an agricultural software developer you thus do not have to think about interface design and data structures. As an added bonus, data can be reused for other purposes as well, while control on content handed out to third parties stays within your application and therefore, if necessary in the hands of the farmer.

- Data Sharing Within Cooperatives: Say, you write a software application for cooperative farming or for enterprises that manage several farms at different places. There may arise a need for data sharing among different production sites or components of your application. agroXML allows to build a web services based peer-to-peer network to exchange data on sites, fields, crops grown, animals kept etc. Data items can be picked from the schemas and provided within a service oriented architecture either within a full-blown SOAP messaging stack or using lightweight, flexible approaches like ReSTful web services.
- Providing Data On Farming Products And Supplies: As a provider of agricultural supplies and goods or an extension service or governmental organization, you may want to offer an additional service to your clients by delivering extended information on the things you sell or have knowledge on. While you could do that in printed form on data sheets and documents or via a standard interactive web sites or e-mail newsletters, you can also do so in machine-readable, electronic form. The information can then easily be imported into management systems relieving your client from cumbersome manual data entry. agroXML provides the standardized way to offer this added value by providing elements for representing data on e. g. varieties, fertilizers, etc.

agroXML is developed by the KTBL and partners among makers of agricultural software systems, machinery companies and service providers. First thoughts on a standardized data exchange format for farm management information systems have already been developed around the year 2000. The term agroXML was coined and registered as a trademark on 16th of September 2003. Representatives of farm management information system providers met in July 2004 at the University of Hohenheim to discuss further steps. A working group was founded, that held its first meeting at 30th of September 2004. A very first development version 0.1 was released in April 2005 containing element and data type definitions for basic documentation of farm work. Currently, agroXML is at version 1.5 aiming for release of 1.6 in 2013.

Structures are defined using W3C's XML Schema. Schema files of the most recent released version are currently available at http://www.agroxml.de/schema/agroxml_1_5. Essential modules with definitions concerning the farm and plant production are currently availabe, modules for livestock farming are in development. These can be used as a whole, but also independently from each other.

agroRDF is an accompanying semantic overlay model that is at the moment still under heavy development. Using the resource description framework (RDF) of the W3C, a set of small, modular ontologies called agroRDF based on the agroXML schemas has been created. They currently cover processes and associated data items in agriculture like harvest, seeding, machines, etc. agroRDF has been mapped to the XML schemas using additional schema attributes from the semantic annotations to WSDL and XML schema (SAWSDL) recommendation of the W3C. That way, data sets can be related to the higher level semantic model providing additional information like class-superclass relations, properties etc. that cannot

easily be conveyed through the XML schema alone. Wherever possible, classes and properties in agroRDF refer to existing ontologies like the QUDT ontology for quantities and dimensions and the vCard and FOAF ontologies for data on people. A mapping into the AGROVOC thesaurus of the FAO has been created allowing e. g. applications like multilingual search in data sets. A prototypical web service showing application of these semantic web technologies to agricultural machinery data has been created showing flexibility in extensions however covering only a single data source. Recently, work is conducted to build a set of web services for livestock farming that demonstrate integration of several data sources and standards using agroRDF as a facilitator. As such, agroRDF serves a broader purpose than the agroXML schemas alone in that it provides mechanisms for inter-standards-integration and interoperability.

2.4.7 Regional Scope

International

2.4.8 Language

English

2.4.9 Example data set

Sample data set showing internal references, integration of GML data types and elements and usage of content lists:

```
<?xml version="1.0" encoding="UTF-8"?>
<AgroxmlDoc              xsi:schemaLocation="http://www.agroxml.de/schema/agroxml1.5/agroxml.xsd"
xmlns="http://www.agroxml.de/schema/agroxml1.5"            xmlns:gml="http://www.opengis.net/gml"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <Farm>
   <Address>
    <Salutation>Herr</Salutation>
    <Name>Mustermann</Name>
    <FirstName>Max</FirstName>
    <City>Damstadt</City>
    <PostalCode>64289</PostalCode>
    <StreetAddressOne>Bartningstraße 49</StreetAddressOne>
    <StreetAddressTwo>Landgrafenstraße 12</StreetAddressTwo>
   </Address>
   <Contact>
    <Phone>+49 6151 7001-0</Phone>
    <Fax>+49 6151 7001-123</Fax>
    <Email>ktbl@ktbl.de</Email>
   </Contact>
   <FarmNumber>123456</FarmNumber>
   <FarmManager>
    <Address>
      <Name>Mustermann</Name>
      <FirstName>Michael</FirstName>
      <City>Damstadt</City>
      <PostalCode>64289</PostalCode>
      <StreetAddressOne>Bartningstraße 49</StreetAddressOne>
      <StreetAddressTwo>Landgrafenstraße 12</StreetAddressTwo>
    </Address>
    <Contact>
    <Phone>+49 6151 7001-0</Phone>
    <Fax>+49 6151 7001-123</Fax>
    <Email>ktbl@ktbl.de</Email>                        </Contact>
   </FarmManager>
   <ContractNumber>987654</ContractNumber>
   <FarmingSystem
codeSpace="http://www.agroxml.de/content/TypeOfFarming.xml#http://www.agroxml.de/content/TypeOfFa
rming.xml"/>
  </Farm>
  <Field id="ID_1">
   <NameOfField>An der Linden</NameOfField>
   <NumberOfField>001</NumberOfField>
   <Area uom="m²">100</Area>
   <SpatialData>
```

```
    <gml:Polygon srsName="epsg:31466 ">
      <gml:Exterior>
        <gml:LinearRing>
          <gml:PosList>3428696.238000 5569671.404000 3428705.124000 5569663.247000 3428732.492000
5569683.740000   3428762.948000   5569706.545000   3428823.367000   5569790.435000   3428862.760000
5569819.350000   3428888.094000   5569837.991000   3428890.230000   5569843.570000   3428891.690000
5569847.383000   3428885.533000   5569853.190000   3428884.721000   5569850.784000   3428880.317000
5569837.746000   3428824.225000   5569802.093000   3428818.407000   5569794.998000   3428746.761000
5569707.636000 3428721.974000 5569689.860000 3428696.238000 5569671.404000</gml:PosList>
        </gml:LinearRing>
      </gml:Exterior>
    </gml:Polygon>
   </SpatialData>
   <Gemarkung>
    <GemarkungName>Kranichstein</GemarkungName>
    <GemarkungNumber>123123</GemarkungNumber>
    <GemarkungCode codeSpace="http://www.gemarkungen.de#Kranichstein"/>
   </Gemarkung>
  </Field>
  <Cultivation>
   <ReferenceField idref="ID_1"/>
   <PrimaryCrop>
    <CropSpeciesCode                          codeSpace="http://www.agroxml.de/content/Crop.xml#WS"
codeListVersionID="1.0" languageID="de"/>
    <Variety>
      <Name>Combi</Name>
      <Code  codeSpace="http://www.agroxml.de/content/Variety.xml#WS.621"  codeListVersionID="1.0"
languageID="de"/>
      <BundessortenamtsID>621</BundessortenamtsID>
      <CommunityPlantVarietyOfficeID>621</CommunityPlantVarietyOfficeID>
    </Variety>
    <MonetaryValuePerHectare>1500.0</MonetaryValuePerHectare>
   </PrimaryCrop>
   <CatchCrop>
    <CropSpeciesCode codeSpace="http://www.agroxml.de/content/Crop.xml#LUZ"/>
    <Variety>
      <Name>Plato</Name>
      <Code codeSpace="http://www.agroxml.de/content/Variety.xml#LUZ.115"/>
      <BundessortenamtsID>115</BundessortenamtsID>
      <CommunityPlantVarietyOfficeID>NMTOKEN</CommunityPlantVarietyOfficeID>
    </Variety>
    <MonetaryValuePerHectare>300.0</MonetaryValuePerHectare>
   </CatchCrop>
  </Cultivation>
</AgroxmlDoc>
```

2.4.10 Status [Proposed, In use, etc.]

Published

2.4.11 Licence

agroXML is published under the W3C open source licence.

2.4.12 Participation

KTBL maintains a committee of experts for defining overall strategy and planning activities within the agroXML development work. Additional working groups are issued on the basis of requirements and tasks defined. These groups commonly are temporary and deal with a certain topic or technical issue. Membership within the working groups is based upon merit, i. e. if somebody has proposed a certain issue to be addressed or has contributed to previous, similar work, he/she may be invited to join a group. There are no membership fees or other restrictions in place. Picking up on a certain topic can be done by contacting the agroXML team via contact information given on the official website. Access to current development versions can be granted upon request and patches handed in will be processed by the development team.

2.4.13 References

[1] M. Kunisch, D. Martini, M. Schmitz and J. Frisch: agroXML: a standard for data exchange in agriculture, EFITA conference ’09.
(http://www.efita.net/apps/accesbase/bindocload.asp?d=6498&t=0&identobj=GxYTuR4v&uid=57305290&sid=57305290&idk=1)

2.5 Animal Identification

2.5.1 Name of standard

ISO 11784:1996: Radio frequency identification of animals -- Code structure

ISO 11785:1996: Radio frequency identification of animals -- Technical concept

2.5.2 URL

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=25881

2.5.3 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Mandatory individual tagging and registration for cattle, sheep and horses; human readable ear tags or RFID

2.5.4 Level

Protocol	Syntax	Semantics	Identification	Metadata
	X		X	

2.5.5 Description

Contains the structure of the radio-frequency identification code for animals. Does not specify the characteristics of the transmission protocols between transponder and transceiver.[1]

The code stored in the transponder contains the country code, a 12 digit identification code and several additional fields. Manufacturer coded transponders are also available. The transponders can only store numbers, but no alpha numeric coding. The use of numbering schemes for the identification number is not recommended because this would leave many numbers unused.[2]

2.5.6 Regional Scope

International

Electronic identification of bovine animals is mandatory in several countries (e.g. Danmark)

2.5.7 Language

English

2.5.8 Status [Proposed, In use, etc.]

International Standard confirmed

International Standard under periodical review (ISO11785)

2.5.9 Licence

The ISO documents are available for a fee.

2.5.10 References

[1] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=25881

[2] European Commission, Directorate General for Health and Consumers: Study on the introduction of electronic identification (EID) as official method to identify bovine animals within the European Union (http://ec.europa.eu/food/animal/identification/bovine/docs/EID_Bovine_Final_Report_en.pdf)

2.6 CPVO

2.6.1 Name of standard

CPVO: Community Plant Variety Office

2.6.2 Source (issuing organisation)

CPVO: Community Plant Variety Office

2.6.3 URL:

http://www.cpvoextranet.cpvo.europa.eu/WD170AWP/WD170AWP.exe/CONNECT/ClientExtranet

2.6.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

System of plant variety rights

2.6.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		X		

2.6.6 Description

The Community Plant Variety Office is an European Union agency, which manages a system of plant variety rights covering the 27 Member States.

Public data on plant varieties include

- Denomination
- Botanical Taxon
- Grant Number
- Status
- Main Applicant
- Application Date
- Filenumber

CPVO (representatives and applicants) clients can also consult information about their files (status of applications, pending fees, debit and credit notes), retrieve documents (copies of invoices…).

2.6.7 Regional Scope

EU

2.6.8 Example data set

Denomination	Botanical Taxon	Grant Number	Status	Main Applicant	Application Date	Filenumber
1400 KE	Malus domestica Borkh.	20092	Granted Community Plant Variety Right	Feno GmbH	19.02.2002	20020286
AFRICAN RED	Malus domestica Borkh.	25350	Terminated	ARC Infruitec-Nietvoorbij	16.12.2004	20042539
ALKMENE SPUR LINUS	Malus domestica Borkh.	21162	Granted Community Plant Variety Right	Andreas Heinrich	12.03.2007	20070605
ALMAGOLD	Malus domestica Borkh.		Active: under procedure	C.R.A.- FRU	10.11.2008	20082498
ALVINA	Malus domestica Borkh.		Active: under procedure	G. & E. Fankhauser Pty Ltd.	04.05.2012	20121005
AMBRO	Malus domestica Borkh.	7809	Granted Community Plant Variety Right	STICHTING VERMEERDERINGSTUINEN	31.10.2000	20001636
ANGOLD	Malus domestica Borkh.		Withdrawn during application procedure	SEMPRA PRAHA A.S.	18.11.1996	19961315

2.6.9 Status [Proposed, In use, etc.]

In use

2.7 DAPLOS

2.7.1 Name of standard

DAPLOS (Data Plot Sheet)

2.7.2 Source (issuing organisation)

UN/CEFACT TBG18 / Agro EDI Europe

2.7.3 URL

http://www.unece.org/trade/untdid/d08a/trmd/daplos_c.htm

2.7.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Description of data crop sheets exchanged between farmers and their partners, for EDIFACT

2.7.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x			

2.7.6 Description

The Data Plot Sheet (DAPLOS) is to be used in Electronic Data Interchange (EDI) between trading partners involved in administration, commerce and transport, both for national and international trade and independent of the type of business or industry. The message describes the data plot sheet exchanged between farmers and suppliers. The information exchanged includes a technical description and information of the crop production in order to give information about traceability to the farmer's partners (cooperatives, manufacturers, suppliers etc.)

2.7.7 Regional Scope

Global

2.7.8 Language

English

2.7.9 Status [Proposed, In use, etc.]

Published

(Message Type : DAPLOS, Version: D, Release: 05B, Contr. Agency: UN, Revision 1, Date: 2006-01-17)

Available on: http://www.unece.org/trade/untdid/d05b/trmd/daplos_c.htm

2.7.10 Licence

There is a strict demand of no claims of IPR of any contributions to the committee work. All specifications IPRs are owned by the UN and as such open for free use by everyone. A backside of the non-proprietary claim is that implementation guidelines are excluded from the committee work.

2.7.11 Participation

Participation is open to all interested parties. Participation can be at the member or observer level. Observers will be allowed full access to and involvement in all discussions. Voting is restricted to members. Membership is open to any expert with broad knowledge in the area of processes, procedures and modeling in the international trade and e-business arenas, the functions of UN/CEFACT, and its groups

2.7.12 References

[1] BUSINESS REQUIREMENTS SPECIFICATION (BRS): Crop Data Sheet process (http://www.unece.org/fileadmin/DAM/cefact/brs/BRS_eDAPLOS_v0.7.pdf)

2.8 ebXML

2.8.1 Name of standard

ebXML (Electronic Business using eXtensible Markup Language)

2.8.2 Source (issuing organisation)

UN/CEFACT and OASIS (Organization for the Advancement of Structured Information Standards)

2.8.3 URL

http://www.ebxml.org/specs/index.htm

https://www.oasis-open.org/

http://www.iso.org/iso/home/store/catalogue_tc/catalogue_tc_browse.htm?commid=53186

2.8.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

Standard method to exchange business messages such as orders, invoices etc.

2.8.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
X	x			

2.8.6 Description

A newer standard for electronic business is ebXML (Electronic Business using eXtensible Markup Language). It is maintained by the UN/CEFACT and by OASIS (Organization for the Advancement of Structured Information Standards). The first version was already issued in May 2001, since then a number of its specifications have become ISO standards. ebXML includes five types of specifications: on business processes [1], on collaboration protocols and agreements [2], on messaging services (ebMS; [3]) on registries and repositories [4, 5] and on core data components. All definitions of the data exchanged over ebXML are stored in an ebXML registry as XML documents. The data pools are managed by service providers or major suppliers. ebMS is based on SOAP [6], the underlying communication protocol is usually HTTP. SOAP Version 1.2 is a lightweight protocol intended for exchanging structured information in a decentralized, distributed environment. "Part 1: Messaging Frame¬work" defines, using XML technologies, an extensible messaging framework containing a message construct that can be exchanged over a variety of underlying protocols.

For ebXML, an implementation of the Core Components Technical Specification [7] is the Universal Business Language [8]. This standard data format has been defined by OASIS and provides XML schemas for business documents (e.g. order, invoice, etc.).

2.8.7 Regional Scope

Global

2.8.8 Language

English

2.8.9 Status [Proposed, In use, etc.]

De-facto standard

The latest contributions of the workgroups working on various specifications have been published in 2006 (business process), 2012 (messaging), 2011 (registry), 2010 (core and protocol). A very small community resides at ebxml.xml.org. A site promoting the standard ebXML is hosted on ebxml.org, but this site is no longer actively updated.

2.8.10 Licence

OASIS provides ebXML specifications free of charge. There are no royalties or fees associated with the use of the ebXML specifications. Openness of the ebXML specifications is a requirement in order to encourage adoption.

2.8.11 Participation

Membership of OASIS is open to all organizations and persons. OASIS has transparent governance and operational procedures in place. Agreement on technical topics is determined by members in a joint technical process that allows them to influence standards and contribute specifications for advancement. Work groups focus on a specific standard. Consensus on topics addressed is reached by consensus. An open voting procedure allows for ratification of proposals. Members of the Board of Directors or Technical Advisory Board are nominated in an open election process and serve a two-year term.

2.8.12 References

[1] J.-J. Dubray, S. St. Amand, M. J. Martin (2006): ebXML Business Process Specification Schema Technical Specification v2.0.4. ebXML Business Process Technical Committee.

[2] OASIS ebXML Collaboration Protocol Profile and Agreement TC (2002): Collaboration-Protocol Profile and Agreement Specification Version 2.0. OASIS ebXML Collaboration Protocol Profile and Agreement Technical Committee.

[3] P. Wenzel (2007): OASIS ebXML Messaging Services Version 3.0: Part 1, Core. OASIS ebXML Messaging Services Technical Committee.

[4] S. Fuger, F. Najmi, N. Stojanovic (2005a): ebXML Registry Information Model Version 3.0. OASIS ebXML Registry Technical Committee.

[5] S. Fuger, F. Najmi, N. Stojanovic (2005b): ebXML Registry Services and Protocols Version 3.0. OASIS ebXML Registry Technical Committee.

[6] N. Mitra, Y. Lafon (2007): SOAP Version 1.2 Part 0: Primer (Second Edition). World Wide Web Consortium.

[7] UN/CEFACT (2003): Core Components Technical Specification – Part 8 of the ebXML Framework, Version 2.01. United Nations Centre for Trade Facilitation and Electronic Business.

[8] J. Bosak, T. McGrath, G. K. Holman (2006): Universal Business Language v2.0. OASIS Universal Business Language (UBL) Technical Committee.

2.9 eCert

2.9.1 Name of standard

Electronic certification

2.9.2 Issuing organization

UN/CEFACT TBG18 / Agro EDI Europe

2.9.3 URL

http://www1.unece.org/cefact/platform/pages/viewpage.action?pageId=5964708

2.9.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

2.9.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x		

2.9.6 Description

eCert is a message standard used in electronic transmission between government inspection and quarantine authorities involved in border clearance activities for agricultural products. The eCert Data Standard and Message Structure has been recognized by UN/CEFACT as a standard for government to government (G2G) exchange of sanitary and phytosanitary certificates.
eCert standard is based on an established business processes that operates in accordance with international standards and best practice.

2.9.7 Regional scope

Global

2.9.8 Language

English

2.9.9 Status

eCert XML schema is available from the UN-CEFACT website (Standards – XML-schemas – version D08B
refers : http://www.unece.org/cefact/xml_schemas/index.htm#2008B).
To access the XML-schema an XML-editor-software-tool is necessary.

- Download the D08B-package.
- Extract the information using the XML-editor-software-tool.

- Launch SPSAcknowledgement_2p0.xsd and SPSCertificate_2p0.xsd (mentioned under Data – Standard).

2.9.10 License

There is a strict demand of no claims of IPR of any contributions to the committee work. All specifications IPRs are owned by the UN and as such open for free use by everyone. A backside of the non-proprietary claim is that implementation guidelines are excluded from the committee work.

2.9.11 Participation

Participation at UN/CEFACT is open to all interested parties. Participation can be at the member or observer level. Observers will be allowed full access to and involvement in all discussions. Voting is restricted to members. Membership is open to any expert with broad knowledge in the area of processes, procedures and modelling in the international trade and e-business arenas, the functions of UN/CEFACT, and its groups. For eCert holds that it involves government to government data exchange, so participation is restricted to governmental parties.

2.9.12 References

[1] www1.unece.org/cefact/platform/download/attachments/5964708/UNCEFACT_ECERT_ImplementationGuide_Draftv1+0+GUIDE.doc?version=1&ei=7LG8ULTQEOz34QTQ7ICwDg&usg=AFQjCNEu06iNBFNbih-ib3Q1laOpnXPpiw

[2] http://www1.unece.org/cefact/platform/pages/viewpage.action?pageId=5964708

[3] http://www.cbp.gov/xp/cgov/trade/trade_programs/textiles_and_quotas/ecert/ecert.xml

2.10 Edibulb standards

2.10.1 Name of standard

Edibulb standards

2.10.2 Issuing organization

Edibulb

2.10.3 URL

http://www.edibulb.nl/index.php?option=com_content&view=category&layout=blog&id=52&Itemid=97

2.10.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

2.10.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x		

2.10.6 Description

Edibulb is a common initiative of trade organizations within the sector of growers, purchase & sales offices and traders. Together with market parties standard messages are developed for electronic message exchange within the industry. These various messages, based on XML Schema, are focused on flower bulbs and are based on globally accepted EDI messages.

The following messages exist:

- Order
- Order confirmation
- Delivery
- Proof of receipt
- Invoice
- Logistics

Next to the messages, Edibulb also supplies standard code lists for the data that is within the messages. One could think of bulb cultivars, but also measures and conditions.

2.10.7 Regional scope

National

2.10.8 Language

Dutch

2.10.9 Status

Various parts of the standards are in various stages of development.

Last publication of most of the messages is from 2007, the logistics message has a more recent version, from 2010.

Most of the types of codes are updated each week, some only each year.

2.10.10 License

Free use, no restrictions. Technical specification is publicly available.

2.10.11 Participation

Active users and their software suppliers can send requests for change, which are processed once a year. Edibulb decides whether the changes are applied in the new version of the standard. No costs are involved in joining Edibulb. Once necessary changes in software must be paid.

Everyone can request a new product code.

2.10.12 References

http://www.edibulb.nl/index.php?option=com_content&view=category&layout=blog&id=52&Itemid=97

2.11 EDIFACT

2.11.1 Name of standard

EDIFACT (United Nations Electronic Data Interchange for Administration, Commerce and Transport)

2.11.2 Source (issuing organisation)

UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business)

2.11.3 URL

http://www.unece.org/cefact/edifact/welcome.html

2.11.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	X	X

Electronic data exchange in business

2.11.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x			

2.11.6 Description

Electronic data interchange (EDI) enables companies to exchange business documents in a standard format. One standard for EDI is the UN/EDIFACT (United Nations Electronic Data Interchange for Administration, Commerce and Transport), which has been developed by the UN/CEFACT (United Nations Centre for Trade Facilitation and Electronic Business) since the eighties. A subset of this standard is EANCOM, which has less optional elements and is easier to handle. The EDIFACT standard lists more than 200 message types, each with a six character name (e.g. ORDER for purchase order message). A message has a hierarchical structure and is a collection of segments, which are characterized by a three character tag and conditional or mandatory data elements. Single characters are used as field separators and terminators. Multiple messages can be grouped together in an interchange and are wrapped into an electronic envelope also consisting of segments. The syntax of EDIFACT is very condensed and not meant to be human readable.

EDIFACT messages can be sent from one company to another using any available communication protocol. In the beginning of EDI, dedicated lines or modems where commonly used. Another way of message exchange are Value Added Networks (VAN) realized by provider companies which simply act as an electronic mail box. The internet protocols (SMTP, HTTP(S), FTP) are also used. Based on HTTP is the specification AS2, which uses signing, encryption and MDN (Message Disposition Notification, the ability to provide return receipts). It is widely used

in the retail sector. For smaller enterprises without own EDI infrastructure who only have to transmit smaller amounts of data, web based applications (WebEDI) are available.

2.11.7 Regional Scope

Global

2.11.8 References

http://www.unece.org/cefact/edifact/welcome.html

2.12 EFSA

2.12.1 Name of standard

EFSA Standard sample description for food and feed

EFSA Guidance on Data Exchange

2.12.2 Source (issuing organisation)

EFSA (European Food Safety Authority)

2.12.3 URL

http://www.efsa.europa.eu/

2.12.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	X

Sample description for food and feed for food safety purposes.

2.12.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
X	x	x		

2.12.6 Description

The EFSA collects data from the EU member states, the European Commission, the industry etc. on food consumption, the incidence and prevalence of biological risks, and occurrence of contaminants and chemical residues. A standard sample description for food and feed is used, which is composed of a list of standardized data elements (definition and structure), controlled terminologies and validation rules [1]. The target is to harmonize the collection of analytical measurement data on food and feed. Controlled terminologies for all parameters of the analysis have been established, e.g. for the analytical method, the country of origin, the result etc. The product code describing the product under analysis is a hierarchical tree with 376 terms such as “Lettuce” or “Goat liver”, thereof 34 root terms such as ”Citrus fruit”, “Baby food”. Each term is coded with a 9-digit product code, e.g. “P0120110A”. Another list of terms describes the processes applied to the product or any indexed ingredient.

A detailed guidance document on data exchange has been published by the EFSA [2]. The main requirement was the simplicity of the protocol and its easy implementation. The transmission of data might be either by manual posting of files (upload to a web application) or by automatic transmission. As file formats, Microsoft Excel files or CSV files (comma separated values) are permitted for a limited period only, as these formats are more susceptible to errors and automatic vali¬dation is more demanding. The preferred format for the data is XML.

The Message Exchange Protocol describes the exchange of messages between sender (e.g. member state authorities) and receiver (the EFSA): the data message, the MRN message (Message Receipt Notification) and the acknowledgement message. The transport layer for the physical exchange of the messages can be FTP or by web services. To meet security requirements, the sender software has to provide an user identification and password and to use a secure internet protocol such as FTP through SSL.

2.12.7 Regional Scope

EU member states

2.12.8 Language

English

2.12.9 Status [Proposed, In use, etc.]

In use. On request from: EFSA

2.12.10 Licence

Guidance documents are publicly available. No restrictions for use.

2.12.11 Participation

Technical Working Group on Data Collection has developed the two guidance documents. The documents seem to be issued only once in the EFSA journal.

2.12.12 References

[1] European Food Safety Authority. Standard sample description for food and feed. EFSA Journal 2010; 8(1):1457. [54 pp.]. doi:10.2903/j.efsa.2010.1457. Available online: www.efsa.europa.eu/efsajournal
[2] European Food Safety Authority. Guidance on Data Exchange. EFSA Journal 2010;8(11):1895. [50 pp.]. doi:10.2903/j.efsa.2010.1895. Available online: www.efsa.europa.eu/efsajournal

2.13 eLab

2.13.1 Name of standard

e-LABs observation report message

2.13.2 Issuing organization

UN/CEFACT TBG18 / Tuinbouw Digitaal (NL)

2.13.3 URL

http://www.tuinbouwdigitaal.net/Onderzoek/Kennisbank/tabid/2046/articleType/ArticleView/articleId/561/e-LAB-Business-Requirements-Specification.aspx

2.13.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X	x	

2.13.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		x		

2.13.6 Description

The purpose of the standard is to define the laboratory observation exchange processes for all users in the agri domain of laboratory observations and the development and installation of a standard reporting message, using the UN/CEFACT Modeling Methodology (UMM) approach and Unified Modelling Language to describe and detail the business processes and transactions involved.

2.13.7 Regional scope

Global

2.13.8 Language

Dutch / English

2.13.9 Status

In development (version 0.1).

2.13.10 Licence

2.13.11 Participation

2.13.12 References

http://www.tuinbouwdigitaal.net/Onderzoek/Kennisbank/tabid/2046/articleType/ArticleView/articleId/561/e-LAB-Business-Requirements-Specification.aspx

2.14 Florecom standards

2.14.1 Name of standard

Florecom standards

2.14.2 Issuing organization

Florecom

2.14.3 URL

http://www.florecom.nl/Diensten/Standaardberichten/tabid/100/language/nl-NL/Default.aspx

2.14.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

Order processing & Transportation in the Dutch flower chain

2.14.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x	x	

2.14.6 Description

Florecom has developed a message set for use in the flower chain, based on EDI messages. Apart from commercial, financial and clock messages, Florecom provides a messaging standard for logistic purposes. Both transport (order and status) and delivery activities are covered.

2.14.7 Regional scope

National

2.14.8 Language

Dutch

2.14.9 Status

Some of the messages (Trader transaction, Confirmation, Supply message BB, and all Financial) have not been updated since 2006. The other messages have newer versions from either 2011 or 2012.

2.14.10 License

Costs are involved in both joining the so-called ‘Order methodology’ and purchasing a special software module supporting this ‘Order Methodology’.

The EDIFACT messages and the functional description of the standards can be found on the website of Florecom. The corresponding XML Schemas are not publicly available, a log-in is required.

2.14.11 Participation

Florecom knows working groups, in which representatives of supply chain parties take part. There exists both a working group for assessing the requests for changes and one for developing new standards.

2.14.12 References

http://www.florecom.nl/Diensten/Standaardberichten/tabid/100/language/nl-NL/Default.aspx

2.15 Frug I Com

2.15.1 Name of standard

Frug I Com

2.15.2 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

Data exchange in the Dutch fruit and vegetable supply chain

2.15.3 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x	x	

2.15.4 Description

Frug I Com is a unique collaboration of the Nederlandse Aardappelen, Groenten- en Fruitketen (Dutch Potatoes, Vegetables and Fruit chain, further referred to as AGF chain). The ultimate goal is to establish electronic exchange of information between the participants in AGF by means of uniform labelling using electronic messages. This standard allows companies within the AGF to make optimum use of the information available in the AGF chain and to apply it to order processing, tracing of products, optimising logistics and quality improvement. The result? A faster and more efficient AGF chain which is less error-prone. [1]

2.15.5 Regional Scope

Netherlands

2.15.6 Language

Dutch

2.15.7 References

[1] http://www.frugicom.nl/en-us/wat.aspx

2.16 GIEA

2.16.1 Name of standard

GIEA: Gestion des Informations de l'exploitation Agricole (management of farm information resources)

2.16.2 Source (issuing organisation)

A consortium composed of several actors: Ministere de l'agriculture, Assemblée Permanente des Chambres d'Agriculture, Cemagref/irstea, INRA, Agro EDI Europe, etc…

2.16.3 URL:

Web site: http://www.projetgiea.fr (No longer available as the project is completed)

2.16.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Management of farm information resources

2.16.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	X	X		

2.16.6 Description

The GIEA Project (project about management of farm information resources), led by APCA (Assemblée Permanente des Chambres d'Agriculture) from 2003 to 2006, federates the actors of agriculture field on the exchange of computerized data to make easier the communication between information systems (Brun et al., 2005). The main result of this project is a dictionary of approximately 200 concepts. This dictionary defines a set of organized concepts and establishes the relationships between these various concepts. This dictionary is represented by UML class diagrams (Pinet et al., 2006). This dictionary has three main topics: farm general data (building, identification of farmers and farm society, contracts and rules), soil (crop production, crop type, event), livestock (animal identification, health status, sanitary event, movement, reproduction).

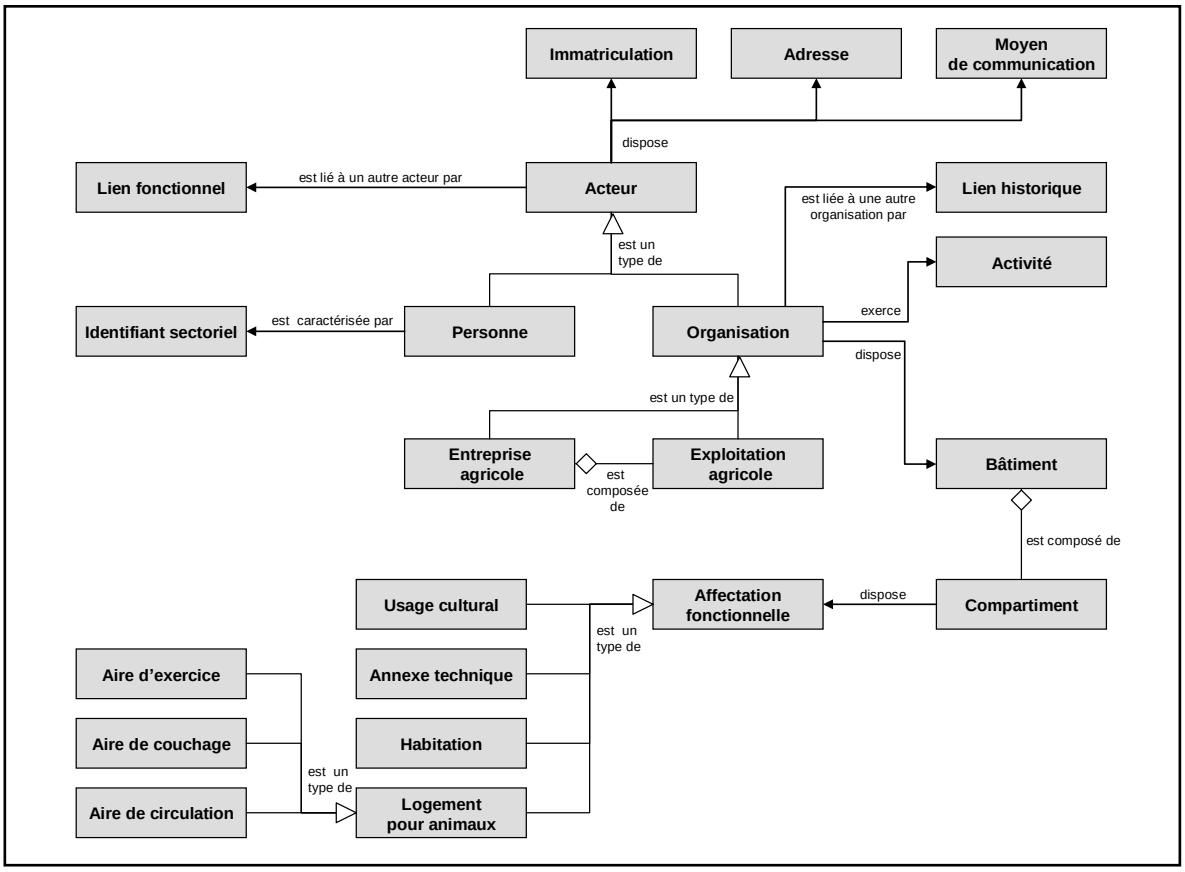
2.16.7 Regional Scope

France

2.16.8 Language

French

2.16.9 Example data set



Simplified version of UML schema for farm general data field.

2.16.10 Status [Proposed, In use, etc.]

Proposed, never used

2.16.11 Licence

Free.

2.16.12 References

POYET, P., BRUN, T. - 2003. GIEA : gestion des informations de l`exploitation agricole - Vers des concepts et un langage communs pour les partenaires économiques et institutionnels de la profession agricole. *Ingénieries - E A T*, n° spécial Technologies pour les agrosystèmes durables, p. 167-175

Brun T., Poyet P., Bopp M., Vigier F., (2005) « Towards an agricultural ontology in France: Contributions of the farm Information Management Project (GIEA) », EFITA/WCCA 2005 Joint Conference, Vila Real, Portugal, July 25-28, p. 1296-1302

DUFY, L., ABT, V., POYET, P. - 2006. GIEA : gestion des informations de l'exploitation agricole. Un projet au service de l'interopérabilité sémantique de la profession agricole. *Ingénieries - E A T*, n° 48, p. 27-36

PINET, F., ROUSSEY, C., BRUN, T., VIGIER, F. - 2009. The Use of UML as a Tool for the Formalisation of Standards and the Design of Ontologies in Agriculture. *Advances in modelling*

agricultural systems, Papajorgji, P.J., Pardalos, P.M. (ed.), Springer, Springer optimization and its applications , vol. 25, p. 131-147

2.17 GML

2.17.1 Name of standard

Geography Markup Language (GML)

2.17.2 Source (issuing organisation)

Open Geospatial Consortium (OGC)

2.17.3 URL

http://www.opengeospatial.org/standards/gml

2.17.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Geographical features.

2.17.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x	x	

2.17.6 Description

The OpenGIS® Geography Markup Language Encoding Standard (GML) The Geography Markup Language (GML) is an XML grammar for expressing geographical features. GML serves as a modeling language for geographic systems as well as an open interchange format for geographic transactions on the Internet. As with most XML based grammars, there are two parts to the grammar – the schema that describes the document and the instance document that contains the actual data. A GML document is described using a GML Schema. This allows users and developers to describe generic geographic data sets that contain points, lines and polygons [1].

2.17.7 Status [Proposed, In use, etc.]

ISO standard (ISO 19136:2007)

[www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32554]

2.17.8 Licence

http://www.opengeospatial.org/about/ipr

2.17.9 References

[1] http://www.opengeospatial.org/standards/gml

2.18 HI-tier

2.18.1 Name of standard

Herkunftssicherungs- und Informationssystem für Tiere (Identification and Information System for Animals)

2.18.2 Source (issuing organisation)

Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten

2.18.3 URL

http://www2.hi-tier.de/

2.18.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
x		

Identification and tracking of animals (pigs, sheep, goats, cattle, horses)

2.18.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
x	x	X	x	

2.18.6 Description

HI-Tier is a central database for the identification and tracking of animals (pigs, sheep, goats, cattle, horses).

For bovine animals, the data to be stored are:

- Identification number (Ear tag)
- Date of birth
- Race
- Sex
- Identification number of mother
- Holding of birth
- Holdings where animal was kept
- Date of each transport
- Date of slaughtering

2.18.7 Regional Scope

Germany

2.18.8 Language

German

2.18.9 Status [Proposed, In use, etc.]

In use

2.18.10 References

Council Regulation (EC) No 820/97 of 21 April 1997 establishing a system for the identification and registration of bovine animals and regarding the labelling of beef and beef products (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997R0820:EN:NOT)

Regulation (EC) No 1760/2000 of the European Parliament and of the Council of 17 July 2000 establishing a system for the identification and registration of bovine animals and regarding the labelling of beef and beef products and repealing Council Regulation (EC) No 820/97 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000R1760:EN:NOT)

http://www2.hi-tier.de/Entwicklung/Grundlagen/Default.htm (in German)

2.19 IACS

2.19.1 Name of standard

Integrated Administration and Control System (IACS)

2.19.2 Source (issuing organisation)

European Commission

2.19.3 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Identification system for payment entitlements, covers Land Parcel Identification System

2.19.4 Level

Protocol	Syntax	Semantics	Identification	Metadata
			x	

2.19.5 Description

According to the principle of shared management, Member States must take the necessary measures to ensure that transactions financed by the European Agricultural Guarantee Fund (EAGF) are not only actually carried out but are also implemented correctly. Furthermore, Member States must prevent irregularities and take the appropriate action if they do occur. For this purpose, the national authorities are required to operate an Integrated Administration and Control System (IACS) in order to ensure that payments are made correctly, irregularities are prevented, revealed by controls, followed up and amounts unduly paid are recovered.

In physical terms, IACS consists of a number of computerized and interconnected databases which are used to receive and process aid applications and respective data. Thus it provides for:

- a unique identification system for farmers;
- an identification system covering all agricultural areas called Land Parcel Identification System (LPIS);
- an identification system for payment entitlements;
- a system for identification and registration of animals (in Member States where animal-based measures apply).

The system ensures a unique identification of each farmer as well as of all agricultural parcels of land and, if needed, of animals. The system covers also the processing of the aid applications.[1]

The regulations allow for diverse representations of the ‚reference parcel‘:Cadastral parcel (CP), Agricultural parcel (AP), Farmers’ block/ilot (FB) and Physical block (PB). The cadastral parcel is based on ownership, whilst the other LPIS reference parcels are based on land cover delineated by topographical boundaries and/or agricultural land use. The latter representations correspond either directly to single Agricultural parcel or indirectly to an association of one or

more agricultural parcels into ‘blocks’ according to production pattern or physical (topographic) boundaries of agricultural land use.[2]

2.19.6 Regional Scope

European Union. Specific regulations for each member state, in some cases also on regional level (e.g. German Federal States)

2.19.7 Language

Multilingual.

2.19.8 Status [Proposed, In use, etc.]

Legal regulations apply, implementation differs on national level.

2.19.9 References

[1] http://ec.europa.eu/agriculture/direct-support/iacs/index_en.htm

[2] http://marswiki.jrc.ec.europa.eu/wikicap/index.php/Reference_parcel

http://mars.jrc.ec.europa.eu/mars/Bulletins-Publications/Status-of-the-LPIS-implementation-in-the-EU-MS-2007

2.20 INSPIRE

2.20.1 Name of standard

INSPIRE (Infrastructure for Spatial Information in the European Community)

2.20.2 Source (issuing organisation)

European Parliament

2.20.3 URL

http://inspire.jrc.ec.europa.eu/index.cfm

2.20.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
x		

Infrastructures for spatial information

2.20.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
x	X	x	x	x

2.20.6 Description

INSPIRE is based on the infrastructures for spatial information established and operated by the 27 Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules. This makes INSPIRE a unique example of a legislative “regional” approach.

To ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and transboundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting). These IRs are adopted as Commission Decisions or Regulations, and are binding in their entirety. The Commission is assisted in the process of adopting such rules by a regulatory committee composed of representatives of the Member States and chaired by a representative of the Commission (this is known as the Comitology procedure).[1]

2.20.7 Regional Scope

European Union

2.20.8 Language

English

2.20.9 Status [Proposed, In use, etc.]

Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) was published in the official Journal on the 25th April 2007. The INSPIRE Directive entered into force on the 15th May 2007

2.20.10 References

[1] http://inspire.jrc.ec.europa.eu/

2.21 ISO 21067:2007

2.21.1 Name of standard

Packaging - Vocabulary

2.21.2 Issuing organization

ISO

2.21.3 URL

http://www.iso.org/iso/catalogue_detail?csnumber=34399

2.21.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	X	

2.21.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		x		

2.21.6 Description

This International Standard is intended to be used as a source document within the global community. This inventory of terms will be useful in a multilingual thesaurus showing concept relationships as well as terms in other languages. Work on this proposed standard, begun in 1987, has been under convenorship of ANSI since 1995 as ISO/TC 122, Working Group 5, Terminology and vocabulary. This International Standard does not cover environmental statements referring to packaging. These are covered by ISO 14021.

This International Standard specifies preferred terms and definitions related to packaging and materials handling, for use in international commerce.

For packaging designed for the transport of dangerous goods, terms and definitions are given in the United Nations Recommendations on the Transport of Dangerous Goods

2.21.7 Regional scope

Global

2.21.8 Language

English

2.21.9 Status

Published

2.21.10 License

Standards are available after paying a fee. Further, a licence agreement is present which holds for downloading the standards.

2.21.11 Participation

Standard is developed by technical committee 122, packaging. TCs are made up of representatives of industry, NGOs, governments and other stakeholders, who are put forward by ISO's members. ISO's full members (member bodies) can decide if they would like to be a participating member (P-member) of a particular TC or an observing member (O-member). P-members participate actively in the work and have an obligation to vote on all questions submitted to vote within the technical committee. O-members follow the work as an observer but cannot make any comments about the development process or vote. 3 kinds of membership: Full member, correspondent member, subscriber member, each needs to pay a fee.

2.21.12 References

[1] www.**evs**.ee/preview/**iso-21067**-2007-en.pdf

2.22 ISO 7563:1998

2.22.1 Name of standard

Fresh fruit and vegetables - Vocabulary

2.22.2 Issuing organization

ISO

2.22.3 URL

http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=14346

2.22.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	X	X

2.22.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
X		x		

2.22.6 Description

This International Standard defines the terms most frequently used in the context of fresh fruits and vegetables.

2.22.7 Regional scope

Global

2.22.8 Language

English

2.22.9 Status

Published

2.22.10 License

Standards are available after paying a fee. Further, a licence agreement is present which holds for downloading the standards.

2.22.11 Participation

Standard is developed by technical committee 34, food products. TCs are made up of representatives of industry, NGOs, governments and other stakeholders, who are put forward by ISO's members. ISO's full members (member bodies) can decide if they would like to be a participating member (P-member) of a particular TC or an observing member (O-member). P-members participate actively in the work and have an obligation to vote on all questions submitted to vote within the technical committee. O-members follow the work as an observer but cannot make any comments about the development process or vote. 3 kinds of membership: Full member, correspondent member, subscriber member, each needs to pay a fee.

2.22.12 References

[1] http://members.wto.org/crnattachments/2010/tbt/uga/10_2040_00_e.pdf

2.23 ISOagriNET

2.23.1 Name of standard

ISO 17532:2007: Stationary equipment for agriculture -- Data communications network for livestock farming

2.23.2 Source (issuing organisation)

Landeskontrollverband Nordrhein-Westfalen e.V. (http://www.lkv-wl.de/index.php?id=316, in German)

2.23.3 URL

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38404

2.23.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Protocol for livestock farming.

2.23.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
X				

2.23.6 Description

ISO 17532:2007 specifies a protocol for the automatic and interactive communication and control of computer systems used in livestock production. It supports communication within the livestock production as well as across the Internet. [1]

ISOagriNET is based on the standards ADED and ADIS [2].

2.23.7 Language

English, German

2.23.8 Status [Proposed, In use, etc.]

International Standard confirmed (2010-06-17)

2.23.9 Licence

The ISO documents are available for a fee.

2.23.10 References

[1] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38404

[2] Goldmann, J: ISOagriNET, Ein Handbuch für Entwickler und Entscheider, Münster 2010. (see www.bfl-online.de)

2.24 ISOBUS

2.24.1 Name of standard

ISOBUS, ISO 11783

2.24.2 Source (issuing organisation)

VDMA
German Engineering Federation (Verband Deutscher Maschinen- und Anlagenbau e.V.)
Agricultural Machinery Association (Fachverband Landtechnik)

2.24.3 URL

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=39122

2.24.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
x		

Communication of tractor and machinery.

2.24.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
x	x	x		

2.24.6 Description

“ISO 11783 as a whole specifies a serial data network for control and communications on forestry or agricultural tractors and mounted, semi-mounted, towed or self-propelled implements. Its purpose is to standardize the method and format of transfer of data between sensors, actuators, control elements, and information-storage and -display units, whether mounted on, or part of, the tractor or implement. It is intended to provide open system interconnect (OSI) for electronic systems used by agricultural and forestry equipment.

ISO 11783-1:2007 gives a general overview of ISO 11783. Its annexes contain the identifiers for messages, addresses, control functions, implements and manufacturers, required for the implementation of a compliant network.

ISO 11783-2:2012 defines and describes the network's 250 kbit/s, twisted, non-shielded, quad-cable physical layer.

ISO 11783-3:2007 describes the data link layer and the use of CAN extended data frames by the network.

ISO 11783-4:2011 describes the network layer, which defines the requirements and services needed for communication between control functions (CFs) in different segments of the ISO

11783 network. The various types of network interconnection units are defined in ISO 11783-4:2011.

ISO 11783-5:2011 describes the management of source addresses for control functions of electronic control units (ECUs), the association of addresses with the functional identification of a device and the detection and reporting of network-related errors. It also specifies procedures, and minimum requirements, for initialization and response to brief power outages of network-connected ECUs.

ISO 11783-6:2010 describes a universal virtual terminal (VT) that can be used by both tractors and implements. It is applicable to both Version 3 and Version 4 VTs and Working Sets.

ISO 11783-7:2009 describes the implement messages application layer of the network, specifying the message set and defining the messages used for communication with and between tractors and connected implements.

11783-8:2005 describes the messages required by tractors and self-propelled implements.

ISO 11783-9:2012 describes the Tractor ECU, the control function that provides the gateway between the network's tractor and implement buses, as well as performing other functions.

ISO 11783-10:2009 describes the task-controller applications layer, which defines the requirements and services needed for communicating between the task controller and electronic control units. The data format to communicate with the farm-management computer, the calculations required for control and the message format sent to the control function are defined in ISO 11783-10:2009.

ISO 11783-11:2011 specifies the identifiers for the data elements used in the Process Data message defined by ISO 11783-10 for a serial data network for control and communications on forestry or agricultural tractors and mounted, semi-mounted, towed or self-propelled implements.

ISO 11783-12:2009 describes the diagnostic system of a serial data network.

ISO 11783-13:2011 specifies the file server (FS) for use by a tractor or self-propelled implement.

2.24.7 Language

English, French, Russian

2.24.8 Status [Proposed, In use, etc.]

ISO 11783-1: International Standard to be revised (2010-10-21)

2.24.9 Licence

The ISO documents are available for a fee.

2.24.10 References

http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=39122

2.25 LanguaL

2.25.1 Name of standard

LanguaL (**Langua aL**imentaria)

2.25.2 Source (issuing organisation)

LanguaL Secretariat and European LanguaL Technical Committee

2.25.3 URL

www.langual.org

2.25.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
x	X	x

Multilingual classification with focus on food consumption and food composition.

2.25.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		x		

2.25.6 Description

A facetted classification is a multihierarchical classification, where each item is described by a number of characteristics, the "facets". LanguaL [1] is a food description thesaurus which uses a facetted classification. Each food is described by a set of standard, controlled terms chosen from facets characteristic of the nutritional and/or hygienic quality of a food, as for example the biological origin, the methods of cooking and conservation, and technological treatments.

The facet term lists are hierarchically structured. The work on LanguaL started in the late 1970's in the USA. In recent years, the EuroFIR (European Food Information Resource), an EU funded project has indexed a large number foods. LanguaL is now multilingual with approximately 70000 terms (English, German, French etc.). The main focus is on food consumption and food composition.

2.25.7 Regional Scope

International

2.25.8 Language

English

2.25.9 Example data set

Facet	Name	Example
Facet A	PRODUCT TYPE	SAUSAGE OR SIMILAR MEAT PRODUCT (EUROFIR) [A0798]
Facet B	FOOD SOURCE	HIPPOPOTAMUS [B2130]
Facet C	PART OF PLANT OR ANIMAL	ROOT, TUBER OR BULB, WITHOUT PEEL [C0240]
Facet E	PHYSICAL STATE, SHAPE OR FORM	DIVIDED INTO SEGMENTS OR WEDGES [E0107]
Facet F	EXTENT OF HEAT TREATMENT	HEAT-TREATED, MULTIPLE COMPONENTS, DIFFERENT DEGREES OF TREATMENT [F0023]
Facet G	COOKING METHOD	DEEP-FRIED [G0029]
Facet H	TREATMENT APPLIED	OLIGOSACCHARIDE ADDED [H0240]
Facet J	PRESERVATION METHOD	PASTEURIZED BY HEAT BEFORE FILLING [J0159]
Facet K	PACKING MEDIUM	PACKED IN GRAVY OR SAUCE, VEGETABLE [K0037]
Facet M	CONTAINER OR WRAPPING	ALUMINUM TUBE, TOP LINED WITH FOIL [M0170]
Facet N	FOOD CONTACT SURFACE	BEVERAGE CAN ENAMEL, NON-CARBONATED BEVERAGE [N0012]
Facet P	CONSUMER GROUP/DIETARY USE/LABEL CLAIM	VERY LOW SODIUM FOOD [P0153]
Facet R	GEOGRAPHIC PLACES AND REGIONS	SCOTLAND [R0224]
Facet Z	ADJUNCT CHARACTERISTICS OF FOOD	APPELLATION CONTROLEE [Z0086]

2.25.10 Status [Proposed, In use, etc.]

2012-10-14: The 2011 version of LanguaL™ published.

2.25.11 Licence

The LanguaL™ Food Product Indexer software and the LanguaL™ Thesaurus is provided to you free of charge.

2.25.12 Participation

Suggestions to introduce new concepts or to improve those proposed in this edition are welcome. Special interest groups on different topics are formed as need arises. Eventual suggestions for updates/corrections should be send to the LanguaL Secretariat and European LanguaL Technical Committee or U.S. LanguaL Technical Committee. The LanguaL Technical Committees publish proposals for new facet terms on the LanguaL Internet site for international discussion and approval before incorporation into the official LanguaL thesaurus. The discussion period is two

months from the date of submission to (date of reception by) the LanguaL Technical Committee. Comments will be sent to the submitter during the discussion period and will be published with the changes in the following update of LanguaL.

2.25.13 References

[1] Møller A., Ireland J.: LanguaL 2010 – The LanguaL Thesaurus. EuroFIR Nexus Technical Report D1.13. Danish Food Information, 2011.
http://www.langual.org/download/LanguaL2010/LanguaL%202010%20Thesaurus%20Final.pdf

2.26 Observations and Measurements

2.26.1 Name of standard

Observations & Measurements (OM)

2.26.2 Source (issuing organisation)

OGC (Open Geospatial Consortium)

2.26.3 URL:

http://www.opengeospatial.org/standards/om

2.26.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X	x	

2.26.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x		

2.26.6 Description

Observations & Measurements (OM) provides general models and schema for supporting the packaging of observations from sensor system and sensor-related processing. The model supports metadata about the Observation, as well as the ability to link to the procedure (i.e. sensors plus processing) that created the observation, thus, providing an indication of the lineage of the measurements.

The O&M Observation XML encoding is very general in the sense that the result can be packaged in any structure specified in XML. A Common Observation specification uses the data components defined in SWE Common and allows for efficient packing of either ASCII or binary blocks, or data structures based on standard MIME-types (e.g. JPEG, J2K, etc.). [1]

Models are provided for the exchange of information describing observation acts and their results, both within and between different scientific and technical communities. Observations commonly involve sampling of an ultimate feature-of-interest. O&M defines a common set of sampling feature types classified primarily by topological dimension, as well as samples for ex-situ observations [2].

2.26.7 Regional Scope

Global

2.26.8 Language

English

2.26.9 Status [Proposed, In use, etc.]

In 2011 the latest version of the O&M – XML Implementation is published, which is version 2.0 [3].

In 2011 O&M 2.0 is also adopted as an ISO standard [2].

2.26.10 Licence

The charter of each Standards Working Group shall specify whether the SWG to be formed is a RAND-Royalty Free SWG or a RAND-Fee SWG. Standards are publicly available.

http://www.opengeospatial.org/about/ipr.

2.26.11 Participation

A working group exists to consider revisions of the implementation standards. Targeted participants of this working group are members of the ISO 19156 EC who are also OGC members and OGC members which are interested in the topics of the standard [4]. Change requests can be submitted by anyone and will be judged by the working group.

Further, the OGC is an open membership organization, with four types of membership options:

- Associate: voting access to working groups, non-voting participation in TC proceedings
- Technical: voting access to working groups and TC
- Principal: voting access to working groups, TC and Planning Committee
- Strategic: voting access to working groups, TC, Planning Committee and Strategic Member Advisory Committee

All types of memberships ask a substantial fee.

2.26.12 References

[1] http://www.ogcnetwork.net/OM

[2] http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=32574

[3] http://www.opengeospatial.org/standards/om

[4] http://www.opengeospatial.org/projects/groups/om2.0swg

2.27 PLU Codes

2.27.1 Name of standard

Price-look up codes

2.27.2 Issuing organization

International Federation for Produce Standards (IFPS)

2.27.3 URL

http://plucodes.com/

2.27.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
		x

2.27.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		X	X	

2.27.6 Description

PLU codes are 4 or 5 digit numbers which have been used by supermarkets since 1990 to make check-out and inventory control easier, faster, and more accurate. They ensure that the correct price is paid by consumers by removing the need for cashiers to identify the product; e.g., whether or not it is conventionally or organically grown. They are primarily assigned to identify individual bulk fresh produce (and related items such as nuts and herbs) and will appear on a small sticker applied to the individual piece of fresh produce. The PLU number identifies produce items based upon various attributes which can include the commodity, the variety, the growing methodology (e.g. organic) and the size group.

The 4-digit PLU codes for produce are assigned randomly within a series of numbers within the 3000 and 4000 series. There is no intelligence built into the 4-digit code. For example, no one number within the 4-digit number represents anything in particular. The 4-digit codes are for conventionally grown produce. 5-digit codes are used to identify organic or genetically modified produce. The prefix of ‘8’ would be placed in front of the 4-digit code for genetically modified produce and the prefix of ‘9’ would be placed in front of the 4-digit conventionally grown code for organic produce. You will not see the 5 digit codes in the PLU codes database since they are simply prefixes added to the conventionally grown produce PLU codes.

2.27.7 Regional scope

Global

2.27.8 Language

English

2.27.9 Status

Codes are continuously updated.

2.27.10 License

Documentation is publicly available. A fee must be paid to apply a code.

Everyone can apply for a code, but only when the criteria of IFPS are met.

2.27.11 Participation

All PLU applications are reviewed by the IFPS members prior to voting. In some regions, national or regional groups may provide input to the IFPS members from their region as expert advice on the validity of a new application in the context of the criteria outlined in the application.

2.27.12 References

http://plucodes.com/

2.28 SANDRE

2.28.1 Name of standard

SANDRE

2.28.2 Source (issuing organisation)

Onema, office national de l'eau et des milieux aquatiques (National office for water and aquatic environments)

2.28.3 URL:

http://www.sandre.eaufrance.fr/

2.28.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X		

Water management

2.28.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
X	X	X	X	X

2.28.6 Description

The framework: Sandre is the framework of data on water of SIE (Système d'information sur l'eau = water information system). It covers the specification documents, the reference data and the services distributed on this site:

- Data dictionaries: Consisting of two volumes. The first volume "General overview on data" explains the practices and operation principales in a specific field of the water sector. The second volume "Dictionary" describes the data introduced in the first volume from an IT perspective.

- Exchange scenarios: Defining the format and the rules for the exchange of the data which are described in the data dicitionaries.

- Administration documents: Defining the scope and the organisational and technical regulations of the reference data.

- Reference data: Describing the basic data in the water sector, for example the code of a water body, its name or localisation etc.

- Support services: Helping with the use of the regulations of Sandre" by issuing certificates of conformity, by monitoring of the development of documents and data over time etc.

2.28.7 Regional Scope

France

2.28.8 Language

French

2.28.9 Status [Proposed, In use, etc.]

In use

2.28.10 Licence

Contact M. Yohann Moreno: y.moreno@oieau.fr

2.28.11 References

Contact M. Yohann Moreno: y.moreno@oieau.fr

2.29 SensorML

2.29.1 Name of standard

SensorML

2.29.2 Source (issuing organisation)

OGC (Open Geospatial Consortium)

2.29.3 URL

http://www.opengeospatial.org/standards/sensorml

2.29.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X	x	

XML encoding for describing sensors

2.29.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		x		x

2.29.6 Description

Sensor Model Language (SensorML) provides standard models and an XML encoding for describing any process, including the process of measurement by sensors and instructions for deriving higher-level information from observations. Processes described in SensorML are discoverable and executable. All processes define their inputs, outputs, parameters, and method, as well as provide relevant metadata. SensorML models detectors and sensors as processes that convert real phenomena to data.

2.29.7 Regional Scope

International

2.29.8 Language

English

2.29.9 Example data set

```
<?xml version="1.0" encoding="UTF-8"?>
<sml:SensorML
 xmlns:sml="http://www.opengis.net/sensorML/1.0.1"
```

```
 xmlns:swe="http://www.opengis.net/swe/1.0.1"
 xmlns:gml="http://www.opengis.net/gml"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xsi:schemaLocation="http://www.opengis.net/sensorML/1.0.1
http://schemas.opengis.net/sensorML/1.0.1/sensorML.xsd" version="1.0">

 <sml:member>
        <sml:System gml:id="siteName">
 <sml:identification>
 <sml:IdentifierList>
                              <sml:identifier name="siteID">
 <sml:Term definition="urn:ogc:def:identifier:OGC:uniqueID">
 <sml:value>urn:ogc:object:system:REAP:siteName</sml:value>
 </sml:Term>
 </sml:identifier>
                       </sml:IdentifierList>
 </sml:identification>
               <sml:components>
                       <sml:ComponentList>
                              <sml:component gml:id="B3310001">

                                     <sml:characteristics>
                                            <swe:DataRecord gml:id="sensorCharateristics">
                                                   <swe:field name="isOn">
                                                          <swe:value>true</swe:value>
                                                   </swe:field>


                                                   <swe:field name="samplingPeriod">
                                                          <swe:value>10.000000</swe:value>
                                                   </swe:field>
                                                   <swe:field name="dataLogger">
                                                          <swe:value>CR800</swe:value>
                                                   </swe:field>

                                                   <swe:field name="sensorServer">
                                                          <swe:value>localhost</swe:value>
                                                   </swe:field>

                                                   <swe:field name="location">
                                                          <sml:value>[330.0, 150.0]</swe:value>
                                                   </swe:field>

                                                   <swe:field name="coefficients">
                                                          <sml:value></swe:value>
                                                   </swe:field>


                                                   <swe:field name="conversion-type">
                                                          <sml:value>Linear</swe:value>
                                                   </swe:field>
                                                   <swe:field name="measurement-unit">
                                                          <sml:value>degrees Celsius</swe:value>
                                                   </swe:field>
                                                   <swe:field name="sampleMethod">
                                                          <sml:value>Average</swe:value>
                                                   </swe:field>
                                                   <swe:field name="samples-per-measurement">
                                                          <sml:value>10</swe:value>
                                                   </swe:field>
                                                   <swe:field name="sensor-make">
                                                          <sml:value>Vaisala</swe:value>
                                                   </swe:field>
                                                   <swe:field name="sensor-measurement">
                                                          <sml:value>Temperature</swe:value>
                                                   </swe:field>
                                                   <swe:field name="sensor-model">
                                                          <sml:value>HMP45A</swe:value>
                                                   </swe:field>
                                                   <swe:field name="serial-number">
                                                          <sml:value>B3310001</swe:value>
                                                   </swe:field>

                                                          </swe:DataRecord>
                                     </sml:characteristics>

                              </sml:component>
```

```
                    </sml:ComponentList>
                </sml:components>
            </sml:System>
    </sml:member>
</sml:SensorML>
```

2.29.10 Status [Proposed, In use, etc.]

Approved by OGC

2.29.11 Licence

Open standard, modified W3C license.

2.29.12 References

http://www.ogcnetwork.net/SensorML

2.30 SSN

2.30.1 Name of standard

Semantic Sensor Network

2.30.2 Source (issuing organisation)

W3C Semantic Sensor Network Incubator group

2.30.3 URL:

http://purl.oclc.org/NET/ssnx/ssn

2.30.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
X	x	

Ontology to describe sensors and observations in terms of capabilities, measurement processes, observations and deployments

2.30.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		x		

2.30.6 Description

"The Sensor and Sensor Network ontology presented here, known as the SSN ontology, answers the need for a domain-independent and end-to-end model for sensing applications by merging sensor-focused (e.g. SensorML), observation-focused (e.g. Observation & Measurement) and system-focused views. It covers the sub-domains which are sensor-specific such as the sensing principles and capabilities and can be used to define how a sensor will perform in a particular context to help characterise the quality of sensed data or to better task sensors in unpredictable environments. Although the ontology leaves the observed domain unspecified, domain semantics, units of measurement, time and time series, and location and mobility ontologies can be easily attached when instantiating the ontology for any particular sensors in a domain." [1]

2.30.7 Regional Scope

International

2.30.8 Language

English

2.30.9 Status [Proposed, In use, etc.]

Under development, used in research projects

2.30.10 Licence

Open standard

2.30.11 References

[1] http://www.w3.org/2005/Incubator/ssn/XGR-ssn-20110628/

http://geog.ucsb.edu/~jano/SSN-XG_SensorOntology.pdf

2.31 UNECE

2.31.1 Name of standard

UNECE standards for Fresh Fruit & Vegetables, Seed potatoes, Meat and Cut flowers

2.31.2 Source (issuing organisation)

UNECE (UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE)

2.31.3 URL

http://www.unece.org/trade/agr/standard/meat/meat_e.html

http://www.unece.org/trade/agr/standard/flowers/flower_e.html

http://www.unece.org/trade/agr/standard/potatoes/pot_e.html

http://www.unece.org/trade/agr/standard/fresh/ffv-standardse.html

2.31.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

UNECE standards for Fresh Fruit & Vegetables, Seed potatoes, Meat and Cut flowers

2.31.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		x		

2.31.6 Description

In order to streamline the flow of information throughout the supply chain and to provide a standard for use between buyer and seller in the meat industry, UNECE (United Nations Economic Commission for Europe) Working Party on Agricultural Quality Standards defined the "UNECE STANDARD Bovine Carcasses and Cuts" [1]. Similar standards exist for caprine, chicken, duck, llama/alpaca [2], ovine, porcine and turkey meat [3]. Each standard gives detailed specifications to identify cutting lines including colour photographs and diagrams. Also, minimum requirements for meat are formulated. All data are coded in a 20-digit string.

The UNECE purchase specification code has been assigned the GS1 application identifier (7002) to be used in conjunction with a Global Trade Item Number (GTIN) and represented in the GS1-128 bar code symbology. This allows the UNECE code information to be included in GS1-128 bar code symbols on shipping containers along with other product information.

2.31.7 Regional Scope

Global

2.31.8 Language

English, French, Russian

2.31.9 Example data set

Data field	Category	Example	Example Code
1	Species	Bovine (Beef)	11
2	Product/cut	Tenderloin	2150
3	Not used	-	
4	Refrigeration	Deep frozen	3
5	Category	Heifer	4
6	Production system	Organic	3
7a	Feeding system	Grain fed	1
7b	Not used	-	
8	Slaughter system	Halal	3
9	Post slaughter system	Specified between buyer and seller	1
10	Fat thickness	3 mm maximum	4
11	Bovine quality	Company standards	2
12	Weight range	Not specified	0
13	Packing	Cuts – vacuum packed	5
14	Conformity assessment	Trade standard conformity assessment	2

2.31.10 Status [Proposed, In use, etc.]

- Fresh Fruit & Vegetables – 2006 version: www.unece.org/trade/agr/standard/fresh/FFV-Std/English/23melons.pdf
- Seed potatoes – 2006 version: www.unece.org/trade/agr/standard/potatoes/pot_e/S-1_e.pdf
- Caprine meat carcases and cuts – 2007 version: www.unece.org/trade/agr/standard/meat/e/Caprine_2007_e.pdf
- Cut flowers – 1994 version: www.unece.org/trade/agr/standard/flowers/flower_e/h1flower.pdf

2.31.11 Licence

The standards can be downloaded cost free from the website and used free of charge.

2.31.12 Participation

The Working Party on Agricultural Quality Standards develops the standards. The WP has four specialized sections - on fresh fruit and vegetables, dry and dried produce, seed potatoes and meat. In view of the global character of commercial agricultural quality standards, any member of the United Nations or of one of its specialized agencies can participate, on an equal footing, in the activities of the Working Party on Agricultural Quality Standards.

2.31.13 References

UNECE (2004): UNECE Standard: Bovine Meat Carcasses and Cuts. 2004 Edition. United Nations Publication ECE/TRADE/326. United Nations Economic Commission for Europe, Working Party on Agricultural Quality Standards.

UNECE (2009): UNECE Standard: Turkey Meat Carcases and Parts. 2009 Edition. United Nations Publication ECE/TRADE/358. United Nations Economic Commission for Europe, Working Party on Agricultural Quality Standards.

UNECE (2006): UNECE Standard: Llama/Alpaca Meat Carcases and Cuts. 2006 Edition. United Nations Publication ECE/TRADE/368. United Nations Economic Commission for Europe, Working Party on Agricultural Quality Standards.

2.32 UNSPSC

2.32.1 Name of standard

United Nations Standard Products and Services Code

2.32.2 Issuing organization

UNDP

2.32.3 URL

http://www.unspsc.org/

2.32.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

2.32.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
		x	x	

2.32.6 Description

The United Nations Standard Products and Services Code is a hierarchical convention that is used to classify all products and services.

2.32.7 Regional scope

Global

2.32.8 Language

English

2.32.9 Status

Two codeset versions are published per year.

2.32.10 License

The latest version of the code will always be available free of charge to the general public.

2.32.11 Participation

Any individual or entity can request a change to the code (addition, deletion, move, or edit) after becoming a member of UNSPSC. Requests are posted on the web site and voted by Segment

Technical Advisers- voting members who have elected to become actively involved in the update of the UNSPSC by contributing their specific expertise.

2.32.12 References

http://www.unspsc.org/

2.33 VBN Code

2.33.1 Name of standard

VBN Code

2.33.2 Issuing organization

VBN

2.33.3 URL

http://www.vbn.nl/en-US/Codes/Pages/default.aspx

2.33.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

2.33.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
			x	

2.33.6 Description

The VBN administers codes for auctions. Floricultural auctions use codes to identify products and describe them in more detail in trading plants and flowers. Product codes are used for identification. Characteristic codes are used for further description of certain aspects of the product important to trade, including quality characteristics (with the inspection code), sorting characteristics and logistical aspects (container code). The information is necessary for the correct product information in the chain. Next to these kinds of codes, VBN also knows group codes, barcodes, country codes and colour codes.

The coding system has been revised under the project name Linnaeus. The product codes in here have been expanded from 5 to 7 positions, more product information can be added, the information in chain messages is available in several languages regulations regarding compulsory characteristics for auction batches have been included in the code lists.

2.33.7 Regional scope

National

2.33.8 Language

Dutch

2.33.9 Status

Continuous development, the list of product codes is updated regularly, new products and changes to products appear continuously.

The technical specification is updated regularly, the current version is 2.9, issued in 2011.

2.33.10 License

Everyone can use codes, no fee for use of inspection of code lists.

2.33.11 Participation

The VBN has auctions as its members. The auctions are co-operations in which growers are united to organize their mutual sale.

Product codes can be requested at VBN. The codes are issued and controlled by VBN. They are accepted when they satisfy the constraints set by VBN. The participants in the decision process are the participants of VBN.

2.33.12 References

http://www.vbn.nl/en-US/Codes/Pages/default.aspx

2.34 WCO Data Model

2.34.1 Name of standard

WCO Data Model

2.34.2 Issuing organization

World Customs Organization (WCO)

2.34.3 URL

http://www.wcoomd.org/en.aspx

2.34.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	

2.34.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x		

2.34.6 Description

The WCO Customs Data Model provides a maximum framework of standard and harmonized sets of data and standard electronic messages to be submitted by trade for Customs and other regulatory purposes to accomplish formalities for the arrival, departure, transit and clearance of goods in international cross-border trade. The revised Kyoto Convention requires Customs administrations to request as few data as necessary to ensure compliance with Customs laws. Customs administrations concerned will therefore require only the data elements they have listed for each customs procedure in the respective data sets. These self-imposed limits discourage future increases in data requirements.

2.34.7 Regional scope

Global

2.34.8 Language

English

2.34.9 Status

Continuous development, the current version is 3.2, issued in November 2011.

2.34.10 License

Purchase of the standard is free for governments, but requires a fee for corporations. Use of the model is free.

2.34.11 References

http://www.wcoomd.org/en.aspx

2.35 GS1 Standards

2.35.1 Name of Standard:

GS1 Standards

2.35.2 Sector

GS1 Standards concentrate on cross company identification and communication. They are not restricted to any sectors. There is a very high adoption rate within the food and logistic industry.

2.35.3 Description

Set of standards for cross company identification, communication, process, master data and classification standards

2.35.4 Source:

GS1 General Specifications

2.35.5 URL

www.gs1.org

2.35.6 GS1 Identification Standards

All GS1 Keys are

- Unique
- Non-significant
- International: GS1 Identification Keys may be used in all countries and all sectors
- Secure: GS1 Identification Keys have a defined structure and most include Check Digits

2.35.6.1 Prerequisite for the Allocation of GS1 Identification Keys: GS1 Global Company Prefix (GPC)

The GCP is allocated by GS1. It is part of every GS1 Identification Key and guarantees its uniqueness.

2.35.6.2 Party identification: Global Location Number

Global Location Number (GLN): The GLN is the worldwide unique identification of each company or physical location within a company.

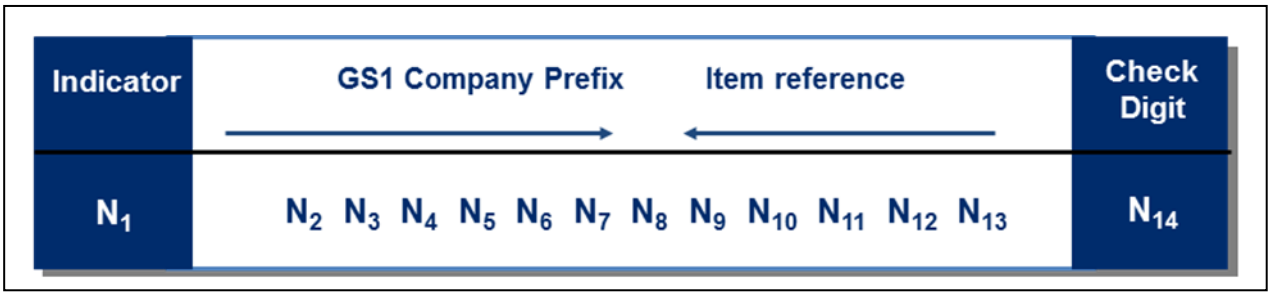
GLN Structure:

GS1 Company Prefix	Location Reference	Check Digit
N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8 N_9 N_{10} N_{11} N_{12}		N_{13}

2.35.6.3 Product identification: Global Trade Item Number (GTIN):

The GTIN identifies each product or service by its unique number that is generated based on the GCP of the brand owner. brand co-operative or producer.

GTIN Structure:



2.35.6.4 Asset Identification: GRAI

Global Returnable Asset Identifier: Identifies any returnable containers or packaging that will be returned to their source.

GRAI Structure:

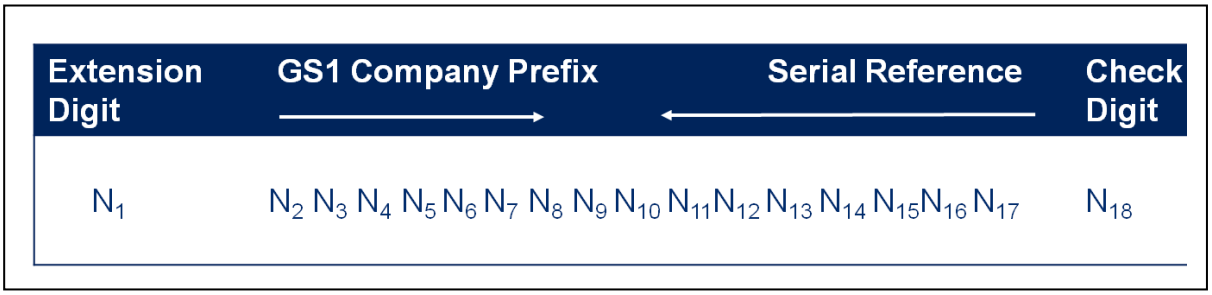
GS1 Company Prefix	Asset Reference	Check Digit	Optional serial number
N_1 N_2 N_3 N_4 N_5 N_6 N_7 N_8 N_9 N_{10} N_{11} N_{12}		N_{13}	X_1 ….X_{16}

Assets, for example crates or boxes belonging to the same type are identified by the same GRAI. GRAIs can be serialized by their optional serial number.

2.35.6.5 Identification of logistic units: SSCC

The Serial Shipping Container Code (SSCC) identifies an item of any composition made up for transport or storage.

SSCC Structure:



2.35.7 Data capture: GS1 Bar Codes and GS1 Application Identifier System

2.35.7.1 GS1 Barcodes

The GS1 System provides several types of bar code for use by GS1 members depending on the application. The reasons for this vary because different bar code types have different strengths. GS1 selects the bar code that best fits the application. The bar codes used by GS1 include EAN/UPC, GS1 DataBar, GS1-128, ITF-14, GS1 DataMatrix, Composite Component and GS1 QR Code.

In the food sector EAN/UPC and from 2014 GS1 DataBar are deployed in an open environment. Whereas EAN/UPC barcodes, encoding GTIN and Restricted Circulation Numbers only have been used on consumer units for decades GS1 DataBar encodes additional information such as a batch, best before date, serial number or net weight.

On logistic units GS1-128 is commonly used encoding data such as GTIN, gross weight, net weight, batch, best before date or the SSCC. Especially in logistic environments GS1 Keys can be encoded in an EPC/RFID tag.

2.35.7.2 GS1 Application Identifier System

The GS1 Application Identifier is used in all symbologies encoding data beyond GTIN. Every kind of information is denominated by an Application Identifier stating the content and the structure of the information. For example the batch/lot number is announced by AI 10 and may have up to 20 alphanumeric characters. The BBD is announced by AI 15. Its structure is YYMMDD (YearYearMonthMonthDayDay).

2.35.7.2.1 Examplary Data Structure:

If encoded in a GS1 Barcode the data structure is as follows

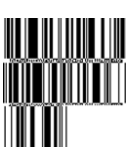
(01)04012345123456(15)130824(10)1249

The BBD of this product is 24 August 2013 and its batch is 1249

Barcode Examples

GS1-128 label Example

GS1 DataBar Example



EAN/UPC-Code on a product

2.35.8 Communication standards

2.35.8.1 EPCIS

2.35.8.1.1 Name of standard

EPCIS (Electronic Product Code Information Services)

2.35.8.1.2 Source (issuing organisation)

EPCglobal Inc. /GS1

2.35.8.1.3 URL

http://www.gs1.org/epcglobal/standards

2.35.8.1.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	x

2.35.8.1.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
X	x			

2.35.8.1.6 Description

EPCIS (Electronic Product Code Information Services) is a standard for the capture and exchange of visibility data of objects identified with an EPC (Electronic Product Code). Examples for objects relevant for the agri-food sector encompass products, animals, shipments, documents, locations, returnable transport items as well as assets. It is important to comprehend that EPCIS is data carrier agnostic. Thus, EPCIS does not necessarily require RFID technology.

It is meant to be complementary to EDI. Each time an EPC is read, an event is generated containing fine-granular visibility data encompassing four dimensions: *what* (uniquely identified objects), *where* (location and read point), *when* (time of event) and *why* (status and business process). The events are stored in decentralized databases (EPCIS repositories). An EPCIS repository has a capture interface for storing as well as a query interface for retrieving event data. The transfer of data via the capture interface is via HTTP, the query interface uses SOAP, XML over AS2 and XML over HTTP(S). All message protocols must be able to use authentication and authorization.

Apart from the Object Name Service (ONS) and EPC Discovery Services, EPCIS is the most important of the three major components of the EPCglobal network. Their interaction is as follows: The ONS (Object Name Service) can be used to provide a lookup service for delivering the network address (URL) of an EPCIS system. In contrast to that, the EPC Discovery Services will serve as a search engine for obtaining information about specific EPCs. However, the latter are yet under development.

A complete free and open source implementation of the EPCIS specification including repository as well as query/ capture clients and interfaces – Fosstrak – has been developed by the Auto-ID Labs. (https://code.google.com/p/fosstrak/wiki/EpcisMain)

2.35.8.1.7 Regional Scope

None – EPCIS is a globally established standard.

2.35.8.1.8 Language

English.

2.35.8.1.9 Example data set

```
<ObjectEvent>
  <eventTime>2013-02-18T06:41:50Z</eventTime>
  <recordTime>2013-02-18T06:41:50Z</recordTime>
  <eventTimeZoneOffset>+01:00</eventTimeZoneOffset>
  <epcList>
    <epc>urn:epc:id:sgtin:4000001.001602.112</epc>
    <epc>urn:epc:id:sgtin:4000001.001602.130</epc>
  </epcList>
  <action>ADD</action>
  <bizStep>urn:epcglobal:cbv:bizstep:commissioning</bizStep>
  <disposition>urn:epcglobal:cbv:disp:active</disposition>
  <readPoint> <id>urn:epc:id:sgln:4000001.00005.0</id> </readPoint>
  <bizLocation> <id>urn:epc:id:sgln:4000001.00002.0</id> </bizLocation>
  <bizTransactionList>
    <bizTransaction
    type=”urn:epcglobal:cbv:btt:desadv>http://example.com/desadv/9876</bizTra
    nsaction>
  </bizTransactionList>
</ObjectEvent>
```

2.35.8.1.10 Status [Proposed, In use, etc.]

In use.

2.35.8.1.11 Licence

Royalty-free.

2.35.8.1.12 References

EPCglobal Inc. (2007): EPC Information Services (EPCIS) Version 1.0.1 Specification.

2.35.8.2 EPC (Electronic Product Code)

2.35.8.2.1 Name of standard

EPC (Electronic Product Code)

2.35.8.2.2 Source (issuing organisation):

GS1/ EPCglobal

2.35.8.2.3 URL

http://www.gs1.org/gsmp/kc/epcglobal

2.35.8.2.4 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	x

2.35.8.2.5 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x		x	

2.35.8.2.6 Description

An EPC is a unique, individual identifier for different types of business objects (i. e. instances of articles, returnable transport items (RTI), shipments, etc.). The EPC is used in information systems that need to track or otherwise refer to business objects. A large subset of applications that use the EPC rely upon RFID Tags as a data carrier. However, it is vital to understand that RFID is not necessarily needed in order to utilize the EPC standard(s).

The following table displays four of the most relevant EPC schemes for the agri-food domain as specified in the EPC Tag Data Standard: Serialized Global Trade Item Number (SGTIN), Serial Shipping Container Code (SSCC), Global Returnable Asset Identifier (GRAI), and Global Location Number with optional extension (SGLN). Apart from that, the EPC can also be used to identify service relations (patients, e.g.), documents (certificates, tenders, eCoupons, etc.) as well as assets (farm machines, etc.).

EPC scheme	**Area of application**	**Example (URI form)**
SGTIN	Trade items	urn:epc:id:sgtin:4012345.066666.12345
SSCC	Shipments; logistics unit loads	urn:epc:id:sscc:4012345.1234567891
GRAI	Returnable/ reusable items	urn:epc:id:grai:4012345.77777.678
SGLN	Locations	urn:epc:id:sgln:4012345.66666.5

2.35.8.2.7 Regional Scope

Globally established

2.35.8.2.8 Language

English

2.35.8.2.9 Example data set

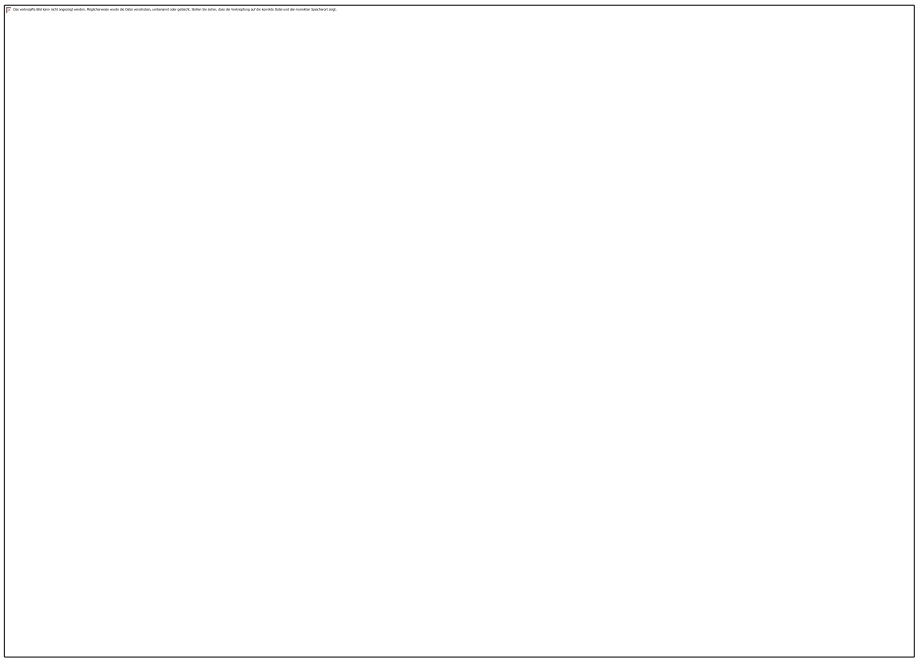
Depending on its field of application, an EPC can be displayed in three different forms (see the beneath figure):

EPC Pure Identity (as used in application systems and EPCIS)

EPC Tag URI (as used in RFID middleware systems)

EPC binary code (as used on RFID transponders)

The latter two (i.e., ‘b’ and ‘c’) are related to RFID only. Thus, the most important EPC representation is the first one. The figure also displays that an EPC can be converted into the corresponding (serialized) GS1 key and vice versa. Taking the example of the GTIN (Application Identifier ‘01’) and a serial number (AI ‘21’), the figure displays the conversion process into the three different (SGTIN) EPC representation forms as indicated above.



2.35.8.2.10 Status [Proposed, In use, etc.]

In use.

2.35.8.2.11 Licence

Royalty-free.

2.35.8.2.12 References

Tag Data Standard (Version 1.6)

2.35.8.3 EANCOM®

2.35.8.3.1 Name of standard

EANCOM®

2.35.8.3.2 URL:

http://www.gs1.org/gsmp/kc/ecom/eancom

2.35.8.3.3 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	x

2.35.8.3.4 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x		

2.35.8.3.5 Description

EANCOM® is a GS1 subset of the UN/EDIFACT standard (United Nations Electronic Data Interchange for Administration, Commerce and Transport), which comprises a set of internationally agreed standards, directories and guidelines for the electronic interchange of data.

EANCOM® is fully compliant to UN/EDIFACT. It provides the collection of only those message elements which are needed by the business application and required by the syntax (mandatory elements). Omitted are optional elements covering very specific business requirements not relevant for GS1 users.

EANCOM® incorporates into the electronic messages the GS1 standards of physical identification of trade items, logistics units and the Global Location Numbers identifying the trading partners. It allows integrating the physical flow of goods with related information sent by electronic means.

The EANCOM® messages are equivalent of traditional paper business documents.
Messages available in the EANCOM® standard cover the functions required to complete a trade transaction:

- messages which enable the trade transaction to take place, e.g. price catalogue, purchase order, invoice, etc;
- messages used to instruct transport services to move the goods;
- messages used in settlement of the trade transactions through the banking system.

2.35.8.3.6 Regional Scope

Global

2.35.8.3.7 Language

English, German and other languages are available.

2.35.8.3.8 Status [Proposed, In use, etc.]

In use

GS1 EANCOM® is an international standard, used by over 100 000 companies worldwide. Therefore is the GS1 EANCOM® standard the leading and most widely used EDI standard in the world today. The international network of GS1 Member Organisations (including GS1 China), covering more than 150 countries, provides support, documentation and training in local languages.

2.35.8.3.9 Licence

The use of EANCOM® is free.

2.35.8.4 GS1 XML

2.35.8.4.1 Name of standard

GS1 XML

2.35.8.4.2 URL:

http://www.gs1.org/gsmp/kc/ecom/eancom

2.35.8.4.3 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness
	x	x

2.35.8.4.4 Level

Protocol	Syntax	Semantics	Identification	Metadata
	X	x		

2.35.8.4.5 Description

XML is an acronym for "eXtensible Markup Language". XML is designed for information exchange over the internet. Within GS1 set of standards, XML is used for Electronic Data Interchange - GS1 eCom.

GS1 XML is designed in such a way that the messaging is transport agnostic. GS1 supports reliable and secure messaging via the use of AS1, AS2, AS3, AS4 and ebMS, as well as other transport protocols. It is very simple to exchange GS1 XML documents using any technical solution or profile, such as Web Services.

The GS1 XML messages are developed using the business process modelling methodology. First, the business process is described, including identification of business data that need to be exchanged between the main parties. This information is then mapped to the electronic messages. Thus, the GS1 XML messages are not always equivalent of traditional paper business documents.

The messages available in the GS1 XML standard cover the following areas of the supply chain:

- Data Synchronisation messages that enable sending information about the trade item attributes and support its automated synchronisation between business partners, using the Global Data Synchronisation Network (GDSN)
- Messages used to order goods and respond to this order;
- Messages used to announce the despatch of goods and confirm their receipt
- Messages requesting payment for the goods sold and informing about the payment being sent
- Messages for planning and execution of transport
- Messages supporting automated replenishment of goods

GS1 XML standards support both Downstream (between the consumer goods manufacturers and retail) and Upstream (between the consumer goods manufacturers and their suppliers of raw material, packaging, etc.) communication.

2.35.8.4.6 Regional Scope

Global

2.35.8.4.7 Language

English, German and other languages are available.

2.35.8.4.8 Status [Proposed, In use, etc.]

In use

GS1 XML standards provide solutions for multiple sectors using the same XML business message. GS1 XML is an international standard, and has been implemented in 33 countries, by more than 22.000 companies.The international network of GS1 Member Organisations (including GS1 China), covering more than 150 countries, provides support, documentation and training in local languages.

2.35.8.5 WebEDI

2.35.8.5.1 Name of standard

WebEDI

2.35.8.5.2 URL:

http://www.gs1.org/gsmp/kc/ecom/eancom

2.35.8.5.3 Sector

SmartFarming	SmartAgriLogistics	SmartFoodAwareness

	x	x

2.35.8.5.4 Level

Protocol	Syntax	Semantics	Identification	Metadata
	x	x		

2.35.8.5.5 Description

WebEDI is an Internet-based method of transfer for connecting business partners with a low data volume who have no EDI infrastructure of their own. It is a way for small and medium-sized enterprises (SMEs) to be connected to Electronic Data Interchange.

WebEDI involves the exchange of electronic documents via an internet enabled platform. The business messages are available to the users as web forms that can either be filled-in manually or in automated way. The message is then converted by the translation application into the relevant eCom standard and transferred to the other user company.

GS1 Global does not provide separate guidelines for the WEB EDI, but some GS1 Member Organisations do provide local guides, e.g. Germany.

The WebEDI recommendations of GS1 Germany were developed in close cooperation and coordination with users from the private sector. Standard data profiles and mask layouts were developed for the following message types on the basis of the EANCOM® standard in the context of GS1Germany's WebEDI recommendations:

• Purchase Order (ORDERS)
• Despatch advice (DESADV)
• Receiving Advice (RECADV)
• Invoice/Credit note (INVOIC)

The recommendations include harmonised data profiles and layouts for:

• Part 1: Retail – connection of suppliers (data and layout, design and layout, process descriptions and ASCII interfaces)
• Part 2: Industry – connection of speciality retailers
• Part 2a: ASCII interface

2.35.8.5.6 Regional Scope

National

2.35.8.5.7 Language

English and German.

2.35.8.5.8 Status [Proposed, In use, etc.]

In use

WebEDI has been implemented in 40 countries by more than 100.000 companies.The international network of GS1 Member Organisations (including GS1 China), covering more than 150 countries, provides support, documentation and training in local languages.

2.35.8.5.9 Licence

The use of WebEDI is free of licence

2.35.8.6 Data Synchronisation: Global Data Synchronisation Network (GDSN)

2.35.8.6.1 Source

http://www.gs1.org/gdsn/ds

2.35.8.6.2 URL

http://www.gs1.org/gdsn/ds

2.35.8.6.3 Description

GDSN consists of a family of standards, including catalogue messages based on GS1 XML, comprising deliverables for fruit and vegetables, data quality, measurement rules and the synchronisation of data pools.

2.35.8.6.4 Licences

The allocation of GS1 Keys (i. e. the availability of a Global Company Prefix) requires the membership of a GS1 Member Organization. The use of GS1 Bar codes, GS1 EDI and GDSN Messages and GPC is free of charge. Data Pools usually charge fees for their services.

2.35.9 Classification Standard: Global Product Classification (GPC)

2.35.9.1.1 Source:

http://www.gs1.org/gsmp/kc/gpc

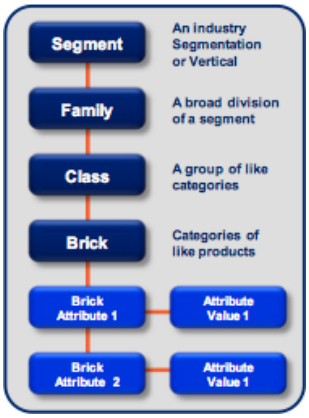
2.35.9.1.2 URL:

http://www.gs1.org/gdsn/gpc

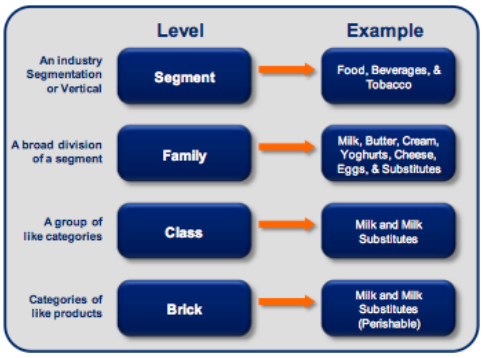
2.35.9.1.3 Description

The GPC is a system that gives buyers and sellers a common language for grouping products in the same way, everywhere in the world.

The foundation of GPC is called a "Brick;" GPC bricks define categories of similar products. Using the GPC brick as part of GDSN ensures the correct recognition of the product category across the extended supply chain, from seller to buyer. Bricks can be further characterised by Brick Attributes.

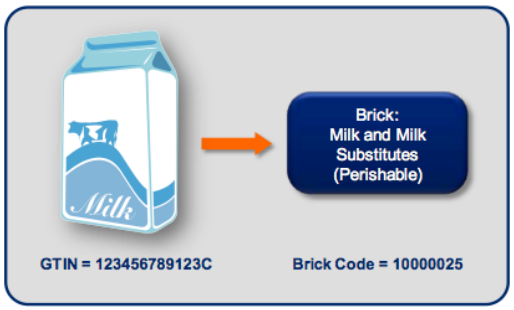


Using GPC hierarchy to find the Brick



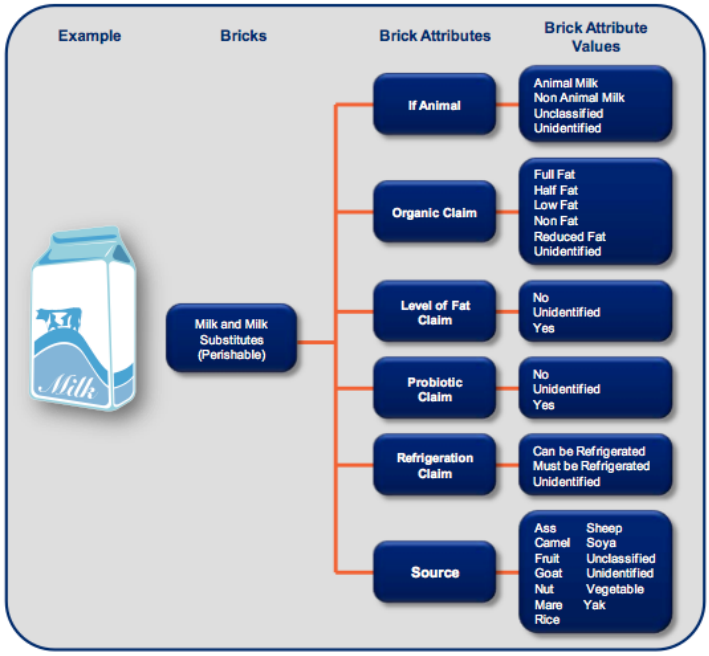
One GTIN, One Brick

A Global Trade Item Number (GTIN) can only be assigned to one Brick.



Using attributes

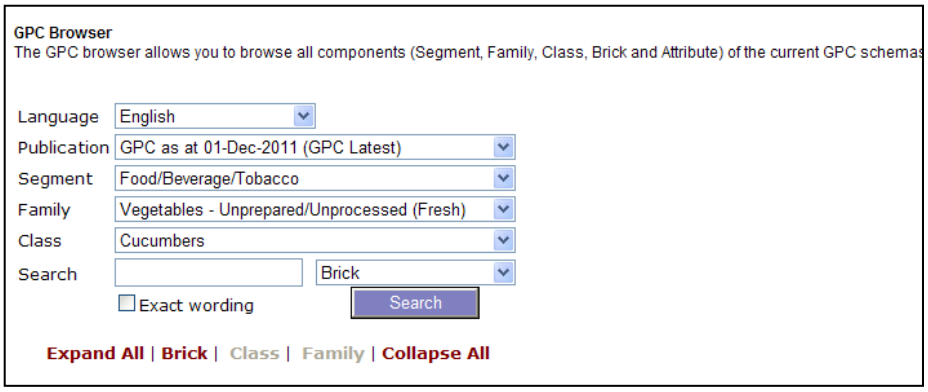
Bricks can be further characterised using attributes where required.

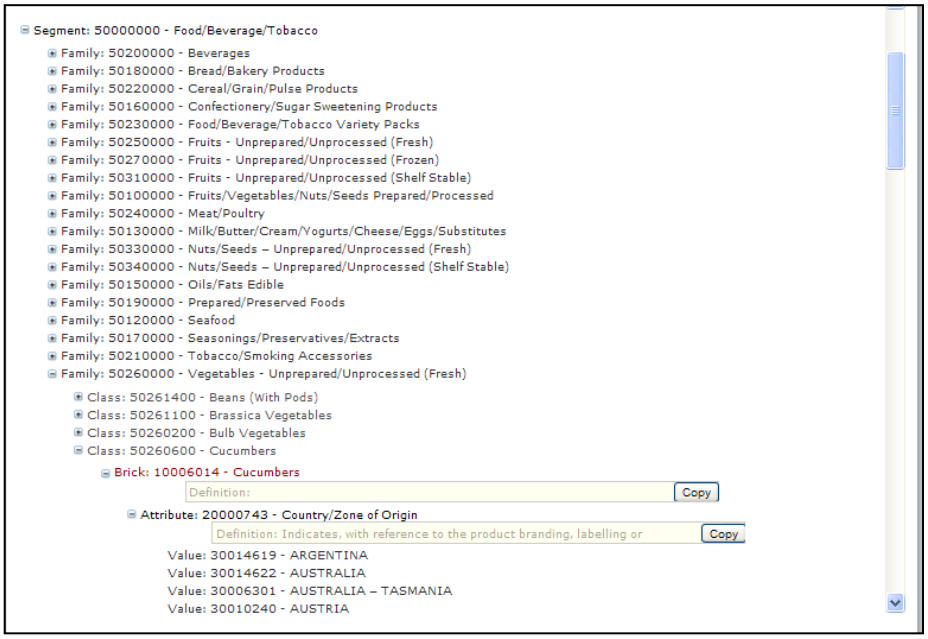


Category scope

GPC is already available for a wide range of categories - and is growing all the time. From 2010 on GPC is available for Fruit and Vegetables; for Flowers and plants the GPC will be available in 2013.

Example: GPC Structure of Cucumbers:




Segment: 50000000 - Food/Beverage/Tobacco
Family: 50200000 - Beverages
Family: 50180000 - Bread/Bakery Products
Family: 50220000 - Cereal/Grain/Pulse Products
Family: 50160000 - Confectionery/Sugar Sweetening Products
Family: 50230000 - Food/Beverage/Tobacco Variety Packs
Family: 50250000 - Fruits - Unprepared/Unprocessed (Fresh)
Family: 50270000 - Fruits - Unprepared/Unprocessed (Frozen)
Family: 50310000 - Fruits - Unprepared/Unprocessed (Shelf Stable)
Family: 50100000 - Fruits/Vegetables/Nuts/Seeds Prepared/Processed
Family: 50240000 - Meat/Poultry
Family: 50130000 - Milk/Butter/Cream/Yogurts/Cheese/Eggs/Substitutes
Family: 50330000 - Nuts/Seeds – Unprepared/Unprocessed (Fresh)
Family: 50340000 - Nuts/Seeds – Unprepared/Unprocessed (Shelf Stable)
Family: 50150000 - Oils/Fats Edible
Family: 50190000 - Prepared/Preserved Foods
Family: 50120000 - Seafood
Family: 50170000 - Seasonings/Preservatives/Extracts
Family: 50210000 - Tobacco/Smoking Accessories
Family: 50260000 - Vegetables - Unprepared/Unprocessed (Fresh)
Class: 50261400 - Beans (With Pods)
Class: 50261100 - Brassica Vegetables
Class: 50260200 - Bulb Vegetables
Class: 50260600 - Cucumbers
Brick: 10006014 - Cucumbers
Definition:
Copy
Attribute: 20000743 - Country/Zone of Origin
Definition: Indicates, with reference to the product branding, labelling or
Copy
Value: 30014619 - ARGENTINA
Value: 30014622 - AUSTRALIA
Value: 30006301 - AUSTRALIA – TASMANIA
Value: 30010240 - AUSTRIA

3 Standardisation bodies

Various organisations provide standards or directories for data. Both public bodies and private associations are involved in the process of standardizing formats that are required for the exchange of data. In this chapter we will briefly describe the most relevant ones for SmartAgriFood.

The **ISO** (International Organization for Standardisation) (www.iso.org) issues standards in all industrial and commercial sectors. Members are national standardisation authorities. The key principles for standardisation are: need in the market and consensus based on global expert opinion. The main work is done by Technical Committees, for agriculture e.g. TC23: "Tractors and machinery for agriculture and forestry". In some cases, there is a relation between other standards-setting organizations or industry associations and the ISO. Standards developed elsewhere thus may be approved later on by ISO. This holds e. g. for some of the standards from the Open Geospatial Consortium, like e. g. GML or from OASIS. Also, the ISO standardisation process may be influenced by such organisations. Of special importance for the agricultural machinery sector are the developments within ISO standard 11783. Activities are managed by the ISOBUS group within the VDMA (Verband Deutscher Maschinen- und Anlagenbau). Also, the Agricultural Electronics Foundation (AEF) actively works out proposals to be introduced into the ISO 11783 standardisation process.

The **W3C** (World Wide Web Consortium) (www.w3.org) is the main international standards organization for the World Wide Web. Its members are mainly businesses, non-profit organizations, universities, governmental entities, and individuals. Recommendations issued by the W3C are for example HTML, XML, RDF and others. Most of the W3C work focusses on generic technologies to be used in a domain independent manner and is thus not within the scope of this deliverable, that covers domain specific standardisation mainly. Increasingly, however, specifications are picked up and published by W3C that are at least specific to large groups of stakeholders, thus covering concepts that fall within a context that could called a super-domain to a number of more specialized domains. One example for this is the Person Core Vocabulary or the Registered Organization Vocabulary (https://dvcs.w3.org/hg/gld/raw-file/default/legal/index.html) originally developed by the ISA programme of the European Union. Both of these recommendations overlap with regard to certain concepts covered with other specifications given within this document.

Another organisation involved in technical standards is the **IETF** (Internet Engineering Task Force, http://www.ietf.org). In contrast to W3C it has no formal membership, it is open to any interested individual. The standardisation process works by the publication of RFCs (Request for Comments). IETF RFCs focus on baseline technology infrastructure standards. They can cover most of the basic infrastructure needs within the FI-PPP programme, although there may be certain areas, in which extensions are needed. Taking into account the importance of identification in the agri-food sector, there are a few IETF standards that have a relation to the domain covered by providing certain means of identifier assignment and representation (e. g. RFC 4122: A Universally Unique Identifier (UUID) URN Namespace or RFC 5134: A Uniform Resource Name Namespace for the EPCglobal Electronic Product Code (EPC) and Related Standards).

While the latter organisations have a rather broad scope, there are a number of more specialised standardisation bodies focusing on agriculture, food, logistics or on topics that are of special relevance within these domains:

GS1 (http://www.gs1.org/) is a global non-profit association with over 100 member organisations. GS1 has developed standards for identification such as key numbers (e.g. GTIN) and data carriers (bar codes, EPC) and communication (e.g. EANCOM). The development

process (Global Standards Management Process) involves working groups with expert delegates from member companies. The responsibility of the national member organisations is the allocation of unique numbers to member companies and providing training and support. The member companies have to pay a fee for obtaining the GS1 company prefix.

A subsidiary of GS1 is **EPCglobal**. Its subscribers are end-users such as manufacturers and solution providers such as hard- and software companies. EPCglobal is leading the development of industry-driven standards for the Electronic Product Code (EPC) to support the use of Radio Frequency Identification (RFID). It assigns EPC Managers Numbers, delivers certification of application and provides other services. Member companies can participate in the development of standards.

Another not-for-profit organisation is **OASIS** (Organization for the Advancement of Structured Information Standards) (www.oasis-open.org). Members are government agencies, software providers and industry groups. The most prominent and widely used standard developed by OASIS is probably the Open Document Format for Office Applications. Apart from that, they are active in standardisation in fields like security, cloud computing, SOA, web services, smart grids, electronic publishing, emergency management etc. OASIS is also responsible for ebXML development. The specifications are all royalty-free.

Also involved in the development of ebXML is the **UN/CEFACT** (United Nations Centre for Trade Facilitation and Electronic Business) (http://www.unece.org/cefact.html). It also produced the UN/EDIFACT standard. The UN/CEFACT provides recommendations for trade facilitations, electronic business standards and technical specifications. There are a number of Trade and Business Groups (TBGs) dealing with certain areas of business. The following TBGs have been identified to have overlaps or relations in their work to the SmartAgriFood project:

- TBG1: Supply Chain
- TBG3: Transport & Logistics
- TBG18: Agriculture

Apart from these, there are TBGs that potentially deal with topics relevant to agri-food in the future or that might become relevant by introducing certain new functionalities within pilot implementation. These include e.g. TBG12, Accounting and Audit or TBG13, Environmental.

Members are governments, intergovernmental organisations, NGOs, chambers of commerce, and companies from the private sector. The permanent groups which develop standards, specifications and guidelines are open to technical experts in the respective fields.

The UN/CEFACT has been established by the UNECE, the United Nations Economic Commission for Europe. The major aim of the UNECE is to promote pan-European economic integration. The Working Party on Agricultural Quality Standards developed a series of standards and recommendations on food products such as meat.

The Open Geospatial Consortium (**OGC**) is an international industry consortium of several hundred companies, government agencies and universities with a main focus on geospatial data. As such, they develop query interfaces for mapping services, geographical data catalogues and indexes and data formats for geometrical constructs represented in geographical coordinate systems. The standards are meant to geo-enable the web and allow for location based services and data exchange between stakeholders interested in spatial information. Within the context of the agri-food sector, OGC standards play a role at the farm level for accessing e.g. publicly available geographic data but also at the logistics level to represent location information. A major development with regard to public sector spatial data standardisation has been the entering into force of the INSPIRE directive in May 2007, establishing an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities

which may have an impact on the environment. The directive addresses 34 spatial data themes needed for environmental applications. Specifications are based on OGC standards enhanced by technical implementation rules.

Regarding the food sector several initiatives support or actively pursue standardisation. The European Food Safety Authority (**EFSA**) operates separately from the European Commission, European Parliament and EU Member States and is governed by an independent Management Board, but is funded by the EU budget. The EFSA collects analytical measurement data for the presence of harmful or beneficial chemical substances in food and feed from a variety of providers such as national authorities, laboratories, research institutes etc. A standard sample description for food and is used (http://www.efsa.europa.eu/en/efsajournal/pub/1457.htm). The standard sample description document was developed by the Technical Working Group on Data Collection (TWG-DC).

Other efforts come from limited term projects. **EuroFIR** (European Food Information Resource) was a five-year Network of Excellence funded by the European Commission's Research Directorate General under the "Food Quality and Safety Priority" of the Sixth Framework Programme for Research and Technological Development. It contributed to the cataloguing of food products (http://www.eurofir.net/food_information/food_identification_and_description). Within the Seventh Framework, the project **TransparentFood** (http://www.transparentfood.eu) identified a number of standards relevant for communication and transparency in the food chain. In the agricultural sector, the **agriXchange** (http://www.agrixchange.org) project implemented a reference framework to enhance information sharing of existing data exchange standards, best practices and proven solutions to the community members.

On national level, various governmental bodies such as ministries, agencies, federal state offices etc. produce standards for data exchange. These are not covered here but addressing through national partners can be a valuable undertaking for incorporating further expertise and for generating awareness and networking of existing activities on the international level.

4 Analysis of pilots

In this chapter, results of the sub-use cases and their set of pilot implementations and of the end-to-end scenario concerning standardisation are evaluated.

The Smart Farming Use Case and the corresponding pilots, Smart Spraying and the Greenhouse Pilot, identified a number of standards to be used. Details are provided in Deliverable 200.3. The standards used include agroXML, SensorXML, Observation and Measurement conceptual model for the Greenhouse Pilot. The Spraying Pilot has used the ISOBUS XML standard and agroXML. The standards have not been used directly, but rather the database schema designs (Entity-Relation Schemata) used in the pilots have been based upon these standards. The Smart Agri-logistics Use Case and the corresponding pilots, the Fruit and Vegetable Pilot and the Flower Pilot, has focussed largely on the use of GS1 standards. A set of suitable or relevant standards has been identified, partly through a qualitative assessment of the relevance for the respective pilots (cf. D300.4). The standards identified include a number of GS1 standards (EPCIS, GPC, GLN, GTIN) which is to be expected as they are the most widely used standards in commerce (GS1). A number of others have been identified as relevant or usable, but have not been used in the current pilots (including AgroVoc, LinguaL, Edibulb). The Smart Food Awareness Use Case has not identified specific standards to use (or re-use) for the TIC pilot, although a detailed description of product data needed has been developed in D400.3 and this will influence the database schema design.

Both pilots in the Smart Farming Use Case (Greenhouse and Spraying) identified needs for extensions. The following gaps, where information is needed, but cannot be expressed, easily exchanged or integrated into existing standards formats, were identified:

- Type of employee
- Interconnections between machines or devices like protocols capabilities
- Multimedia content such as images or videos
- Link to information concerning the food-chain and traceability
- Information on wind direction and air pressure, which are important parts of weather data

No standard is currently available for the communication between the Service Bus and the FMS controller (see D200.3, Table 9.1) and for the communication between the FMS and the GEs. In the communication within the GEs, the main issue are the missing semantics for the description of domain specific business services, e.g. spraying contracts.

The Smart Food Awareness Use Case revealed a large gap in the standardisation which exists in the retailer-consumer interaction, although the TTAM pilot makes use of the GS1 EPCIS technology.

In the Smart Agri-logistics Use Case the semantic standards for the range of business functions is the main gap. There are also a gaps related with harmonization in the case of cross-border transport of animals and meat

With respect to the TTAM pilot, lots of data are available on the animals and their upbringing, because animal identification is mandatory and standards and technologies are available for this task. However, harmonisation is still needed in the case of cross-border transport of animals and meat. Data that are collected during breeding and upbringing are currently used mainly for herd management. It has to be carefully evaluated which data are relevant for the next steps in the production chain and for the consumer and how to turn these data into signals. These data could then be included into EPCIS as an additional, extensible data backpack.

The TIC pilot focusses on making information available for the consumer according to his needs. As already stated in the analysis of the Smart Agri-logistics Use Case, a number of food

catalogues is available. A more detailed description of product data which are relevant for consumer awareness has been developed in D400.3 and this has the potential to be formalised into an appropriate standard or ontology. Each of the attributes within this data model has to be analysed in detail and a standard vocabulary has to be worked out for a number of them. No standard is available for this type of consumer-directed product description. As a complement to it, also consumer demands should be enabled to be formally described. The goal is to enable match-making between real-world product properties and demanded properties allowing for consumers to make informed choices.

The same gap in standardisation (no standard for retailer-consumer interaction) has also been found in the end-to-end Scenario. However, the recommendation is to avoid to create new standards but to expand and to complement the existing GS1 standards with other standards and vocabularies. Further details concerning the end-to-end Scenario can be found in D100.4.

Concerning the Future Internet Core Platform, specific standardisation needs of the agri-food sector that go beyond the general needs also provided by other sectors have not been identified in the pilots within this phase. This is partly due to specifications still being too vague for match-making of planned functionalities with sector-specific requirements. Intensifying the dialogue during concrete application implementation within phase 2 is however seen as an important step towards future standardisation work (cf. Chapter 7). Setup of a cross-project FI-PPP standardisation working group was planned for beginning of 2013, but has not been active until mid of the year. Activities are assumed to be picked up during the start of the second phase.

5 Challenges and opportunities

The complexity and heterogeneity of the agri-food supply chain is one that clearly is in great need of further uptake of data standards. The recent horsemeat scandal (January/February 2013) has highlighted the complexity of food supply chains. A great many actors take part in the supply of any one product and it would be imperative that information about that product and its path from original producer to final consumer is tracked, is traceable and above all is query-able. There are a number of challenges and opportunities which become visible when there are food safety (or labelling) crises.

5.1 Challenges

The following challenges concerning standardization in the agri-food sector can be identified:

- The very large number of different organisation which participate in the food supply chain make it very difficult to get agreement to use a data model/knowledge representation standard.
- Different actors along the supply chain require different types of information, much of which is idiosyncratic or cultural-specific (e.g. grain transporters in the UK need to specify what the previous load of the lorry was).
- The business case is not always obvious. Unless regulation imposes it, there is little willingness to invest in standards and related technology, due to the small economic margins on agricultural products.
- The existing wide variety of standards which cover different aspects of the necessary data, with some overlaps, create further confusion. It is not clear to most actors what standards they should be following beyond those forced upon them for commercial purposes (e.g. GS1).
- Sharing of data is viewed in some quarters with enthusiasm (e.g. artisanal food producers) and in other areas with trepidation (e.g. industrial food production). Some types of data are shared more easily than other (place of origin vs. type of pesticide used). Thus data access and privacy are important, but also getting one's name widely known is important.

Part of the challenges are shaped by non-functional requirements to applications. Developing specifications that are on the long run to be turned into standards involves taking these factors into account at an early stage in development. Aspects to be considered are e. g.:

- security
- performance
- accessibility
- usability
- stability
- portability
- cost
- operability
- interoperability
- scalability
- concurrence
- maintainability

5.2 Opportunities

The following opportunities concerning standardization in the agri-food sector can be identified:

- Standards are becoming both more important and cheaper to deploy. The growth of smartphone apps in various areas of food production and retail provide an opportunity if such apps where able to import or export (consume and publish) data in standardised formats.
- Repeated crises in the food industry are making the need for standards more urgent and the economic necessity becomes clear.
- Consumers are now used to have access to all kind of information, so information about their food becomes a growing consumer demand. This is leveraged by the general movement for transparency and public availability of data.
- Health and labelling scandals provide an opportunity for politicians to impose labelling requirements. Those requirements would be far less onerous on farmers, food producers, logistics and retail if all actors followed the same data standards.

Across a number of deliverables within the SmartAgriFood project, we have discussed the potential that Semantic Web technologies could provide in making the wider uptake of standards both easier and more approachable. Standards like the GS1 family have two issues. One is characteristic of all standards organisations in that they take a long time to add further elements/data points to their standard. This means in a fast moving world with constant changes in data modelling requirements, GS1 is usually behind the game. The second issue is rather more technical. Concerning a specific identification number, GS1 technologies are set up to provide the user with a set of data. Thus with a GTIN one can obtain product information. However, as things currently are, one cannot query the GS1 system in the reverse order, i.e. provide a set of parameters/constraints and get back a set of GTINs or GLNs. Thus in a food safety or labelling crisis, it is extremely difficult to request all products and their locations with certain characteristics. Semantic technologies provide solutions for a number of these aspects. They can be used to develop new standards and correspondingly maps between different standards. Semantic technologies can be used to complement GS1 without replacing or competing. Vocabularies and ontologies can be written to cover new areas or topics. Just as important, semantic technologies are supported by the W3C and are underpinned by free standards for knowledge representation. The Linked Data model provides an opportunity for data publishing and consumption which has the potential of being low cost and accessible to the majority of food supply chain actors - from the very large supermarkets to the very small farmer or food processor.

6 Recommendations and Strategy

This document provides an extensive list of relevant existing standards that were identified in the context of the SmartAgriFood project. In the future, it is a relevant task to continue to identify current and emerging, relevant standards. This can be done by monitoring the activities of standardisation bodies.

In SmartAgriFood, the implementation of the pilots used existing standards whenever possible. In the next development steps, it is very important to continue this strategy and to align the project results with standards. Any additional data format or protocol that is created when not necessary increases the workload and hampers interoperability. "Re-inventing the wheel" needs to be prevented. The monitoring activities will keep developers aware about existing and emerging standards. The focus of all work should be on domain specific standards, but the experience in pilot development and trials concerning generic standards and technologies need to be communicated to the FI PPP partners and community. In some cases, it will be necessary to contribute to standardisation activities and to extend existing standards. This will be done in close collaboration with the respective FI PPP activities, e.g the FI PPP standardisation WG, but also with partners outside of the FI PPP program. Examples for this task are the contribution to the further development of agroXML or the various GS1 standards. Another subtask is the harmonisation of national standards, which involves the translation and multilingualisation of standards which are currently restricted to one country. This can be considered as a contribution to prevent "Re-inventing the wheel". A number of overlaps and intersections have been identified, where several standards cover the same scope. This is mainly the case for product catalogues, where a number of classification systems exist even for food and agricultural products but also for basic organizational and person data or location data. This is the obvious result of the fact, that there is an infinite number of ways to model the real world. Therefore it recommended to evaluate new technologies to map various ontologies onto each other. One possible approach could be to use facetted classification systems. SmartAgriFood can provide the experience and research results gathered during pilot development and deliver reference process models in order to support further standardisation activities.

Despite all efforts to stick to existing standards, gaps have been identified where some interfaces and data exchange processes are not covered by current standards or standardisation efforts. If the opportunity arises, new standards have to be established. This is especially required when new technologies or new business processes are developed. An example for this task is the Consumer Awareness sub-use case. Here, a data format both for the product backpack data, which gives more information on the products, and for the description of consumer interests that match the product backpack data, have to be developed. This development task consists of several steps: specification, implementation and standardisation. In order to reach broad acceptance of the envisaged standard, several issues have to be considered. During the specification, the relevant stakeholders must be involved at an early stage. The specification must be generic enough to cover all needs. It needs to be orthogonal to fit into existing technological frameworks and to ensure scalability. In the next steps, syntax and semantics have to be defined. These have then to be applied in the pilot and early trial development to evaluate and ensure the quality needed. Finally, the project team has to enter into the standardisation process to gain acceptance beyond the project community.

As an FI PPP project, SmartAgriFood has to demonstrate the utility and applicability of the FI-Ware Generic Enablers in the agri-food domain. The project has demonstrated this extensively in a number of deliverables, but in order to develop the data and services ecosystem, which the EC has hoped to kick-start partly through the FI PPP programme, there needs to be far greater use of data standards. As noted in the previous paragraph, while a certain number of gaps need to be covered, the whole domain does not cry out for the creation of new standards. Rather what is

needed is the decision to use one specific set of standards either through a policy decision from government/EC, or through common agreement among commercial actors. The latter is unlikely, given the complex and heterogeneous nature of the agri-food sector. Repeated discussions within the SmartAgriFood consortium point to the need for regulation to impose data standards on the sector. In conclusion we provide the following recommendations for standardisation for large scale experimentation in phase 2 of FI-PPP.

Recommendation 1. Encourage regulators to impose data standards for the whole agri-food sector from farm to fork.

Given the time consuming nature of standards development, and the difficulty of achieving consensus, reuse of components already given in certain standards is of crucial importance. With regard to identification and within supply chain management, the obvious core to any regulatory imposed set of standards has to be the GS1 family. Over time, GS1 need to expand to cover the gaps in both content and functionality by seamless integration of standards in other areas.

Recommendation 2. Base a core supply chain management infrastructure layer providing identification and event querying mechanisms around GS1 and complement it in a modular way with other standards providing new functionalities and data content.

The danger in all such regulatory interventions is that we end up with a sclerotic system unable to adapt rapidly enough to technological changes and developments in business needs. GS1 standards can serve as a baseline infrastructure for core services and provide an open, extensible set of standards determined by its members.

Recommendation 3. Provide a generic mapping layer based on the semantic technology stack that facilitates inter-standards interoperability and standards extensibility.

We suggest applying semantic technologies to provide a layer of interoperability with growing standards in other areas. This provides a technological infrastructure currently missing from GS1. It is meant to allow for flexible combination of data represented in different standards and for facilitated extensions of data models while keeping interoperability at a high level by formally describing semantics.

Recommendation 4. Ensure active participation in relevant standardisation bodies and working groups.

This can be done by including standardisation bodies as a project partner in FI-PPP phase 2 projects or by participation in their working groups, technical committees, etc. Besides it is important to actively participate in the overarching FI-PPP working group on standardisation to identify common standardisation needs and if applicable take concerted actions towards standardisation bodies.

Recommendation 5. Setup communication facilitators between information technology experts and domain experts

As presented in 1.2, there is an ideal, orthogonal, modular layering of standards. Any higher level domain-specific standard however relies on lower layer encoding or notation technologies. To be able to efficiently implement applications based on a domain specific standard it is important, that technically appropriate representation methods are used. Making the correct choice involves a certain broad information technology expertise that is commonly not existing among domain experts. On the other hand, IT experts do not have sufficient knowledge of the domain to make an educated choice. No modelling technique can currently overcome this gap. It is therefore important to place moderators that are able to communicate to both sides.

Recommendation 6. Ensure orthogonality in specifications by staying up-to-date with regard to standards developed elsewhere.

In an ideal electronic communication world it is possible to exchange any layer within a protocol stack individually without adversely affecting other layers. This can be achieved by elaborating sets of separate functionalities to be encapsulated within the different layers. For this to work, it is necessary to constantly keep informed about other standardisation activities at different levels. Reading specifications of other initiatives is therefore a necessity to be informed about functionality ranges already provided elsewhere.

7 Action Plan for Phase 2

From the gaps and recommendations that were identified in the previous chapters, the following actions and tasks can be defined as a follow-up for FI PPP phase 2 activities:

- Provision of guideline documents for the use of standards within agri-food and logistics: This lists and describes the standards which are applied or which most probably will be applied in the later use case trials and serves as an entry point to developers to direct them to information resources, give best practices and high-level "cookbook" style recipes concerning implementation of standardized interfaces.
- Investigation on technology standards for cross sectorial system and data integration: One of the most important gaps identified was a lack of semantic interoperability between standards. Therefore, technologies to facilitate mapping content of data encoded in different standards and for linking any kind of product-, location-, partner- and consumer-related information are of crucial importance for sector-wide integration. The role that Semantic Web technologies can play in complementing GS1 and other standards has to be investigated for providing additional domain modelling and functionality. The overall purpose is to build the basis for enabling information gathering on a very fine granular level (e.g. energy/water consumption of product instances) while overcoming cross-company and cross-sectoral barriers due to different formats, identification schemes, protocols, EDI messages, etc.
- The most marked media breaks and heterogeneities exist at the end nodes of the supply chain, i.e. from-farm and to-consumer. One of the tasks is therefore to strengthen already existing approaches for data exchange at the end nodes of the supply chain by addressing issues at appropriate standardisation organizations. This has to be dealt with from two directions: On the farm level e.g. issues will be discussed within ISO TC23 to raise awareness about the increasing demand to move information up-chain and within organizations providing standards one step up the chain, like e.g. GS1 to find solutions for picking up and handing of this information.
- Identify to which extent standards have to be extended or modified and work out a set of concrete, technical proposals to be handed to and discussed within standardisation organizations. Apart from the high-level overview provided in this document, this requires in-depth preparatory work on aspects chosen with regard to existing activities.

As has been mentioned in Chapter 6, recommendations 4, 5 and 6, pushing broad-scale knowledge and information exchange between stakeholders and experts in standardisation is an important point to consider. Apart from partners running their own standardisation activities like GS1, KTBL or the Open Group, there are several partners also active in other standardisation working groups that can put issues identified within the SmartAgriFood project onto the discussion agenda of these organisations. Stakeholders at the Wageningen University and Research Center are e.g. active in ISOBUS standardisation and national standardisation activities. Via the Dutch Ministry of Agriculture, there are contacts to UN/CEFACT TBG 18 and INSPIRE interest groups. KTBL is among others involved in an AEF ISOBUS working group, has contacts to ISO TC23 and to OGC working groups. Machinery providers like John Deere and Kverneland also participate in ISOBUS development. First steps in initiating discussion between stakeholders active in agri-food standardisation has been made within workshops conducted within the agriXchange project and in summer 2012 within the SmartAgriFood project. An up-to-date list of relations to different standardisation organisations is currently worked out and will be used during phase 2 to further enhance communication among different projects and initiatives.

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