GS1 Germany

The Global Language of Business

Basic Materials Interoperability

Input Material to DIASCA Project

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Table of Contents

1 Introduction

Companies often want to address some of their internal traceability needs – such as traceability on products bought from and sold to direct trading partners through their systems (such as ERP, WMS). Their systems, including proprietary identification and existing business processes, are often able to provide such traceability information on direct trading partners, but not from trading partners further upstream and downstream.

New drivers for traceability and transparency such as due diligence have emerged – requiring increased transparency between producers' trading partners and with consumers. Retailers and foodservice operators, suppliers (product, ingredient, packaging), processors, manufacturers, distributors, logistics providers and solution providers, regulators - and consumers - are all demanding fast, accurate and complete information that can be seamlessly accessed across traceability systems.

2 GS1 Standards enabling Traceability and Interoperability

2.1 Global GS1 Traceability Standard (GTS)

The GTS is GS1's framework for the design of interoperable traceability systems for supply chains. The objective of the GS1 Global Traceability Standard (GTS) is to assist organisations and industries in the design and implementation of traceability systems internally and across companies and other boarders based on the GS1 system of standards.

At a strategic level, this standard aims at providing key insights and knowledge for organisations or industries that are developing long-term traceability goals.

It sums up the interoperability requirements on **Identification**, Automatic Identification and Data Capture (**AIDC**) and **Data Sharing**

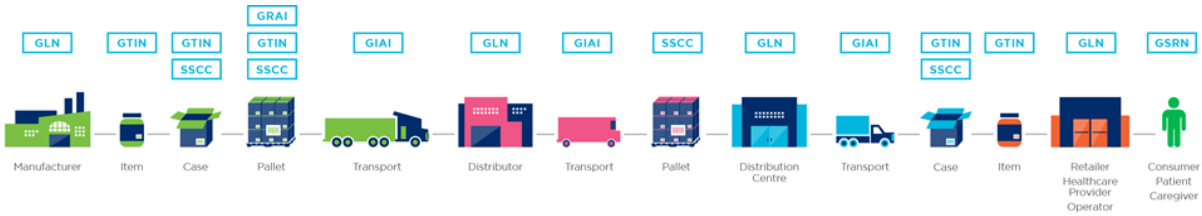

Figure X: Traceability across value networks

It is generic with the meaning of technology agnostic and thus applicable to all products to entire value networks.

GTS2 introduces two key concepts for achieving truly valuable interoperable traceability. They are:

- Critical Tracking Events (CTEs): These are the actual events (e.g., receiving, packing, shipping, transporting) that occur to the traceable object during its lifecycle.
- Key Data Elements (KDEs): These are the pieces of data that describe the actual instances of the CTEs.

URLs:

https://www.gs1.org/standards/gs1-global-traceability-standard/current-standard

https://www.gs1.org/standards/gs1-global-traceability-standard/current-standard (HTML-Version)

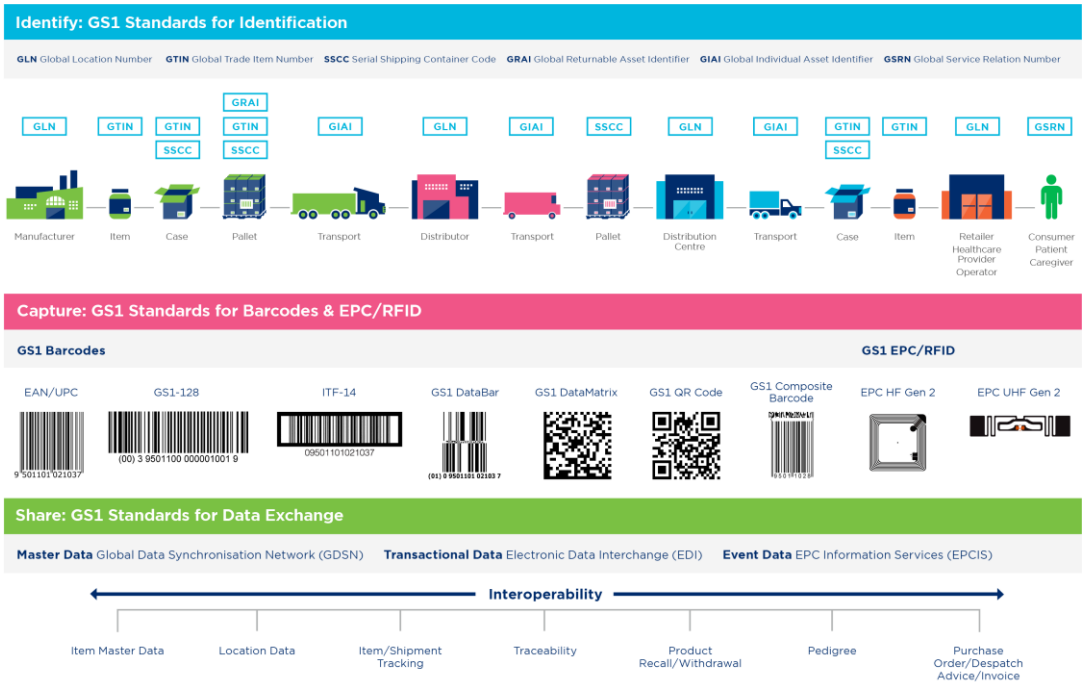

Figure X: GS1 system of standards: Identify – Capture - Share

2.2 Identification Standards

GS1 identification standards such as the Global Trade Item Number® and Global Location Number uniquely identify the objects that are moving throughout supply chains and the locations to which and from which they travel. Identification keys enable the connection of physical and information flows within a trading partner's processes as well as across different trading partners' processes.

URLs:

- *https://www.gs1.org/standards/barcodes-epcrfid-id-keys/gs1-general-specifications*
- *https://www.gs1.org/1/gtinrules//en/*
- *https://www.gs1.org/standards/id-keys*

The most relevant things for the topic of traceability are described in detail below.

2.2.1 Global Trade Item Number

The Global Trade Item Number (GTIN) can be used by a company to uniquely identify all of its trade items. GS1 defines trade items as products or services that are priced, ordered or invoiced at any point in the supply chain.

The GTIN can be encoded in a barcode or an EPC/RFID tag. By scanning the barcode or EPC/RFID tag, companies can efficiently and accurately process products and related information; for example, at check out in a store, when receiving goods in a warehouse, and when administering medication in a hospital. GTINs can be used to unambiguously identify trade items online, for example in catalogues, in electronic messages such as purchase orders and invoices, and embedded in web pages to optimise use by search engines and other information consumers.

The GTIN is fully compatible with ISO/IEC-15459 – Part 4: Individual Products and Product Packages

URLs:

- *https://www.gs1.org/standards/id-keys/gtin*
- *https://www.gs1.org/1/gtinrules/en/tree/29/upstream* (GTIN Management Rules upstream)

- *https://www.gs1.org/services/verified-by-gs1 (*Look-up tool for GTIN information and verification)

2.2.2 Global Location Number (GLN)

The Global Location Number (GLN) can be used by companies to identify their locations, giving them complete flexibility to identify any type or level of location required. It provides a globally unique, standardised identifier that allows companies to answer the questions "who" and "where" within their own organisation and throughout the entire supply chain.

The GLN can be applied for the identification of

- *A company as a legal entity like corporations, subisidaries or government bodies*
- *Functions within that company like accounting department or quality assurance,*
- *Physical locations such as warehouses or dock doors,*
- *Physical sub-locations like shelves within a warehouse or*
- *Digital locations (electronic address that is used for communication between computer systems).*

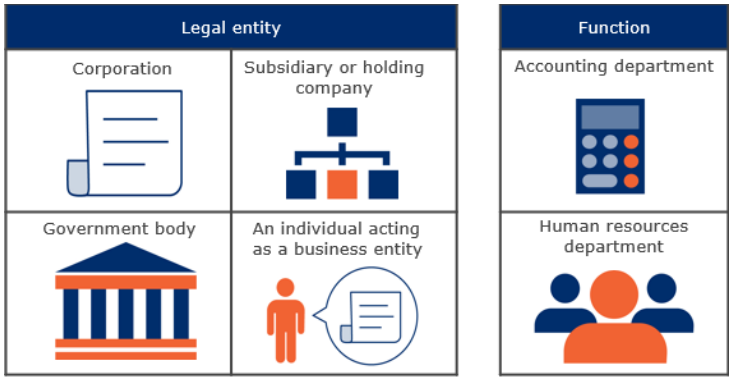

Figure A: Examples of GLN for parties

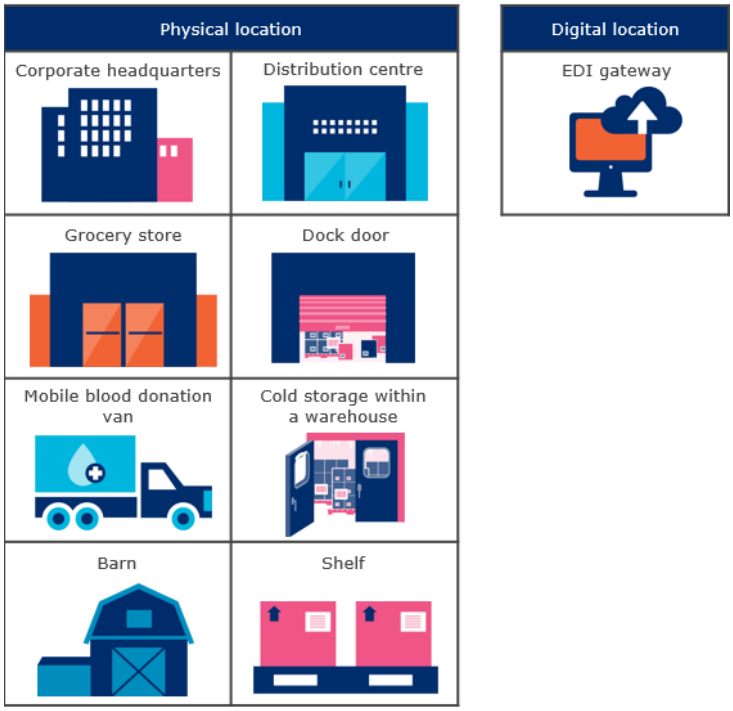

Figure B: Examples of GLNs for locations

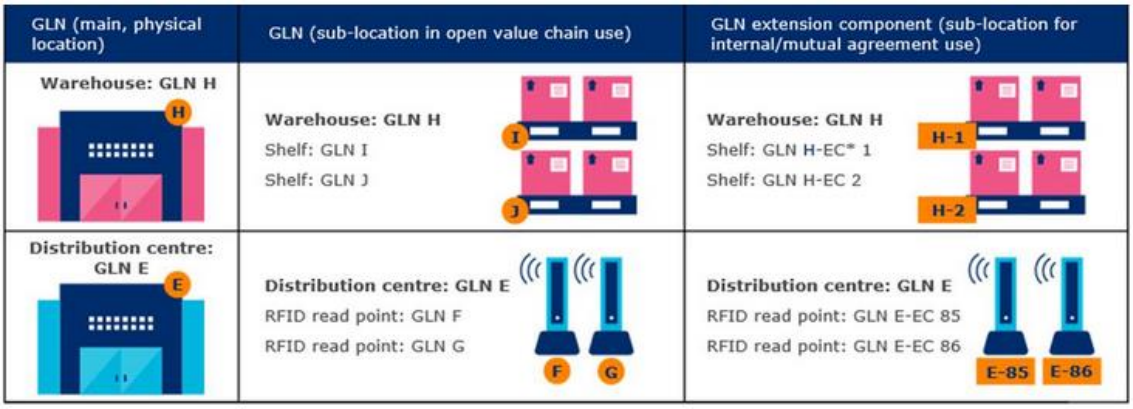

Figure C: Sub-location identification example

The GLN is fully compatible with ISO standard 6523. The International Code Designator (ICD) for GLN is '0088'

URLs: *https://www.gs1.org/standards/id-keys/gln* and *https://gepir.gs1.org/index.php/search-by-gln* (look-up tool for GLNs allocated to companies worldwide)

2.2.3 Serial Shipping Container Code (SSCC)

The Serial Shipping Container Code (SSCC) can be used by companies to identify a logistic unit, which can be any combination of trade items packaged together for storage and/ or transport purposes; for example a case, pallet or parcel.

The SSCC is a crucial key for traceability, since it uniquely identifies each distributed logistic unit and its content. The SSCC enables companies to track each logistic unit for efficient order and transport management. The SSCC can be encoded in a barcode or EPC/RFID tag, ensuring the logistic unit can be accurately and easily identified as it travels between trading partners, anywhere in the world. When SSCC data is shared electronically via EDI or EPCIS, this enables companies to share information about the status of logistic units in transit, and reliably link it to related transport information such as shipment details.

The SSCC is fully compatible with ISO/IEC 15459 – Part 1: Unique Identifiers for transport units. This is often referred to as the ISO License Plate and is a prerequisite for tracking and tracing logistic units in many international supply chains.

URL: *https://www.gs1.org/standards/id-keys/sscc*

2.2.4 Global Individual Asset Identifier (GIAI)

The Global Individual Asset Identifier (GIAI) is one of the two GS1 Keys for asset identification. Companies can apply a GIAI on any asset to uniquely identify and manage that asset. This could be a computer, desk, vehicle, piece of transport equipment, sensor or spare part, as just a few examples.

URL: *https://www.gs1.org/standards/id-keys/global-individual-asset-identifier-giai*

2.2.5 GS1 Digital Link

The GS1 Digital Link standard extends the power and flexibility of GS1 identifiers by making them part of the web. That means that GS1 identifiers, such as the GTIN, are now a gateway to consumer information that strengthens brand loyalty, improved supply chain traceability information, business partner APIs, patient safety information and more.

Where a URL typically points to a single, specific website, GS1 Digital Link enables connections to all types of business-to-business and business-to-consumer information. If you're adding a QR code or NFC tag to a product, using the GS1 standard means you're not only providing a URL for people to scan, you're also carrying GS1 identifiers – the same identifiers relied upon throughout industry – and following a non-proprietary, no vendor-lock system. This means the brand owner remains in complete control but can still link to any number of information sources, all from one symbol, saving space and improving efficiency.

URL: *https://www.gs1.org/standards/gs1-digital-link*

2.3 AIDC Standards

Standards for Automatic Identification and Data Carrier (AIDC) like barcodes along with data sharing standards such as the Global Data Synchronisation Network® and EPCIS enable automated processing and sharing of information between and across trading partners.

Barcodes are symbols that can be scanned electronically using laser or image-based technology. They are used to encode information such as key identifiers (product, shipment, location, etc.) and key attributes (serial numbers, batch/lot numbers, dates, etc.) via GS1 syntaxes (plain, GS1 element string and GS1 Digital Link URI). Barcodes play a key role in supply chains, enabling parties like retailers, manufacturers, transport providers and hospitals to automatically identify and track products as they move through the supply chain. GS1 utilises several types of barcodes to satisfy different business requirements.

Linear barcodes, like the U.P.C. code commonly found on consumer goods, use a series of variable-width lines and spaces to encode data, including the GTIN for product identification. 2D barcodes use patterns of squares, hexagons, dots and other shapes to encode data. Because the data is encoded in a two-dimensional pattern, 2D barcodes can hold more data than 1D barcodes while still appearing physically smaller.

URL: https://www.gs1.org/standards/barcodes

2.4 Data Sharing Standards

2.4.1 Global Data Synchronisation Network (GDSN)

The GS1 GDSN makes it possible for any company, in any market, to share high-quality product information seamlessly. Because companies of all sizes need the same thing – timely and reliable product information – to ultimately benefit consumers and patients.

With GS1 GDSN, high quality product content is uploaded, maintained and shared automatically, ensuring trading partners have immediate access to the most current and complete information needed to exchange products on both local and global markets.

URL: https://www.gs1.org/standards/gdsn

2.4.2 Electronic Product Code Information Services (EPCIS)

The goal of EPCIS is to enable disparate applications to create and share visibility event data, both within and across enterprises. Ultimately, this sharing is aimed at enabling users to gain a shared view of physical or digital objects within a relevant business context.

"Objects" in the context of EPCIS typically refers to physical objects that are identified either at a class or instance level and which are handled in physical handling steps of an overall business process involving one or more organisations. Examples of such physical objects include trade items (products), logistic units, returnable assets, fixed assets, physical documents, etc. "Objects" may also refer to digital objects, also identified at either a class or instance level, which participate in comparable business process steps. Examples of such digital objects include digital trade items (music downloads, electronic books, etc.), digital documents (electronic coupons, certificates, etc.), and so forth. EPCIS data consist of "visibility events," each of which is the record of the completion of a specific business process step acting upon one or more objects.

EPCIS is a critical component for traceability systems. EPCIS shares traceability data between trading partners about the physical movement and status of products in the supply chain.
As products travel from supplier to manufacturer, and then to distributor and retailer and pharmacy, and ultimately to the consumer, traceability data is generated each step of the way. EPCIS and its Core Business Vocabulary standard enable different applications to create and share event data, which is critical for interoperable traceability systems.

The combined EPCIS, Core Business Vocabulary (CBV), CTEs and KDEs provides all stakeholders with a shared view of the following:

- Who or which parties are involved?
- What is the primary product being traced?
- Where did a movement or event that included the product take place?
- When did a movement or event that included the product occur?
- Why was the product at that location at that time?[1]
- What business process was happening?
- What business transactions were taking place?
- What are the conditional information about an object or physical location?

URLs: https://www.gs1.org/standards/epcis and https://ref.gs1.org/epcis/

[1] Within an EPCIS message geo locations and geo fences can be used as attributes to locations and parties.

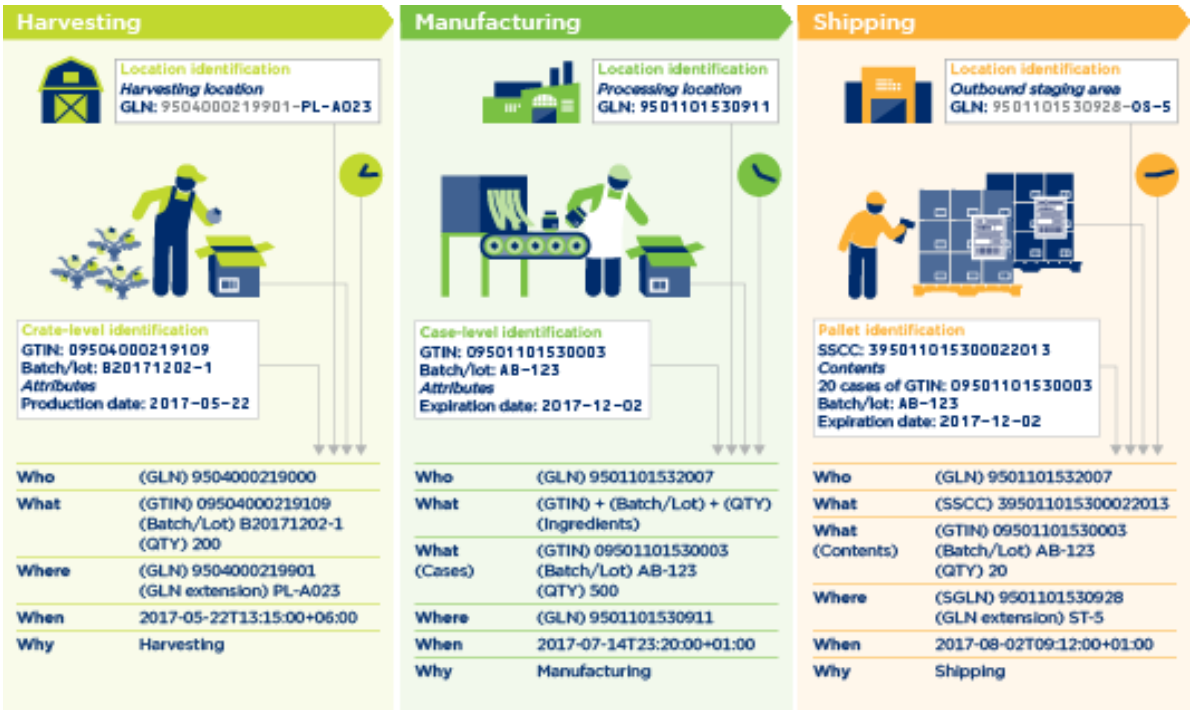

Figure D: Examples of Visibility Events

2.4.3 Electronic Data Interchange (EDI)

GS1 EDI (Electronic Data Interchange) provides global standards for electronic business messaging that allow automation of business transactions commonly occurring across the entire supply chain. It covers master data alignment, order and delivery and financial settlement management, as well as transport and warehouse management. The main business partners in scope for this are retailers, manufacturers, material suppliers and logistic service providers.

GS1 has currently three sets of complementary EDI standards:

- GS1 EANCOM®
- GS1 XML
- GS1 UN/CEFACT XML

They are being implemented in parallel by different users, although XML is better adapted to exchange information using the internet-based technologies.

URL: *https://www.gs1.org/standards/edi*

3 Vocabularies, Classifications and Data Models

3.1 GS1 Web Vocabulary

The GS1 Web Vocabulary collects terms defined in various GS1 standards and data systems and made available for general use following Linked Data principles. It is designed as an extension to *schema.org* and, where relevant, mappings and relationships arising from that vocabulary are made explicit.

The initial focus of the GS1 Web Vocabulary is consumer-facing properties for clothing, shoes, food beverage/tobacco and properties common to all products. This includes properties related to EU 1169 as defined in the GDSN and GS1 Source Standards. In addition, the vocabulary includes the

definition of parties and of a product offer (a product offered by a party for a price). Properties and their definitions come from existing GS1 standards including GDSN, GS1 Source and GPC.

The GS1 Web Vocabulary was originally developed as the primary output of the GS1 SmartSearch standard but it now fulfils a broader remit.

The GS1 Digital Link makes it possible to express any set of GS1 identifiers as a Web URI and therefore the identified item can be the subject of machine-readable facts and assertions made about it. The GS1 Web Vocabulary includes the link types used in GS1 Digital Link to annotate links to related resources, such as standard product information pages, instruction manuals, related videos, certification information, brand owner APIs, traceability information and more.

URL: *https://www.gs1.org/voc/*

3.2 GS1 Core Business Vocabulary (CBV)

The GS1 Core Business Vocabulary (CBV) is a companion standard to EPCIS and specifies the structure of vocabularies and specific values for the vocabulary elements to be utilised in conjunction with the GS1 EPCIS standard.

The goal of this standard is to specify various vocabulary elements and their values for use in conjunction with the EPCIS standard, which defines mechanisms to exchange information both within and across organisation boundaries. The vocabulary identifiers and definitions in this standard will ensure that all parties who exchange EPCIS data using the Core Business Vocabulary will have a common understanding of the semantic meaning of that data.

URL: *https://www.gs1.org/sites/default/files/docs/epc/CBV-Standard-1-2-2-r-2017-10-12.pdf*

3.3 GS1 Smart Search

The GS1 SmartSearch standard enables businesses to benefit from: More accurate search results for consumers to find the products and information they need. A lower bounce rate, i.e. people landing on a page and immediately navigating away as it's not relevant to them.

GS1 SmartSearch standard allows businesses to increase sales through:

- More relevant search results
- More detailed and accurate product information displayed in search results

The GS1 SmartSearch standard achieves these benefits by making it possible to create structured data about a product and relate this data to its GTIN. The structured data about the product can then be used by search engines, smartphone apps, etc. to deliver a richer experience to the consumer.

GS1 has been working collectively with GS1 members, standards organisations (W3C) and search engine companies to make it easier to discover and describe products on the web.

GS1 SmartSearch has recently been welcomed as the first external extension to schema.org.

URL: *https://www.gs1.org/standards/gs1-smartsearch*

3.4 Global Data Model

The GS1 Global Data Model (GDM) and Attribute Definitions for Business (ADB) standards enable greater data quality within the GS1 Global Data Synchronisation Network (GS1 GDSN). The GS1 Global Data Model standard defines a globally consistent set of foundational product attributes needed to list, order, store, move and sell products.

Implementing the GS1 Global Data Model standards within GS1 GDSN will improve data accuracy and completeness for consumers across their omnichannel purchasing journey, and increase operational efficiency for brand owners, retailers and data pools.

By providing a consistent business language and usage statements for these foundational attributes, the ADB standard clarifies sometimes difficult technical terminology, and helps data senders get their content right.

URL: *https://www.gs1.org/services/gdsn/global-data-model*

3.5 Global Product Classification (GPC)

The Global Product Classification (GPC) classifies products by grouping them into categories based on their essential properties as well as their relationships to other products. GPC offers a universal set of standards for everything from a car to a litre of milk and for everything from camping equipment to footwear, home and appliances to toys.

URL: *https://www.gs1.org/standards/gpc*

4 System and Certification Standards

4.1 Hypertext Transfer Protocol (HTTP)

The is a n application layer protocol in the Internet protocol suite model for distributed, collaborative, hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web

4.2 Standard Generalized Markup Language (SGML)

The Standard Generalized Markup Language (SGML; ISO 8879:1986) is a standard for defining generalized markup languages for documents. ISO 8879 Annex A.1 states that generalized markup is "based on two postulates":

- Declarative: Markup should describe a document's structure and other attributes rather than specify the processing that needs to be performed, because it is less likely to conflict with future developments.
- Rigorous: In order to allow markup to take advantage of the techniques available for processing, markup should rigorously define objects like programs and databases.

SGML is with it’s derivatives HTML and XML is widely used in the internet.

4.3 Extensible Markup Language (XML)

XML (https://www.w3.org/XML/) is a format for storing, transmitting, and reconstructing arbitrary data. It defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. The *World Wide Web Consortium's (W3C) XML 1.0 Specification* of *1998* and several other related specifications—all of them free open standards—define XML.

The design goals of XML emphasize simplicity, generality, and usability across the Internet. It is a textual data format with strong support via Unicode for different human languages. Although the design of XML focuses on documents, the language is widely used for the representation of arbitrary data structures such as those used in web services.

Several schema systems exist to aid in the definition of XML-based languages, while programmers have developed many application programming interfaces (APIs) to aid the processing of XML data.

4.3.1 XML Schema Definition (XSD)

XSD, a recommendation of the W3C, specifies how to formally describe the elements in an XML document. It can be used by programmers to verify each piece of item content in a document, to assure it adheres to the description of the element it is placed in.

4.4 JavaScript Object Notation (JSON)

JSON is an open standard file format and data interchange format that uses human-readable text to store and transmit data objects consisting of attribute–value pairs and arrays (or other serializable values). It is a common data format with diverse uses in electronic data interchange, including that of web applications with servers.

JSON is a language-independent data format and promoted as a low-overhead alternative to XML as both of these formats have widespread support for creation, reading, and decoding in the real-world situations where they are commonly used. After RFC 4627 had been available as its "informational" specification since 2006, JSON was first standardized in 2013, as ECMA-404.[8] RFC 8259, published in 2017, is the current version of the Internet Standard STD 90, and it remains consistent with ECMA-404.[9] That same year, JSON was also standardized as ISO/IEC 21778:2017.[3] The ECMA and ISO/IEC standards describe only the allowed syntax, whereas the RFC covers some security and interoperability considerations.[10]

4.5 YAML

YAML, introduced as *Yet Another Markup Language,* is a human-readable data-serialization language. It is commonly used for configuration files and in applications where data is being stored or transmitted. YAML targets many of the same communications applications as Extensible Markup Language (XML) but has a minimal syntax which intentionally differs from SGML.

Unlike JSON, which can only represent data in a hierarchical model with each child node having a single parent, YAML also offers a simple relational scheme that allows repeats of identical data to be referenced from two or more points in the tree rather than entered redundantly at those points.

4.6 Simple Object Access Protocol (SOAP)

SOAP s a messaging protocol specification for exchanging structured information in the implementation of web services in computer networks. It uses XML Information Set for its message format, and relies on application layer protocols, most often HTTP for message negotiation and transmission.

4.7 Representational state transfer (REST)

REST is a software architectural style that was created to guide the design and development of the architecture for the World Wide Web. REST defines a set of constraints for how the architecture of an Internet-scale distributed hypermedia system, such as the Web, should behave.

REST has been employed throughout the software industry and is a widely accepted set of guidelines for creating stateless, reliable web APIs. The goal is to increase performance, scalability, simplicity, modifiability, visibility, portability, and reliability. This is achieved through following REST principles such as a client–server architecture, statelessness, cacheability, use of a layered system, support for code on demand, and using a uniform interface. A web API that obeys these REST constraints is informally described as RESTful.

4.8 API description

4.8.1 Web Services Description Language (WSDL)

WSDL is an XML-based interface description language that is used for describing the functionality offered by a web service. The acronym is also used for any specific WSDL description of a web service (also referred to as a WSDL file), which provides a machine-readable description of how the service can be called, what parameters it expects, and what data structures it returns. Therefore, its purpose is roughly similar to that of a type signature in a programming language.

The latest version WSDL 2.0, became a W3C recommendation.

4.8.2 Web Application Description Language (WADL)

WADL is a machine-readable XML description of HTTP-based web services. It models the resources provided by a service and the relationships between them. WADL is intended to simplify the reuse of web services that are based on the existing HTTP architecture of the Web. It is platform and language independent and aims to promote reuse of applications beyond the basic use in a web browser. WADL was submitted to the World Wide Web Consortium , but the consortium has no current plans to standardize it. Nevertheless, it is the REST equivalent of SOAP's Web Services Description Language (WSDL), which can also be used to describe REST web services.

4.8.3 Open Data Protocol (OData)

Open Data Protocol (OData) is an open protocol that allows the creation and consumption of queryable and interoperable REST APIs in a simple and standardized way. Microsoft initiated OData in 2007 and Versions up t V3.0 have been released under the Microsoft Open Specification Promise. In 2014 Version 4.0 was standardized at OASIS and in April 2015 OASIS submitted OData v4 and OData JSON Format v4 to ISO/IEC JTC 1. In December 2016, ISO/IEC published OData 4.0 Core as ISO/IEC 20802-1:2016 and the OData JSON Format as ISO/IEC 20802-2:2016.

4.8.4 OpenAPI Specification

The OpenAPI Specification, previously known as the Swagger Specification, is a language-agnostic specification for machine-readable interface files for describing, producing, consuming, and visualizing RESTful web services. Previously part of the Swagger framework, it became a separate project in 2016, overseen by the OpenAPI Initiative, an open-source collaboration project of the Linux Foundation. With OpenAPI's declarative resource specification, clients can understand and consume services without knowledge of server implementation or access to the server code.

4.8.5 RESTful Service Description Language (RSDL)

RSDL is a machine- and human-readable XML description of HTTP-based web applications. The language allows documenting the model of the resource(s) provided by a service, the relationships between them, and operations and the parameters that must be supplied for the operations. It specifies if parameters are mandated; and describes possible overloads as parameters sets.

RSDL is intended to simplify the reuse of web services that are based on the HTTP architecture of the web. It is platform- and language-independent and aims to promote reuse of applications beyond the basic use in a web browser by both humans and machines.

Unlike WADL, it concentrates on describing URIs as stand-alone entry points in to the application which can be invoked in different ways, does not require traversing over URI components to figure out URI structure, and supports URI/Headers/body parameters overloads. This makes it human-readable and easily consumed by both humans and machines.

4.8.6 RESTful API Modeling Language (RAML)

RAML is a YAML-based language for describing RESTful APIs. It provides all the information necessary to describe RESTful or practically RESTful APIs. Although designed with RESTful APIs in mind, RAML is capable of describing APIs that do not obey all constraints of REST (hence the description "practically RESTful"). It encourages reuse, enables discovery and pattern-sharing and aims for merit-based emergence of best practices.

5 References

5.1 References to Standards, Industry Agreements and Implementation References

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- African Organisation for Standardisation (2020): African Standard - Sustainable cocoa — Part 2: Requirements for Cocoa Quality and Traceability, https://members.wto.org/crnattachments/2020/TBT/GHA/20_6090_00_e.pdf
- BCI, GCP, ICAC, ICO (2019): The Delta Framework, https://www.deltaframework.org/
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora): https://cites.org/sites/default/files/eng/prog/e/E-SC70-Inf-32%20bis.pdf
- CRISTAL Enhancing standards in supply chain visibility for the crop protection industry: https://croplifeeurope.eu/wp-content/uploads/2021/02/ECPA_Cristalbrochure_Web_01.pdf
- CRISTAL common practices for bar coding and labelling of agro products: https://croplife.org/wp-content/uploads/2017/02/CRISTAL-COMMON-PRACTICES-FOR-BAR-CODING-AND-LABELLING-OF-AGRO-PRODUCTS-1....pdf
- Core Business Vocabulary (CBV):
  - https://www.gs1.org/sites/default/files/docs/epc/CBV-Standard-1-2-2-r-2017-10-12.pdf (PDF)
  - https://ref.gs1.org/epcis/ (browsable version of CBV Linked Data)
- EPCIS: https://www.gs1.org/standards/epcis
- GCP, COSA, Rainforest Alliance (2019): Global Coffee Data Standard, http://datastandard.globalcoffeeplatform.org/en/latest/index.html
- Global Data Synchronization Network (GDSN): https://www.gs1.org/standards/gdsn
- Global Data Model: https://www.gs1.org/services/gdsn/global-data-model
- Global Product Classification (GPC): https://www.gs1.org/standards/gpc
- GS1 Australia and Manbulloo traceability use case: https://wmcpr.com.au/gs1-and-manbulloo-create-next-level-whole-of-chain-tracking/
- GS1 Digital Link: https://www.gs1.org/standards/gs1-digital-link
- GS1 General Specifications: GS1 General Specifications: https://www.gs1.org/standards/barcodes-epcrfid-id-keys/gs1-general-specifications
- GS1 Global Traceability Standard (GTS):

  https://www.gs1.org/standards/gs1-global-traceability-standard/current-standard

  https://www.gs1.org/standards/gs1-global-traceability-standard/current-standard (HTML-Version)
- GS1 Identification Standards:
  - GS1 ID Keys https://www.gs1.org/standards/id-keys
  - GIAI: https://www.gs1.org/standards/id-keys/global-individual-asset-identifier-giai
  - GLN: https://www.gs1.org/standards/id-keys/gln
  - GLN Management Rules: https://www.gs1.org/1/glnrules//en/

- Look-up Tool for allocated GLNs: https://gepir.gs1.org/index.php/search-by-gln
- GTIN: https://www.gs1.org/standards/id-keys/gtin
- GTIN Management Rules general: https://www.gs1.org/1/gtinrules//en/
- GTIN Management Rules upstream: https://www.gs1.org/1/gtinrules/en/tree/29/upstream
- Look-up tool for GTIN information and verification: https://www.gs1.org/services/verified-by-gs1
- SSCC: https://www.gs1.org/standards/id-keys/sscc

- GS1 Smart Search: https://www.gs1.org/standards/gs1-smartsearch
- GS1 Traceability Case Study Library: https://www.gs1.org/standards/traceability/case-study-library
- GS1 Traceability Reference Book: https://www.gs1.org/standards/traceability/case-study-library/traceability-reference-book
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