
**Blockchain and distributed ledger
technologies — Identifiers of
subjects and objects for the design of
blockchain systems**

*Technologies des chaînes de blocs et technologies de registre
distribué — Identifiants des sujets et des objets pour la conception des
systèmes de chaînes de blocs*

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 307, *Blockchain and distributed ledger technologies*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document, which is on the available standards and registers of identifiers of subjects and objects issued by government agencies and standard development organizations (SDOs) (see [Annex A](#)), is intended to support designers with the innovation process for their development of (international) blockchain systems for multiple purposes. It also supports the interoperability of those systems with non-blockchain systems because identifiers are mission critical building blocks of information technology systems including the blockchain systems.

Identifiers can identify “subjects” (with rights and obligations) or “objects” (without rights and obligations). This distinction is relevant in legal systems of any country in case at least two subjects of the same or of multiple countries are involved.

Subclause [4.3](#) addresses decentralized identifiers that leverage blockchain (see [W3C \[1\]](#)). This document is not a report on those “decentralized identifiers” standards and registers.

This document is intended to support designers of blockchain and other systems.

Identifiers issued by the public sector and used in information technology systems are mostly products of a national history (including national legislation) and were mostly not designed for a computer age. This historical legacy hinders the development of global standards and registers on the identification of subjects and objects.

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Blockchain and distributed ledger technologies — Identifiers of subjects and objects for the design of blockchain systems

1 Scope

This document provides an overview of identifiers [and their standards and register(s)] relevant for the design of blockchain systems and the interoperability of those systems with non-blockchain systems.

The following criteria were used for inclusion of identifiers in this document:

- Identifiers (and their standards and registers) issued by the public sector for subjects and objects such as citizen numbers, business registration numbers or land registration numbers;
- Identifiers that are internationally recognized and fulfil one of the following criteria:
 - An identifier is an international standard of an SDO (Standard Development Organization);
 - An identifier is a de facto standard according to the norms of the industry involved (even if it is not an international standard of an SDO).
- Identifiers that have relevance for DLT systems as it fulfils one of the following criteria:
 - An identifier that has been used without DLT, but has proven to solve the problems of DLT services using DLT;
 - An identifier that was designed with the usage of DLT in mind from the beginning.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 22739, *Blockchain and distributed ledger technologies — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22739 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

attribute

characteristic or property of an entity

[SOURCE: ISO/IEC 24760-1:2019, 3.1.3, modified — Example deleted.]

3.2

credential

set of data presented as evidence of a claimed or asserted identity and/or entitlements

[SOURCE: ISO/IEC 29115:2013, 3.8, modified — Note to entry deleted.]

3.3

decentralized identifier

DID

globally unique persistent identifier that does not require a centralized registration authority and is often generated and/or registered cryptographically

[SOURCE: W3C Decentralized Identifiers (DIDs) v1.0]

3.4

decentralized identifier subject

DID subject

entity identified by a DID and described by a DID document

[SOURCE: W3C Decentralized Identifiers (DIDs) v1.0]

3.5

entity

item inside or outside an information and communication technology system such as a person, organization, a device, a subsystem, or a group that has recognizable distinct existence

3.6

identifier

attribute or set of attributes that uniquely characterizes an identity in a domain

Note 1 to entry: An identifier can be a specifically created attribute with a value assigned to be unique within the domain.

[SOURCE: ISO/IEC 24760-1:2019, 3.1.4, modified — Note to entry deleted.]

3.7

object

entity without rights and obligations

3.8

subject

entity with rights and obligations

3.9

verifiable credential

tamper-evident credential that has authorship that can be cryptographically verified

[SOURCE: W3C Verifiable Credentials Data Model v1.1]

4 Considerations for the design of blockchain systems

4.1 General

Designers of a blockchain system make choices for the design of their application such as:

- Which subjects will be included in the DLT service?
- Are the subjects only from one country (such as healthcare insurance) or from multiple countries (such as for the international supply chain)?

- Are the identifiers of subjects of the public sector mandatory for the DLT service or are other options possible (central or decentralized identifiers)?
- Which objects are planned to be included in the DLT service?
- Are the preferred identifiers standards available?
- Are the identifier data registers available and accessible?
- Do the available identifiers and attributes have the required data quality for the DLT service?
- Is the DLT system and its identifiers intended to be used with two (or more) DLT systems and/or with non-DLT systems and/or should interoperability of the two or more systems or applications be ensured to exchange information (data)?

An overview of subjects (natural persons and legal entities) and an overview of objects such as products, assets, locations, documents, legal rights, and messages are included in this document. Objects are owned by one or more subjects. In this document the object identifiers are distinguished in object identifiers of “horizontal industries” (used by any industry) and object identifiers used by “vertical industries” (used by a specific industry). [Annex B](#) provides an overview of identifier categories.

4.2 Reference Architecture

As specified in ISO 23257, [\[6\]](#) DLT data can be classified according to its source as shown in [Figure 1](#).

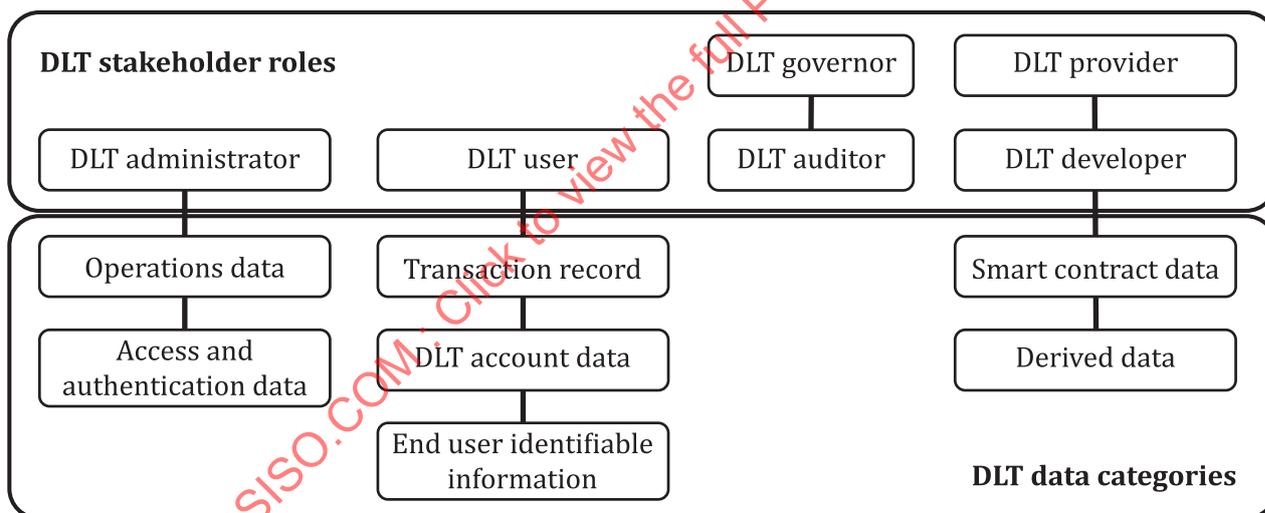
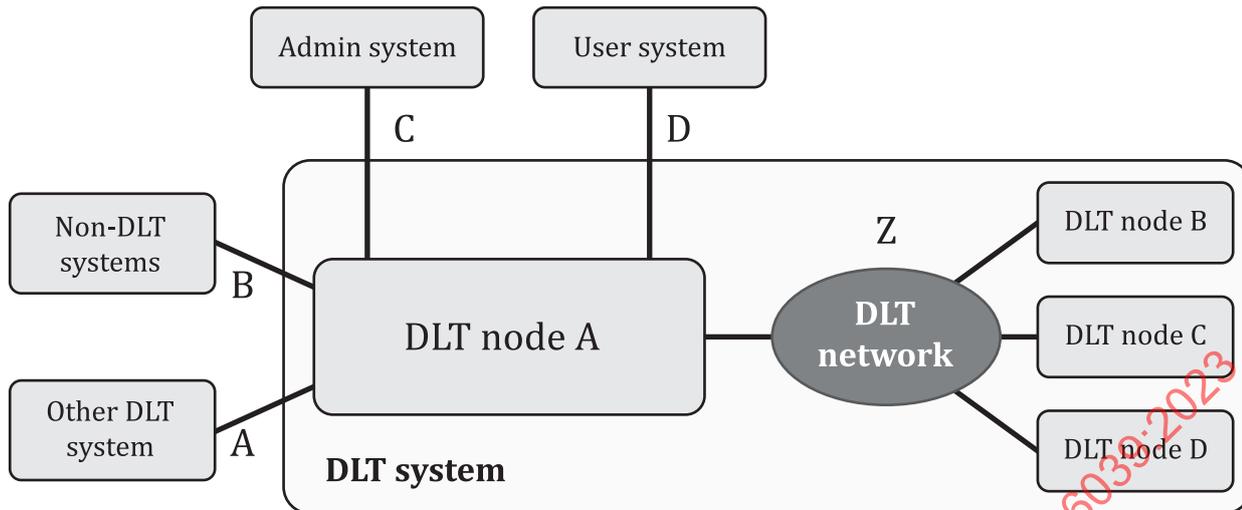


Figure 1 — Data categories from DLT stakeholder role perspective

The data sources identified here align with the six DLT roles identified in ISO 23257 [\[6\]](#) as DLT subjects: administrators, users, providers, developers, governors and auditors. Among these, administrators, users and providers are typically the most relevant roles to use case definition. Stakeholders achieve their aims by means of role-based interactions with the DLT system: A specific example could be the data flows of subjects involved in the international supply chain: the exporter and its bank, the customs of the exporter, the freight forwarders, the customs of the importer, the importer and its bank, all those subjects need high quality identifiers of their business partners (and so the customs) involved and of the goods that are shipped.



SOURCE: ISO/TR 3242:2022, Figure 4

Figure 2 — Off-chain/on-chain data flow model

The identifier data (and relevant attributes) of subjects and objects are the data connectors to ensure an efficient end-to-end digital process, mostly via multiple digital ecosystems of the market participants involved. The passing of reference identifiers in the dataflow across on-chain and off-chain systems contributes to the immutable, enhanced trust environment of a DLT system.

Interoperability requires high quality and accurate data (including of identifiers) that are key to correctly recording and tracking the data-related operations of stakeholders to avoid operational risks. There are many definitions of data quality. ISO 8000-8 [7] and ISO/IEC 25012 [8] are excellent references for designers to review the data quality of the identifiers that they will include in their design.

4.3 Decentralized Identifiers

Designers could consider the use of decentralized identifiers for their DLT systems. In response to regulatory differences in relation to data privacy (for natural persons identifiers, attributes and data) and governance across global trade ecosystem, two concepts have emerged to address compliance: self-sovereign identity management and decentralized identifiers.

Decentralized identifier is an old and established concept. Examples include using a public key or a transformation of it as an identifier and using Universally Unique Identifier.[10] Many addresses used in blockchain systems, such as for cryptocurrencies fall into this category.

W3C has published a framework [Decentralized Identifiers (DIDs) of 19 July 2022][1] acknowledging a need in some circumstances for a globally unique identifier that is “self-sovereign”, that is, one that does not depend on any issuing authority and defining Decentralized identifiers (DIDs) as a new kind of identifier that enables verifiable, decentralized identity.

For the design process, a clear view of which subjects and objects is relevant to consider in the DLT system and if all market participants involved will be committed to use a DLT system with decentralized identifiers. The designers need also to understand if the DLT system is a stand-alone system or needs to interact with other DLT systems and/or with non-DLT systems of one or more market participants. See [Figure 2](#) where interoperating DLT and non-DLT systems can be usefully modelled.

Decentralized identifiers are often used in a verifiable credential and are associated with subjects such that the verifiable credential can be easily ported from the repository to another without the need to reissue the credential. W3C has defined that anything can be a DID subject: person, group, organization, physical thing, digital thing, logical thing, etc.”

The verification of “identifiers (and their attributes)” contained in verifiable credentials with the registers involved is mission critical to ensure the identification of subjects and objects.

This document does not have verifiable credentials in its scope but it lists categories of identifiers and attributes that can be contained as claims in verifiable credentials.

5 Identifiers of subjects

5.1 General

The United Nations members are sovereign states.^[12] Countries stipulate in their legislation how identifiers for their citizens and legal entities are issued and who is allowed to use those identifiers for which public or private purpose. The government agencies involved that issue the identifiers are regarded the authoritative source of the identifiers and their attributes.

Subjects are entities with rights and obligations according to the legislation of the country involved. There are two categories of subjects in countries: natural persons and legal entities for which government agencies issue unique identifiers.

Governments agencies use their (unique) identifiers (and attributes) for the communication with their citizens for their services and for e-government services inclusive for their social benefits programs. For communication with legal entities, government agencies use the identifier (and attributes) issued by the business register of their jurisdiction. Government agencies sometimes use additional identifiers for specific functions such as tax numbers, VAT numbers, etc. Government identifiers are in general an integral part of the authentication process for citizens and legal entities to get access to e-government services.

Businesses have their own onboarding process for their customers, suppliers and partners and use a CRM (Customer Relationship Management) system with identifiers. The identifier is used for many business processes such as the invoicing process, reconciliation of payments data, access to helpdesks, loyalty schemes and the authentication of the customers, suppliers and partners to specific e-commerce or e-service of the business involved. In several industries, an industry identifier is used for joint business processes often based on a rulebook, master agreement and/or a common platform.

This clause gives an overview of public and private identifiers (and attributes) designers could consider to use for their CRM systems and applications

5.2 Identifiers of natural persons

5.2.1 Public sector identifiers

5.2.1.1 National identity number

The United Nations mention that the civil registration systems for the citizens of a jurisdiction have three basic functions:

- 1) A legal and administrative function;
- 2) A statistical function;
- 3) The identity management function.

The identity management function assumes that civil registration provides accurate input into an identity management systems or population register. The identity management system also services a legal and identity function. The legal and administrative function of the provision of credentials enable individuals to prove their identity.

The United Nations stresses that “Everyone has the right to be recognized as a person before the law, as enshrined in [Article 6](#) of the Universal Declaration on Human Rights”^[13].

The national identification number is used by government agencies as a means of tracking their citizens, permanent residents and temporary residents for the purpose of work, taxations, government benefits, education, healthcare and other official functions. The issuing of the identification number is stipulated by the legislation of the country involved. Each country has its own standard for the identifier (and attributes) of the citizen record. The access to registers with citizens data is limited by the laws of the country involved. The UN published guidelines on the legislative framework for civil registrations. [14] The UN publishes no overview of “national identification numbers”. See Reference [15] for more information on national identification numbers.

The OECD provides an overview of “tax identification numbers” (TIN) of many of the UN member countries, or the functional equivalent for their citizens with the rules of the country involved in relation to the issuance, structure, use and validity of its TIN. See Reference [16] for more information.

The authentication schemes of/for government agencies include directly or indirectly the citizen number issued by the government involved.

5.2.1.2 Passport

The ICAO (International Civil Aviation Organization) issues the specifications for machine readable passports. A passport is a travel document (so an object) issued by a government, primarily for the purpose of travel, to certify the personal identity and nationality of its holder. The ICAO specifications [17] include mandatory data elements such as:

- the issuing state or organization (in code);
- the passport number must uniquely identify the document from all other machine readable documents issued by the state;
- a primary and a secondary identifier as defined by the state.

ISO/IEC 7501-1 [18] defines machine readable passports.

5.2.2 Private sector identifiers

Businesses and NGOs design(ed) their own identifier (and attributes) for the registration of their natural person customers or members. These identifiers can include industry standards (such as part of the credit card number). Businesses (such as organizations in the financial industry) must also often include an identifier issued by a public sector agency of the country involved in the files of their customers. These identifiers mostly can only be used for specific purposes allowed or prescribed by the legislation of the country involved.

5.2.2.1 ISO 24366 Financial services — Natural Person Identifier (NPI)

ISO 24366 [19] specifies a machine-readable, unambiguous natural person identifier (NPI) and the relevant reference data to uniquely identify the natural person relevant to any financial transaction rather than the personal identifying information.

5.3 Identifiers of legal entities

5.3.1 Public sector identifiers

5.3.1.1 Identifiers of legal entities registered in business registers

All countries have legal entities (with rights and obligations) of several legal forms (see 5.3.2.1) that are in general registered with an identifier in a business register or other public register of that country. Not all countries have a complete register of all legal entities of all their legal forms. All business registers have their own (national) identifier standard for legal entities and do not use a standard of an international SDO (Standard Development Organization). All business registers have their own rules on the access to the data of legal entities and if a fee is required to get access to (part of) the data.

The G20-FSB mandated the Global Legal Entity Identifier Foundation (GLEIF) to take care of the “Registration Authorities List”,^[20] which includes over 770 business registers, and other relevant registers of which the data are available free of charge for any user. The register of the Registration Authorities is available.

The OECD makes an overview available^[16] to many UN member countries of their “tax identification numbers” (TIN) for legal entities or their functional equivalents with the rules of the country involved in relation to the issuance, structure, use and validity of its TIN.

5.3.1.2 ISO 20275 Financial services — Entity legal forms (ELF)

ISO 20275^[21] specifies the elements of an unambiguous scheme to identify the distinct entity legal forms in a jurisdiction. Its aim is to enable legal forms within jurisdictions to be codified and thus facilitate the classification of legal entities according to their legal form. See Reference^[22] for the ELF register of all legal forms of the UN sovereign states.

5.3.1.3 ISO 17442-1 Financial services — Legal entity identifier (LEI) — Part 1: Assignment

ISO 17442-1^[23] specifies the minimum elements of an unambiguous legal entity identifier (LEI) scheme to identify the legal entities relevant to any financial transaction.

It is applicable to “legal entities”, which include, but are not limited to, unique parties that are legally or financially responsible for the performance of financial transactions or have the legal right in their jurisdiction to enter independently into legal contracts, regardless of whether they are incorporated or constituted in some other way (e.g. trust, partnership, contractual). It includes governmental organizations, supnationals and individuals when acting in a business capacity, but excludes natural persons. It also includes international branches as defined in ISO 17442-1:2020, 3.5.

The LEI is designed for automated processing. It can also be conveniently used in other media interchange when appropriate (e.g. paper document exchange).

NOTE Examples of eligible legal entities include, without limitation:

- all financial intermediaries;
- banks and finance companies;
- international branches;
- all entities that issue equity, debt or other securities for other capital structures;
- all entities listed on an exchange;
- all entities that trade financial instruments or are otherwise parties to financial transactions, including business entities, pension funds and investment vehicles such as collective investment funds (at umbrella and sub-fund level) and other special purpose vehicles that have a legal form;
- all entities under the purview of a financial regulator and their affiliates, subsidiaries and holding companies;
- sole traders (as an example of individuals acting in a business capacity);
- counterparties to financial transactions.

See Reference^[24] for the register of issued LEIs.

ISO 17442-2^[25] specifies a standardized way of embedding the legal entity identifier (LEI) code, as represented in ISO 17442-1, in digital certificates, represented by the International Telecommunications Union (ITU) Recommendation X.509 and its equivalent International Standard, ISO/IEC 9594-8.

ISO 17442-2 specifies the structure of a public key certificate conforming with ISO/IEC 9594-8 in which the LEI is embedded.

5.3.1.4 ISO 5009 Financial services — Official Organizational Roles (OOR) — Scheme for official organizational roles

ISO 5009 [26] specifies an unambiguous scheme to list official organizational roles by jurisdiction in a standardized way.

It is not the purpose of ISO 5009 to compare or align official organizational roles across different countries or jurisdictions, so as not to limit the usage or relevance of ISO 5009. To understand the powers associated with each official organizational role, users of ISO 5009 can consult applicable regulation or legislation, documents of the legal entity in which the official organizational role exists and procedures specific to each organizational entity.

5.3.1.5 Traders Identification Number (TIN)

The TIN is the technical standard of the World Customs Organization (WCO) for a globally unique identification of AEO (Authorized Economic Operators). See Reference [27] for more information.

5.3.1.6 Economic Operators Registration Identification Number (EORI)

The Economic Operators Registration and Identification number (EORI)[28] is required for business and people in the EU customs territory as an identification number in all customs procedures when exchanging information with customs administrations. Non-EU economic operators also need an EORI number for specified purposes in relation with the EU customs.

5.3.1.7 EU VAT Identification Number (IOSS)

The EU IOSS (Import One Stop Shop) VAT Identification Number allows suppliers in e-commerce selling imported goods to buyers in the EU to collect, declare and pay the VAT to tax authorities at the moment the goods are imported to the EU. See Reference [29] for more information.

5.3.1.8 EuroGroups Register (EGR)

The EGR consists of all statistical units that are related to enterprise groups, which have at least one unit in the EU. The EGR access is restricted to official SBR statisticians in EU NSOs (National Statistical Organizations). See Reference [30] for more information.

5.3.1.9 Global Groups Register (GGR)

The GGR ID and the GGR register of the United Nations covers the world's 100 largest multinational enterprises (MNE) groups. The GR identifies the MNE groups and their legal structures across countries. See Reference [31] for more information.

5.3.2 Private sector identifiers

5.3.2.1 Global Location Number (GLN)

The GS1®¹⁾ GLN (Global Location Number) enables companies the unique and unambiguous identification of any type of party or location, whether physical or digital, used in business processes. Identification in this manner is a prerequisite for efficient communication between trading partners. A GLN acts as a database key to reference party or locations specific information that which more fully describes the entity. Its function is to reduce input errors and increase efficiency. The GS1 GLN is recognized by ISO/IEC 6523.

1) GS1 is a registered trademark of GS1 Switzerland. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

The GLN is widely used in sharing electronic data between companies, since it enables unambiguous identification of the parties, locations and systems. The GLN is a foundational key in related GS1 standards. See Reference [32] for more information.

5.3.2.2 ISO/IEC 6523-1 Information technology — Structure for the identification of organizations and organization parts — Identification of organizations identification schemes

ISO/IEC 6523-1 [33] specifies a structure for the globally and unambiguously identifying organizations, and parts thereof, for the purpose of computer data exchange. It also makes recommendations regarding where prior agreements can be concluded between interchange partners.

In the development of ISO/IEC 6523-1, it has been recognized that a single method of all organization on an international basis is neither feasible nor practicable. Instead, ISO/IEC 6523-1 recognizes existing methods of identification and provides a means for systemically incorporating these in a uniform structure for the purposes of information exchange. An organization can be identified by more than one identification method.

ISO/IEC 6523-2 [34] specifies the procedure for the registration of organization identification schemes and the requirements for the administration of an ICD (International Code Designator) values, to designate these identification schemes. End June 2022 an ICD was issued to about 200 Organization Identification Schemes. See Reference [35] for more information.

5.3.2.3 DUNS Number

A DUNS²⁾ number is a unique nine digits identifier created by the credit bureau Dun & Bradstreet. DUNS numbers are a standard numbering system to identify business across the globe. See Reference [36] for more information.

5.3.2.4 PermID

The PermID (Permanent Identifier) is an open, permanent and universal identifier used by different stakeholders and partners within or outside an organization. PermIDs are open, permanent and universal identifiers where the underlying attributes capture the context of the identity they represent. See Reference [37] for more information.

5.3.2.5 ISO 9362 Banking — Banking telecommunication messages — Business Identifier Code (BIC)

ISO 9362 [38] specifies the elements and structure of a universal code for financial and non-financial institutions, for which such an international identifier is required to facilitate automated processing of information for financial services (amongst others for the payments and securities industries and for trade finance).

The BIC is used for addressing messages, routing business transactions and identifying business parties among more for the SWIFT network. See Reference [39] for more information on the register.

6 Identifiers of objects

6.1 Introduction

This document distinguishes between identifiers of objects used in multiple industries (horizontal) included in 6.2 and of objects used mainly in a specific industry (verticals). The industry overview in 6.2 and 6.3 has been created based on the received contributions of identifier experts.

2) DUNS is a registered trademark of The Dun and Bradstreet Corporation. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named.

6.2 Identifiers of objects used in multiple industries (“horizontal”)

6.2.1 Supply chain

The (international) supply chain covers the delivery of good and services. It covers subject identifiers of market participants and government agencies (see above) and object identifiers such as for products, assets, locations and documents (see below), and for the payments (see below).

The public sector is actively involved in the (global) supply chain via their custom and statistical agencies and their food and drugs agency, to assess the quality of the food and drugs, and for the sustainability of the production and distribution of the global supply chains. Market participants have reporting requirement obligations to those government agencies and do so with the required identifier and/or available identifier standards.

GS1 is a SDO that provides open and global standards and has a suite of identification standards designed to support supply chain operations for a majority of product value chains. Stakeholders who use GS1 identifiers with GS1 standards for transactions and events achieve interoperability with trading partners as well as other operational benefits. GS1 standards are technology agnostic and can be used for the design of DLT and non-DLT systems. The GS1 identifiers are relevant for many end-to-end supply chains.

The majority of the GS1 identifiers are relevant for the supply chain of any industry whereas some are particularly relevant for specific industries. The [Figure 3](#) diagram illustrates a linear supply chain with notable GS1 identification keys supporting the movement of goods.

The GS1 Identification keys are clarified in Global Standards One^[40] along with GS1 standards to enable a more visible supply chain^[41].

The UN published a guide on the traceability in the global supply chains^[42].

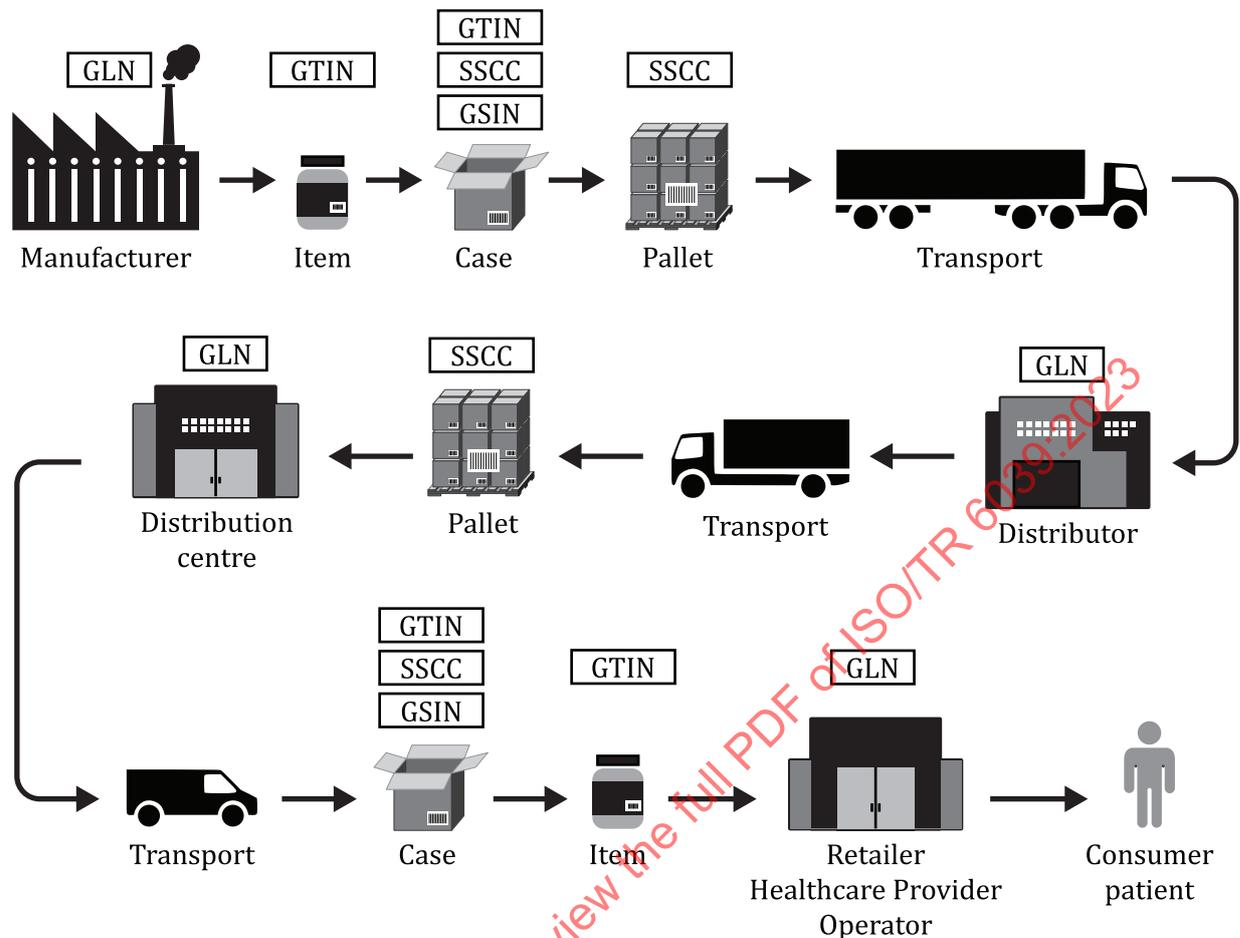


Figure 3 — Illustration of a GS1 linear supply chain with GS1 identification keys supporting the movements of goods

6.2.1.1 Global Trade Item Number (GTIN)

The GS1 Global Trade Item Number is used to identify any item (product or service) upon which there is a need to retrieve predefined information and that can be priced, or ordered, or invoiced at any point in any supply chain. This definition covers raw materials, consumer packaged goods, healthcare items and items for general distribution, all of which can be priced, ordered or invoiced between trading partners. See Reference [43] for more information.

6.2.1.2 Global Location Number (GLN)

The GS1 Global Location Number enables the unique and unambiguous identification of any type of party or location, whether physical or digital, used in business processes. Identification in this manner is a prerequisite for efficient communication between trading partners. A GLN acts as a database key to reference party or location specific information that which more fully describes the entity. Its function is to reduce input errors and increase efficiency. The GS1 GLN is recognized by ISO/IEC 6523.

The GLN is widely used in the sharing of electronic data between companies, since it enables unambiguous identification of the parties and locations, whether physical or digital. The GLN is a foundational key in the related GS1 standards. See Reference [32] for more information.

6.2.1.3 Serial Shipping Container Code (SSCC)

Items that have been assembled together for transport and/or storage can be considered as logistical units that are identified with a GS1 identification key named the SSCC (Serial Shipping Container Code).

Each instance represents an individual assemblage of objects, while in transport and/or storage, and until that have been separated to enable a logistic unit's individual journey to be referenced. The SSCC ensures that logistic units are identified with a number that is unique worldwide. The SSCC can be used by companies for any combination of trade items packaged together such as a case, pallet or parcel. See Reference [44] for more information.

6.2.1.4 Global Returnable Asset Identifier (GRAI)

A returnable asset is a reusable package or transport equipment of a certain value, such as a beer keg, a gas cylinder, a plastic pallet, or a crate. The GS1 system identification of a returnable asset, the Global Returnable Asset Identifier (GRAI), enables tracking as well as recording of all relevant data. See Reference [45] for more information.

6.2.1.5 Global Individual Asset Identifier (GIAI)

In the GS1 system, an individual asset is considered a physical entity made up of any characteristics. This element string identifies a particular physical entity as an asset. Individual Asset Identifier (GIAI) can remain with the asset when changing hands depends on the particular business application. If it remains with the asset it cannot be reused. This element string might, for example, be used to record the life-cycle history of aircraft parts. By symbol marking the GIAI, AI (8004), on a given part, aircraft operators are able to automatically update their inventory database and track assets from acquisition until retirement. The GIAI is also used with Automatic Identification and Data Capture (AIDC) for medical devices within the micro-logistics cycle of use, cleaning and sterilization. See Reference [46] for more information.

6.2.1.6 Global Service Relation Number (GSRN)

The Global Service Relation Number (GSRN) is a non-significant number used to identify the relationship between an organization offering services and the individual entities providing or benefitting from the services. The GSRN provides unique and unambiguous identification. It is the key to accessing information, stored on computer systems, relevant to service(s) provided and received. In some cases, these services could be recurring. The GSRN can also be used for referencing information transferred via Electronic Data Interchange (EDI). See Reference [47] for more information.

6.2.1.7 Global Identification Number for Consignment (GINC)

This number identifies a logical grouping of goods (one or more physical entities) that has been consigned to a freight forwarder and is intended to be transported as a whole. The consignment number is allocated by a freight forwarder (or a carrier acting as a freight forwarder) or a consignor, but only if prior agreement of the freight forwarder is given. See Reference [48] for more information.

6.2.1.8 Global Shipment Identification Number (GSIN)

The Global Shipment Identification Number (GSIN) is a number assigned by a consignor (seller) of goods. It provides a globally unique number that identifies a logical grouping of logistic units for the purpose of a transport shipment from that consignor (seller) to the consignee (buyer). It identifies the logical grouping of one or several logistic units each identified with a separate SSCC and containing trade items as being part of a specific seller/buyer relationship and that travels under one despatch advice and/or Bill of Lading. It can be used by all parties in the transport chain as a communication reference, for example, in Electronic Data Interchange (EDI) messages where it can be used as a shipment reference and/or a consignor's loading list. The GSIN fulfils the requirements of the UCR (Unique Consignment Reference) of the World Customs Organization (WCO). See Reference [49] for more information.

6.2.1.9 Global Document Type Identifier (GDTI)

The Global Document Type Identifier is the GS1 identification key used to identify documents, electronic messages and digital files for the purposes of document control. Any aspect of referenced modification,

version control, specific instance recording would fall into the process of document control, either internal or externally with trade partners, where unique identification is required.

The word “document” is applied broadly to cover any paper(s) or digital file(s). The Global Document Type Identifier (GDTI) can be used to identify any type of document including but not limited to:

- Commercial documents (e.g., invoice, purchase order);
- Documents that infer a right (e.g., proof of ownership);
- Documents that infer an obligation (e.g., notification or call for military service);
- Identification documents (e.g., driver’s licence, passport);
- Digital files;
- Electronic messages.

See Reference [50] for more information.

6.2.1.10 Global Coupon Number (GCN)

Paper coupons can be identified by a Global Coupon Number (GCN) assigned by the coupon issuer. The GCN comprises a GS1 Company Prefix followed by a coupon reference. It can be supplemented by an optional serial number. The GCN provides a globally unique identification for a coupon, with an optional serial number. See Reference [51] for more information.

6.2.1.11 Component/Part Identifier (CPID)

A Component/Part (C/P) is defined as an item that is intended to undergo at least one further transformation process to create finished goods for the purpose of downstream consumption. C/P examples can include:

- Drive motor for washing machine;
- Fan assembly for a jet engine;
- Pipe/tube;
- Printed circuit board for television;
- Starter motor for vehicle;
- Magnetic coil for a Magnetic Resonance Imaging (MRI) machine;
- Wheel axle.

See Reference [52] for more information.

6.2.1.12 Global Model Number (GMN)

The GS1 Global Model Number (GMN) is the GS1 identification key used to identify a product model or product family based on attributes common to the model or family as defined by industry or regulation. See Reference [53] for more information.

6.2.2 Telecom

6.2.2.1 Issuer Identification Number (IIR)

The Issuer Identification Number of the ITU is issued to identify a telecom company in a country which is working in an international environment^[54].

6.2.2.2 ITU-T E.164

This ITU recommendation provides the structure and functionality for the categories of numbers used for international telecommunications. It includes standards for identifications of countries, networks, subscriber numbers, etc.^[55]

6.2.2.3 Mobile Country Codes (MCC) and Mobile Network Codes (MNC)

MNCs are used to identify the country in wireless networks (GSM, etc.) which a subscriber belongs to. In order to uniquely identify a mobile subscriber network, the MCC is combined with a MNC. The combination of MCC with MNC is called HNI (Home Network Identity). The HNI combined with the MSIN (Mobile Subscriber Identification Number) results in the ISMI (Integrated Mobile Subscriber Identifier)^[56].

6.2.2.4 Subscriber Identity Module (SIM)

The SIM (Subscriber Identity Module) card is a microchip in a mobile (smart) phone that connects it to a particular network and has a fundamental role in mobile telecommunications. It provides a secure means for authentication of devices onto networks.^[57] GSMA, representing the mobile operators, including the device makers, equipment providers and internet companies, develops and maintains the specifications of the SIM^[58].

6.2.2.5 Universal Integrated Circuit Card (UICC)

In a GSM (Global System for Mobile communication) network, the UICC contains a SIM application and in an UMTS (Universal Mobile Telecom System) network, it contains a USIM (Universal Subscriber Identity Module) application. An UICC can contain several applications, making it possible for the same smart card to give access to both GSM and UMTS networks, and also provide storage of a phone book and other applications. It is also possible to access a GSM network using a USIM application and it is possible to access UMTS networks using a SIM application with mobile terminals prepared for this^[57].

6.2.2.6 Embedded UICC (eUICC)

An embedded-SIM (eSIM) or embedded universal integrated circuit card (eUICC) is a form of programmable SIM card that is embedded directly into a device. The surface mount format provides the same electrical interface as the full size, 2FF, and 3FF SIM cards, but is soldered to a circuit board as part of the manufacturing process. In machine to machine (M2M) applications where there is no requirement to change the SIM card, this avoids the requirement for a connector, improving reliability and security. An eSIM can be provisioned remotely; end-users can add or remove operators without the need to physically swap a SIM from the device^[57].

6.2.2.7 Embedded Subscriber Identity Module (eSIM)

eSIM is the top level generic descriptor applied to the Devices and eUICCs that support Remote SIM Provisioning^[57].

6.2.2.8 eUICC Identity Scheme (eIS)

This GSMA service provides eUICC manufacturers with the unique code necessary for them to produce globally unique, eUICC serial numbers. Markedly, this scheme complements the existing ITU E.118 scheme^[59].

6.2.2.9 International Mobile Equipment Identity (IMEI)

A globally unique identifier (hard-coded in the handset) that can be used to identify a device on the mobile network^[60].

6.2.2.10 International Mobile Subscription Identity (IMSI)

The international mobile subscription identity (IMSI) is a number that uniquely identifies every user of a cellular network. It is stored as a 64-bit field and is sent by the mobile device to the network. It is also used for acquiring other details of the mobile in the home location register (HLR) or as locally copied in the visitor location register^[61].

6.2.2.11 International Mobile Subscription Identity (MSISDN)

A MSISDN uniquely classifies a subscription in the Global System for Mobile Communications (GSM) or Universal Mobile Telecommunications System (UMTS) networks. It is the telephone number of the Subscriber Identity Module (SIM) card displayed on mobile or cellular phones^[62].

MSISDN numbering adheres to numbering plans defined in ITU Telecommunications Standardization Sector (ITU-T) recommendation E.164. The MSISDN and International Mobile Subscriber Identity (IMSI) are essential to identifying mobile subscribers. The IMSI usually identifies the SIM and is used as a subscriber database key. The MSISDN is the number dialed to bond calls to mobile phones.

A MSISDN can be written in various ways, depending on the source or standardization body and is limited to 15 digits, excluding prefixes^[55].

6.2.2.12 Type Allocation Code (TAC)

Device brand owners and manufacturers need the Type Allocation Code (TAC) to create the first 8 digits of the International Mobile Equipment Identity (IMEI), the number that identifies each unique mobile device on all GSM networks. TAC is required for all 3GPP-compatible equipment types worldwide including IoT devices, modems and wearables. See Reference ^[63] for the standard and see Reference ^[64] for the register.

6.2.3 Internet

6.2.3.1 ICANN Domain Names

Domain names are the identifier for the internet. In general domain names identify a network domain or it represents an IP (Internet Protocol) resource. Domain names are formed by the rules and procedures for the DNS (Domain Name System) of ICANN^[65].

6.2.3.2 Domain Name System (DNS)

The Domain Name System (DNS) is the system and network protocol used on the Internet to translate computer names into numerical addresses (IP addresses) and vice versa. Although this is called "translating", it is nothing more than looking up names in tables that have numbers associated with them. DNS is a client-server system: a requester (client) uses the DNS protocol to request a name or address from a provider (DNS server), to which the server returns a reply. Looking up a number by a name is called forward lookup; looking up a name with a number reverse lookup^[66].

6.2.3.3 Internet Protocol address (IP address)

An Internet Protocol address is a numerical label assigned to each devices connected to a computer network that uses the Internet Protocol for communication. An IP address serves two main functions: host or network interfaces identification and locating addressing. IANA^[67] is responsible for the global coordination of the IP addressing systems as well as the Autonomous Systems numbers issued for routing Internet traffic. RIPE^[68] publishes the IPs of the available networks and its owners.

6.2.3.4 ISO/IEC 21823-1 Internet of things (IoT) — Interoperability for internet of things systems — Part 1: Framework

The IoT Framework provides an overview of interoperability as it applies to and for IoT systems. ISO/IEC 21823-1 enables peer-to-peer interoperability between separate IoT systems with the use of identifiers. It provides a common understanding of interoperability as it applies to IoT systems and the various entities within them^[69].

6.2.4 Patents and trade marks

WIPO (World Intellectual Property Organization) is a special agency of the United Nations with 193 member states. The majority of the member states have legislation to protect intellectual property rights (patents and trademarks). The government agency registers those IP rights with an identifier issued by the government agency involved. WIPO has published an overview of all WIPO members^[70]. WIPO also makes the trademarks available in the WIPO Global Brand Database.^[71] Five large IP organizations EPO (European Union), JPO (Japan), KIPO (Korea), CNIPA (China) and USPTO (US) cooperate in five IP offices^[72].

WIPO has dialogues how identifiers (Digital Object Identifiers) could contribute to better access to the available IP documentation.

6.2.5 Postal services

6.2.5.1 ISO 3166-1 Codes for the representation of names of countries and their subdivisions — Part 1: Country code

ISO 3166-1 defines internationally recognized codes of letters and/or numbers that can be used when referring to countries and their subdivisions. However, it does not define the names of countries because this information comes from United Nation sources (Terminology Bulletin Country Names and the Country and Region Codes for Statistical Use maintained by the United Nations Statistic Division). See Reference ^[73] for more information.

6.2.5.2 ISO 19160-1 Addressing — Part 1: Conceptual model

It defines a conceptual model for address information (address model). The model is presented in UML. The model provides a common representation of address information, independent of actual addressing implementations. The model provides a basis for developing address specifications by individual countries or communities. See Reference ^[74] for more information.

6.2.5.3 Universal Post Codes

The UPU (Universal Postal Union) has 192 members (that are UN members). Addressing practices and standards differ from country to country. There are more than 200 address formats in the world. At present around 130 countries use postcodes as part of their addressing system. The UTU Universal Post Code Database contains the raw postcodes of the member countries. See Reference ^[75] for more information.

6.3 Identifiers of objects used in specific industries (“verticals”)

6.3.1 Logistics industry

6.3.1.1 Products

6.3.1.1.1 Global Trade Item Number (GTIN)

The GS1 Global Trade Item Number is used to identify any item (product or service) upon which there is a need to retrieve predefined information and that can be priced, ordered or invoiced at any point in

any supply chain. This definition covers services and products, from raw materials through to end user products, all of which can have predefined characteristics^[43].

6.3.1.1.2 Serial Shipping Container Code (SSCC)

Items that have been assembled together for transport and/or storage can be considered logistical units that are identified with a GS1 identification key named the SSCC (Serial Shipping Container Code). Each instance represents an individual assemblage of objects, while in transport and/or storage, and until they have been separated to enable a logistic unit's individual journey to be referenced. The SSCC can be used by companies for any combination of trade items packaged together such as a case, pallet or parcel^[44].

6.3.1.1.3 Global Service Relation Number (GSRN)

The Global Service Relation Number (GSRN) is a non-significant number used to identify the relationship between an organization offering services and the individual entities providing or benefitting from the services. The GSRN provides unique and unambiguous identification. It is the key to accessing information, stored on computer systems, relevant to service(s) provided and received. In some cases, these services could be recurring. The GSRN can also be used for referencing information transferred via Electronic Data Interchange (EDI)^[47].

6.3.1.1.4 Global Identification Number for Consignment (GINC)

The GS1 Global Model Number (GMN) is the GS1 identification key used to identify a product module or product family based on attributes common to the model or family as defined by industry or regulation^[48].

6.3.1.1.5 Global Shipment Identification Number (GSIN)

The Global Shipment Identification Number (GSIN) is a number assigned by a consignor (seller) of goods. It provides a globally unique number that identifies a logical grouping of logistic units for the purpose of a transport shipment from that consignor (seller) to the consignee (buyer). It identifies the logical grouping of one or several logistic units each identified with a separate SSCC and containing trade items as being part of a specific seller/buyer relationship and that travels under one despatch advice and/or Bill of Lading. It can be used by all parties in the transport chain as a communication reference, for example, in Electronic Data Interchange (EDI) messages where it can be used as a shipment reference and/or a consignor's loading list. The GSIN fulfils the requirements of the UCR (Unique Consignment Reference) of the World Customs Organization (WCO). See References ^[49] and ^[51] for more information.

6.3.1.1.6 Component/Part Identifier (CPID)

A Component/Part (C/P) is defined as an item that is intended to undergo at least one further transformation process to create finished goods for the purpose of downstream consumption. C/P examples can include:

- Drive motor for washing machine;
- Fan assembly for a jet engine;
- Pipe/tube;
- Printed circuit board for television;
- Starter motor for vehicle;
- Magnetic coil for a Magnetic Resonance Imaging (MRI) machine;
- Wheel axle.

See Reference [52] for more information.

6.3.1.1.7 Global Model Number (GMN)

The GS1 Global Model Number (GMN) is the GS1 identification key used to identify a product model or product family based on attributes common to the model or family as defined by industry or regulation. The GMN comprises the GS1 Company Prefix, a model reference and check character pair. The model reference utilizes characters from GS1 AI encodable character set 82 and its structure is left to the discretion of the brand owner who assigns it.

See Reference [53] for more information.

6.3.1.2 Assets

6.3.1.2.1 Global Returnable Asset Identifier (GRAI)

A returnable asset is a reusable package or transport equipment of a certain value, such as a beer keg, a gas cylinder, a plastic pallet, or a crate. The GS1 system identification of a returnable asset, the Global Returnable Asset Identifier (GRAI), enables tracking as well as recording of all relevant data. See Reference [45] for more information.

6.3.1.2.2 Global Individual Asset Identifier (GIAI)

In the GS1 system, an individual asset is considered a physical entity made up of any characteristics. This element string identifies a particular physical entity as an asset. Individual Asset Identifier (GIAI) can remain with the asset when changing hands depends on the particular business application. If it remains with the asset it cannot be reused. This element string might, for example, be used to record the life-cycle history of aircraft parts. By symbol marking the GIAI, AI (8004), on a given part, aircraft operators are able to automatically update their inventory database and track assets from acquisition until retirement. The GIAI is also used with Automatic Identification and Data Capture (AIDC) for medical devices within the micro-logistics cycle of use, cleaning and sterilization. See Reference [46] for more information.

6.3.1.2.3 ISO 6346 Freight containers — Coding, identification and marking

ISO 6346 [76] provides a system for the identification and presentation of information about freight containers. It specifies an identification system with mandatory marks for visual interpretation and optional features for automatic identification and electronic data interchange and a coding system for data on containers size and type. The Registration Authority is the International Container Bureau. See Reference [77] for more information.

6.3.1.2.4 IMO Ship Identification

The IMO Ship Identification Number Scheme of the International Maritime Organization, a specialized UN agency for shipping, includes a unique identifier for ships, registered ship owners and management companies. The IMO number identifies a ship and does not change when the ship's owner, country of registry (flag) or name changes. See Reference [78] for more information.

6.3.1.2.5 Mobile assets

The International Registry of Mobile Assets [79] takes care of the execution of the Cape Town & Aircraft Protocol. SITA, [80] the network of the aviation industry, mandated Aviaretto [81] to operate the International Registry of Mobile Assets for planes, etc.

6.3.1.2.6 FIATA Digital Identity

The FIATA Digital Identity format (including identifiers of the FIATA membership number, Business Register number, the VAT number and the LEI) and registry, which allows freight forwarders (and

customs) to exchange authenticated and secured data and sign documents. See Reference [82] for more information.

6.3.1.3 Locations

6.3.1.3.1 Global Location Number (GLN)

The GS1 Global Location Number enables the unique and unambiguous identification of any type of location used in business processes. Identification in this manner is a prerequisite for efficient communication between trading partners. A GLN acts as a database key that references location specific information that is repeatedly applied. Its function is to reduce input errors and increase efficiency.

The GLN is widely used in the sharing of electronic data between companies, since it enables unambiguous identification of the parties, locations and systems. Therefore the GLN is a foundational key in the related GS1 standards. See Reference [32] for more information.

6.3.1.3.2 UN/LOCODE

The United Nations Code for Trade and Transport Locations (UN/LOCODE) includes over 103 000 locations in 249 countries and territories used by shipping companies, freight forwarders and in the manufacturing industry around the world. It is also applied by national governments and in trade related activities, such as statistics. See Reference [83] for more information.

6.3.1.3.3 IATA Airline Designator Codes

The AD Codes are used for as the single point of reference for reservations, schedules, timetables, telecommunications, ticketing, cargo documentation, legal tariffs, and other commercial/traffic purposes. These codes are essential for the identification of passenger and cargo traffic documents. See Reference [84] for more information.

6.3.1.3.4 IATA Location Code

The IATA location identifier is a repository of worldwide airports as well as bus stations, rail stations and ferry ports that are involved in intermodal (containers) air travel. See Reference [84] for more information.

6.3.1.4 Documents

6.3.1.4.1 Global Coupon Number (GCN)

Paper coupons can be identified by a Global Coupon Number (GCN) assigned by the coupon issuer. The GCN comprises a GS1 Company Prefix followed by a coupon reference. It can be supplemented by an optional serial number. The GCN provides a globally unique identification for a coupon, with an optional serial number. See Reference [50] for more information.

6.3.1.4.2 Global Document Type Identifier (GDTI)

The Global Document Type Identifier is the GS1 identification key used to identify documents, electronic messages and digital files for the purposes of document control. Any aspect of referenced modification, version control, specific instance recording would fall into the process of document control, either internal or externally with trade partners, where unique identification is required.

The word “document” is applied broadly to cover any paper(s) or digital file(s). The Global Document Type Identifier (GDTI) can be used to identify any type of document including but not limited to:

- Commercial documents (e.g. invoice, purchase order);
- Documents that infer a right (e.g. proof of ownership);

- Documents that infer an obligation (e.g. notification or call for military service);
- Identification documents (e.g. driver's licence, passport);
- Digital files;
- Electronic messages.

See Reference [50] for more information.

6.3.1.4.3 Certificates of origin

A Certificate of origin is an international trade document that certifies that goods in a particular export shipment are wholly obtained, produced, manufactured or processed in a particular country. They declare the "nationality" of the product and also serve as a declaration by the exporter to satisfy customs and trade agreements. See Reference [85] for more information.

6.3.1.4.4 IATA Airway Bill

The IATA Air Way Bill is a unique and critical air cargo e-document that constitutes the contract of the carriage between the "shipper" (freight forwarder) and the "carrier" (airline). The IATA designator codes and locations coded are included in the e-AWB. See Reference [86] for more information.

6.3.1.4.5 Letter of Credit (LoC) of the International Chamber of Commerce (ICC)

A Letter of Credit (also known as a documentary credit) is a payment mechanism used in international trade to provide a guarantee from a bank to an exporter of goods (based on the ICC UCP 600 global rules). See References [87] and [88] for more information.

6.3.1.4.6 ATA Carnet for international customs documents of the ICC

An ATA (Admission Temporaire/Temporary Admission) Carnet is an international customs document that permits duty-free and tax-free temporary import of goods for up to one year. See Reference [89] for more information.

6.3.1.4.7 Bill of Lading (B/L or BOL) of the ICC

A Bill of Lading (B/L or BOL) is a document issued by a carrier (or their agent) to acknowledge receipt of the cargo for shipment. See Reference [90] for more information.

6.3.2 Agricultural and food industry

The agri-food sector includes agriculture, food, drinks and tobacco production for human and animal consumption. The sector includes regulated and licenced activities that lead to the safe production, processing and packaging of produce.

The management of agri-food systems from farm to fork requires multiple object identifiers for use across all global trade territories and for regulatory purposes.

In this clause, an overview is presented of the available public and private identifier standards specific for the agricultural and food industry. These industries also make use of the subject identifiers presented in [Clause 5](#) and the object identifiers presented in [6.2](#) such as of GS1. [Annex C](#) provides an overview of the ISO Technical Committees and standards relevant for the agricultural industry.

6.3.2.1 Agricultural commodities

Commodities such as wheat, rice, beef, etc. are used in the production processes for human and animal consumption. The FAO (Food and Agricultural Organization of the United Nations) published the

definitions and classification of commodities with a comprehensive overview of the FAO Commodities Groups^[91].

Commodities are traded bilateral and at commodities exchanges. Commodities exchanges use their own identifiers (tickers) for the traded commodities (spot and derivatives) at their exchange. In 6.3.3.4 Commodities more information is presented on the available identifier standard and register of commodities.

6.3.2.2 Agriculture and food

The production of food is regulated to meet environmental, industrial and food safety standards and quality assurance, (e.g. animal welfare, farm safety, fair trade); and to minimize the environmental impact of commercial farming and forestry on soil, water and peripheral habitats where wild species prevail. See Table 1 for more information. On-farm processes and identifiers serve to facilitate record-keeping and to support evidence of farming standards, food safety, provenance and authenticity over time. See Table 2 for more information.

Other types of agriculture also exist where produce is not for consumption, e.g. forestry and non-food crops (e.g. commercial growers of flowers and ornamental plants). Similarly regulated for process verification and environmental impact, food safety standards are not required. Identifiers are already included in DLT-systems covering agri-food. See Table 3 for more information.

Table 1 — Cultivation type and tasks

Cultivation type	Functions and tasks
Tillage	Soil sampling (quality and structure), pesticide use, fertilizer use
Dairy	Daily milk records
Livestock	Feed records, grass sampling (NPK and sward diversity), veterinary records
Aquaculture	Disease and parasite management, water temperature and quality monitoring
Algaculture	Fertilizer record, water temperature and quality assessments
Hydroponics	Environment management e.g. clean room, water and nutrient quality monitoring

Table 2 — Examples of identifiers

Entity	Identifier
Farm	Address, geolocation, e.g. GIS
Subject	O/manager, permanent or seasonal farm operative, contractor, e.g. Licence
Livestock	movement passport, veterinary book, UID, e.g. RFID
Crop	Species, varietal, origin, e.g. seed type
Certification	QA, IGP, premium consumer categories, e.g. organic certification
Equipment	Tractor, trailer, unmanned aviation e.g. drone

Table 3 — Five agri-food contexts where DLT is commercially deployed

Context	Description
Corporate social responsibility schemes	Corporate brand values are enhanced by limiting impact and/or protecting endangered habitats - boglands, native woodlands, fresh watercourses, e.g. JBS's (global beef producer) Green Platform initiative in the Amazon.
Traceability optimization	Farm to fork transparency, swift product recall and enhanced consumer trust, e.g. IBM Food Trust, Trace Alliance and GS1 pilots.
Food integrity assurance and fraud countermeasures	IGP, protected marine species and other high-value product category protection e.g. Consorzio Arrancia Rossa, FishCoin, BeefLedger.
Decentralized Finance (DeFi)	Peer to peer market place, transparent securitization and crowd-funding, e.g. tokenising produce and on-farm assets in Argentina with Abakus Co., World Bank's sponsored Agri-Ledger Co. to deliver fair and timely payments to farmers in Haiti and Congo.
Industry/Agriculture 4.0	Integrated approach to applying emerging technologies including Cloud (IoT, edge, fog and transparent computing) AI and DLT to accelerate, efficiency, sustainability and profitability, e.g. Breedr, Ripe.io, Origin Chain Networks

Important aspects include successful communication, correct labelling and strong links between an item and its digital record or twin with recognisable identifier standards, e.g. quality assurance schemes; certifications, e.g. organic, halal; appropriate packaging and labelling, e.g. nutrition content, allergen; and with unique interoperable digital identifiers, e.g. GS1 identifiers. Further information is included in [Annex C](#).

6.3.2.3 Public sector

6.3.2.3.1 Land

In [6.3.10](#), general information is made available on identifiers for land administration and real estate.

6.3.2.3.1.1 Soil horizon

Domain of a soil with a certain vertical extension, more or less parallel to the surface and homogeneous for most morphological and analytical characteristics, developed in a parent material layer through paedogenic processes or made up of in-situ sedimented organic residues of up-growing plants (peat) [\[92\]](#).

6.3.2.3.1.2 CORINE Land Cover (CLC)

The CLC system is a hierarchical classification of European habitats. Currently deployed to assist visual interpretation of high resolution satellite imagery from Copernicus, Land Monitoring Service the European Union's Earth observation programme. See Reference [\[93\]](#) for more information.

6.3.2.3.1.3 MODIS vegetation indices - NASA

MODIS vegetation indices, produced at multiple spatial resolutions, provide consistent spatial and temporal comparisons of vegetation canopy greenness, a composite property of leaf area, chlorophyll and canopy structure [\[94\]](#).

6.3.2.3.1.4 Habitats

Protected habitats and of wild fauna and flora. See Reference [\[95\]](#) for more information.

6.3.2.3.2 Water

6.3.2.3.2.1 2006/60/EC Framework for community action in the field of water policy

Framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater and thereby contributes to: the provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use, a significant reduction in pollution of groundwater, the protection of territorial and marine waters. See Reference [96] for more information.

6.3.2.3.2.2 Standards for reclaimed water intended for agricultural irrigation

Reclaimed water quality classes and permitted uses and irrigation methods. Indicative list of preventive measures referred to in point 7 of Annex II or in any other equivalent national or international standards, e.g. ISO 16075-2. See Reference [97] for more information.

6.3.2.3.3 Agriculture

The INSPIRE code list register of the European Commission contains the code lists and their values as defined in the INSPIRE implementing rules on the interoperability of spatial datasets and services.[98] It covers the identification of the production of crop (plants, fungi, etc.) and animal products for food, for sale, own consumptions or industrial purposes including the biofuel plants. See Reference [99] for more information.

6.3.2.3.4 Cultivation systems

Rearing of animals and/or cultivation of plants. See Reference [100] for more information.

6.3.2.3.5 Agricultural licences

The government agencies of many countries issue licences with an unique identifier for tree felling, cattle breeding, medical cultivation (e.g. hemp) licences, and industrial emissions licences.

6.3.2.4 Private sector

6.3.2.4.1 Agricultural equipment

The production of food is supported by agricultural equipment for which the International Standards in [Table 4](#) are available. These include also identifier standards.

Table 4 — Agricultural equipment standards

Standard	Further information
Personal Protective Equipment (PPE)	ISO 27065. See Reference [101] for more information.
Agricultural electronics	Standards by ISO/TC 23/SC 19 Agricultural electronics[102]. Standard by ISO/TC 23 Tractors and machinery for agriculture and forestry[103].
Farm aviation	ISO 21895 [104].
IoT	ISO/IEC 30162 [105].
Irrigation equipment	Standards by ISO/TC 23/SC 18 Irrigation and drainage equipment and systems[106].

6.3.2.4.2 Infrastructure

6.3.2.4.2.1 Farming infrastructure

Farm dwellings, animal husbandry infrastructure (animal dwellings and processing infrastructure linked to farms), manure storage and other farming infrastructure (e.g. buildings linked to plant handling and processing in farms)^[107].

6.3.2.4.2.2 Agricultural and aquaculture facilities

Farming equipment and production facilities (including irrigation systems, greenhouses and stables)^[108].

6.3.2.4.2.3 AgriBuilding

A building used for agricultural or aquaculture activities^[109].

6.3.2.4.3 Crops (including tobacco and forestry)

Variety registration is a precondition for the certification of seed. See [Table 5](#) for more information on those standards.

Table 5 — Crops (including tobacco and forestry standards)

Standard	Further information
Plant varieties	European Commission, Common Catalogue of varieties of agricultural plant species ^[110] .
Vegetables	European Commission, Common Catalogue of varieties of vegetable species ^[111] .
Fruit	European Commission, Fruit Reproductive Material Information System (FRU-MATIS) ^[112] .
Forestry	European Commission, Forest Reproductive Material Information System (FORE-MATIS) ^[113] .

6.3.2.4.3.1 Industrial crops

Crops that are normally not sold directly for consumption because they need to be industrially processed prior to final use^[114].

6.3.2.4.3.2 Energy crops

Crops used for the production of biofuels or other renewable energy^[115].

6.3.2.4.3.3 Permanent crops

Crops not grown in rotation, other than permanent grassland, which occupy the soil for a long period and yield crops over several years^[116].

6.3.2.4.3.4 Permanent crops under class

Permanent crops under class. See Reference [\[117\]](#) for more information.

6.3.2.4.3.5 Mushrooms, energy crops and genetically modified crops

Mushrooms, energy crops and genetically modified crops. See Reference [\[118\]](#) for more information.

6.3.2.4.3.6 Dried pulses and protein crops of which peas, field beans and sweet lupins

Dried pulses and protein crops of which peas, field beans and sweet lupins. See Reference [119] for more information.

6.3.2.4.3.7 Dried pulses and protein crops for the production of grain

Crops sown and harvested mainly for their protein content[120].

6.3.2.4.3.8 Aromatic plants, medicinal and culinary plants

Plants or parts of plants for pharmaceutical purposes, perfume manufacture or human consumption[121].

6.3.2.4.3.9 Plants harvested green

All 'green' arable crops intended mainly for animal feed, grown in rotation with other crops and occupying the same parcel for less than five years (annual or multiannual fodder crops)[122].

6.3.2.4.3.10 All genetically modified crops

Genetically modified crops (GMC)[123].

6.3.2.5 Livestock species

Classification and identification of livestock species[124].

6.3.2.6 Food and beverage industry**6.3.2.6.1 Public sector****6.3.2.6.1.1 Product identification****6.3.2.6.1.1.1 Foodx2 Code**

The food classification and description system FoodEx2 (revision 2). EFSA supporting publication 2015:EN-804. 90 pp. (European Food Safety Authority, 2015)[125].

6.3.2.6.1.1.2 Agricultural products assurance with geographical origin

Protected quality schemes for agricultural products and foodstuffs, for agricultural products or foodstuffs with identifiable specific characteristics, in particular those linked to their geographical origin[126].

6.3.2.6.1.2 Food safety**6.3.2.6.1.2.1 Labelling: mandatory food information**

EU Regulation No 1169/2011 regulates the provision of food information to consumers. See Reference [127] for more information.

6.3.2.6.1.2.2 Dietary reference Values (DRVs)

The EFSA's (European Food Safety Authority) Dietary reference values (DRVs) indicate the amount of a nutrient which must be consumed on a regular basis to maintain health in an otherwise healthy individual (or populations)[128].

6.3.2.6.1.2.3 Standard reference for the Food and Nutrient Database for Dietary Studies

Nutrient values for the Food and Nutrient Database for Dietary Studies (FNDDS), used for national nutrition monitoring and labelling by manufacturers. USDA National Nutrient Database for Standard Reference [129].

6.3.2.6.1.2.4 Substances or products causing allergies and intolerances

EU Regulation No 1169/2011 regulates the provision of food information to consumers including for substances or products causing allergies and intolerances. See Reference [130] for more information.

6.3.2.6.1.2.5 Genetically modified food and feed

Common measures for the contained use of genetically modified micro-organisms with a view to protecting human health and the environment[131].

6.3.2.6.2 Private sector

6.3.2.6.2.1 Food supply chain

In 6.2.1, a comprehensive overview is available of the GS1 object identifiers used for the supply chain of food and other agricultural products

6.3.2.6.2.2 Manufacturing of food beverages and tobacco products

Manufacturing of meat, fish, fruit and vegetables, oils and fats or derived products, dairy products, grain mill and starch products, prepared animal feeds, other food products, beverages and tobacco products[132].

6.3.3 Financial industry

6.3.3.1 Securities industry

6.3.3.1.1 ISO 6166 Financial services — International securities identification number (ISIN)

ISO 6166 specifies a uniform structure for the identification of financial instruments as well as referential instruments, irrespective of the technology used including tokenized instruments, using a unique identification code and associated descriptive data. The Association of National Numbering Agencies (ANNA) is the Registration Authority that also publishes ISIN guidelines. See Reference [133] for the standard and Reference [134] for the register.

6.3.3.1.2 ISO 10383 Securities and related financial instruments — Codes for exchanges and market identification (MIC)

ISO 10383 [135] specifies a universal method of identifying exchanges, trading platforms or non-regulated markets and trade reporting facilities as sources of prices and related information in order to facilitate automated processing. SWIFT is the Registration Authority. See Reference [136] for the register.

6.3.3.1.3 ISO 4914 Financial services — Unique product identifier (UPI)

ISO 4914 provides the framework allowing for a unique UPI code to be assigned to each distinct OTC derivative product that is reportable to trade repositories. The standard defines the UPI code structure and the set of reference data elements having specific value that will describe the products.

The issuance of UPIs and the collection of codes and reference data elements for each product will be maintained by the UPI service provider ANNA-DSB[137] that was mandated by the Financial Stability Board. The DSB is subject to the Regulatory Oversight Committee (ROC).[138] See Reference [139] for more information.

6.3.3.1.4 ISO 10962 Securities and related financial instruments — Classification of financial instruments (CFI) code

ISO 10962 specifies codes for an internationally valid system to classify financial and referential instruments. The classification system applies to financial instruments negotiated internationally as well as domestic instruments. The word “financial instruments” refers not only to classical securities, but also covers the innovative financial products that have emerged in different markets (a trend that is expected to continue in the future) and referential instruments on which financial instruments are derived. See Reference [140] for the standard and Reference [141] for the register.

6.3.3.1.5 ISO 18774 Securities and related financial instruments — Financial Instrument Short Name (FISN)

ISO 18774 defines and describes rules for an international valid system of building short names of any kind of financial instrument with a defined structure. It is intended for use in any application in the trading and administration of securities globally. The Association of National Numbering Agencies (ANNA) is the Registration Authority. See Reference [142] for the standard and Reference [141] for the register.

6.3.3.1.6 ISO 23897 Financial services — Unique transaction identifier (UTI)

ISO 23897 specifies the elements of an unambiguous scheme to identify a financial transaction whenever useful and agreed by the parties of community involved in the transaction. It does not specify the timing of assignment of who is responsible for its generation, so as not to limit the usage or relevance, nor does it consider a need to establish a data record for the unique transaction identifier (UTI) itself. See Reference [143] for more information.

6.3.3.1.7 Financial Instrument Global Identifier (FIGI)

The FIGI standard of the SDO: Object Management Group is a 12 character, alphanumeric, randomly generated ID of active and inactive instruments. The identifier itself acts as a Uniform Resource Identifier (URI) to link to a set of metadata that uniquely and clearly describes the instrument. See Reference [144] for more information and Reference [145] for the register.

6.3.3.2 Payments industry

6.3.3.2.1 ISO 4217 Currency codes

ISO 4217 specifies the structure for a three-letter alphabetic code and an equivalent numeric code for the representation of almost 300 currencies. For those currencies having minor units, it also shows the decimal relationship between such units and the currency itself. See Reference [146] for the standard and Reference [147] for the register.

6.3.3.2.2 ISO 13616-1 Financial services — International bank account number (IBAN) — Part 1: Structure of the IBAN

ISO 13616-1 specifies the elements of an international bank account number (IBAN) used to facilitate the processing of data internationally in data interchange, in financial industries as well as within and between other industries. The IBAN is designed for automated processing but can also be used conveniently in other media exchange when appropriate (e.g. paper document exchange). See Reference [148] for more information.

6.3.3.2.3 ISO/IEC 7812-1 Identification cards — Identification of issuers — Part 1: Numbering system

ISO/IEC 7812-1 [149] specifies a numbering system for the (international) identification (IIN) and the primary account number (PAN) of cards. Only one IIN will be assigned to each card issuer. This IIN is used only to identify the card issuer and is used when information is exchanged between the acquirer

and the issuer for clearing and settlement. The American Bankers Association^[150] is the Registration Authority.

6.3.3.2.4 ISO 8583-1 Financial transaction card originated messages — Interchange message specifications — Part 1: Messages, data elements and code values

ISO 8583-1 specifies the application of institution identifiers (IIC: Institution Identification Code: several roles), account identifiers and message type identifiers of card messages for card schemes. See Reference ^[151] for more information.

6.3.3.3 Token identifiers

6.3.3.3.1 ISO 24165-1 Digital token identifier (DTI) — Registration, assignment and structure — Part 1: Method for registration and assignment

ISO 24165-1 ^[152] specifies the assignments and generation of a random, unique, fixed-length (8 characters plus checksum) identifiers for digital tokens. The identifier is assigned to the token. Central Bank currencies are excluded. With the rise of peer-to-peer payment systems relying less on centralized authorities, and instead on aspects of cryptography, decentralized processing and a distributed network for the maintenance of a shared record transaction activity, the need to identify the digital tokens issued, traded, transacted or stored on these networks has grown. Etrading Software Ltd is the Registration Authority^[153].

6.3.3.3.2 International Token Identifier Number (ITIN)

The token identifier is an open market standard for a unique ID of a token for the safe and secure identification of cryptographic tokens. The International Token Standardization Association takes care of the database with about 5,000 tokens. The ITIN identifier has 8 alphanumeric characters and 1 alphanumeric character as checksum. See Reference ^[154] for more information.

6.3.3.4 Commodities

Commodity derivatives are traded bilateral and at commodities exchanges such as on the Chicago Mercantile Exchange^[155] and the London Metal Exchange.^[156] Derivatives are cleared by clearing houses such as LCH^[157] that are as licensed firms subject to oversight of securities regulators that receive on a daily basis data of the counterparties and positions taken. The following categories of commodity derivatives are distinguished:

- soft commodities that are grown such as wheat, rice, rubber, timber, etc.;
- hard commodities that are mined such aluminium, copper, coal, etc.;
- energy commodities such as electricity, gas and oil.

Commodity exchanges use their own identifiers (tickers) for the traded commodities (spot and derivatives) at their exchange. Bloomberg published with the use of the FIGI standard the most comprehensive overview of the available identifiers (tickers) for commodities and the commodity exchanges (exchange codes) involved. With the quick search of the attached link it is possible the FIGI identifier and ticker for all the types of commodities and/or commodity exchange. See Reference ^[158] for the standard and Reference ^[159] for the register.

6.3.4 Healthcare industry

For the identification of subjects (patients and hospitals, etc.) of the healthcare system in most countries, the identifiers of the government agencies are used.

6.3.4.1 ISO/TS 22220 Health informatics — Identification of subjects of health care

ISO/TS 22220 [160] specification indicates the data elements and structure to accurately and procedurally appropriate and sensitive identification of individuals in healthcare in a face-to-face setting supported by computer technology, or through interactions between computer systems. It provides guidelines for improving the positive identification of subjects of care within and between healthcare organizations.

6.3.4.2 Pharmaceutical industry

6.3.4.2.1 ISO 11616 Health informatics — Identification of medicinal products — Data elements and structures for unique identification and exchange of regulated pharmaceutical product information

ISO 11616 [163] is intended to provide specific levels of information relevant to the identification of a medicinal product or group of medicinal products. The identification is applied in order to uniquely identify pharmaceutical products throughout the product life cycles to support pharmacovigilance, regulatory and other activities worldwide. It is not intended to be a scientific classification for pharmaceutical products.

6.3.4.2.2 Supply chain identifiers

The pharmaceutical Industry also uses extensively “international identifiers” of GS1 such as the GIAI and GTIN identifiers. See 6.2.1 for the relevant standards that are available.

6.3.5 Media industry

6.3.5.1 ISO 2108 Information and documentation — International Standard Book Number (ISBN)

ISO 2108 [164] is globally recognized and used in the book supply chain, facilitating, for example, ease and speed of processing orders. An ISBN uniquely identifies each product form or edition of a separately available monographic publication that is published by a specific publisher and that is available to the public. ISO 2108 specifies how the ISBN is constructed, how it is assigned and used as well as the metadata associated with the ISBN allocation and the administration of the ISBN system. See Reference [165] for the register.

6.3.5.2 ISO 3297 Information and documentation — International standard serial number (ISSN)

ISO 3297 [166] defines the unique identification of serials and other continuing resources. Each ISSN is a unique identifier for a serial or other continuing resource in a defined medium whether print or electronic. See Reference [167] for the register.

6.3.5.3 ISO 3901 Information and documentation — International Standard Recording Code (ISRC)

ISO 3901 [168] specifies the code for the unique identification of recordings. The ISRC is applicable to the identification of audio recordings and music video recordings whether the recording is in analogue or digital form. See Reference [169] for the register.

6.3.5.4 ISO 15706-1 Information and documentation — International Standard Audiovisual Number (ISAN) — Part 1: Audiovisual work identifier

ISO 15706-1 [170] establishes and defines a voluntary standard numbering system for the unique international identification of audio-visual works. See Reference [171] for the register.

6.3.5.5 Entertainment Identifier Registry (EIDR)

The EIDR ID uniquely identifies an audiovisual asset, covering individual and serial works and their versions and manifestations. EIDR records include references to other audiovisual identification systems. See Reference [172] for the register.

EIDR is a non-profit industry-run identifier service used to identify both commercial and non-commercial content in commercial, non-profit and archived settings. EIDR is an implementation of the Digital Object Identifier [173] for which the EIDR Association is the Registration Agency and takes care of the specification and access to identifiers and their registered data.

6.3.5.6 ISO 15707 Information and documentation — International Standard Musical Work Code (ISWC)

The ISWC code specifies a means of uniquely identifying a musical work. See Reference [174] for the standard and Reference [175] for the register.

6.3.5.7 ISO 27730 Information and documentation — International standard collection identifier (ISCI)

ISO 27730 [176] specifies the structure of identifiers for collections, fonds and series. The identifier standard is intended for the use of organizations such as libraries, museums and archives.

ISCI allows decentralized allocation of identifiers because it is based on ISIL, the standard identifier for libraries and related organizations. If an organization has an ISIL code, it can start allocating ISCI based on it.

6.3.5.8 ISO 27729 Information and documentation — International standard name identifier (ISNI)

ISO 27729 [177] uniquely is used to uniquely identify persons and organizations by parties involved in creative activities throughout the media content industry as well as public personas of both such as pseudonyms, stage names, record labels or publishing imprints. See Reference [178] for the register.

6.3.5.9 ISO 17316 Information and documentation — International standard link identifier (ISLI)

ISO 17316 specifies [179] an identifier of links between entities in the field of information and documentation. These entities can be document media resources, people or more abstract items such as times or places. See Reference [180] for the register.

6.3.5.10 ISO 10957 Information and documentation — International standard music number (ISMN)

ISO 10957 [181] specifies the international music number to uniquely identify editions of notated music. See Reference [182] for the register.

6.3.5.11 Archival Resource Key (ARK)

Archival Resource Keys serve as persistent identifiers or stable trusted references for information objects maintained by the ARK Alliance. See Reference [183] for more information.

6.3.5.12 IETF RFC 8141 Uniform Resource Names (URNs)

The URN is a unique identifier for Internet resources. It can be used to replace the URL in library catalogues or in other listings systems and can also be used as stable reference within documents. See Reference [184] for more information.

6.3.5.13 ISO 20247 Information and documentation — International library item identifier (ILII)

ISO 20247 [185] specifies the international library item identifier which is used for the unique identification of items held by libraries and related organizations.

6.3.5.14 ISO 26324 Digital Object Identifier (DOI)

ISO 26324 [173] specifies the syntax of DOI names (individual identifiers) and the functionality of the DOI system, including the general principles for the creation, registration and administration of DOI names. The standard is used for the identification of an entity in any material form (digital or physical) and abstraction (such as a textual work) where there is a functional need to distinguish it from other entities. The International DOI Foundation takes care of the maintenance. See Reference [186] for more information.

6.3.5.15 Ad-ID

Ad-ID is the advertising industry standard for identifying advertising assets across all media platforms. See Reference [188] for more information.

6.3.6 Electronic devices industry

The electronics industry consists of various sectors. The producers of devices of that industry seem all to use their own proprietary company identifiers. In case the devices are linked to a mobile network (also) SIM identifiers are used.

6.3.6.1 Media Access Control address (MAC-address)

A MAC address is a unique identification number assigned to a device (NIC: Network Interface Controller) in a (local) network. ISO 9542 [189] ES-IS (End System to Intermediate System) provides the interaction standard between end-systems (hosts) and intermediate systems (routers). In the OSI model, a MAC address falls in the data link layer. MAC is also known as hardware address or physical address. It allows devices in a network to communicate with each other. Virtually every network device has a fixed MAC address determined by the manufacturer. MAC addresses are relevant for local networks. See Reference [190] for the register.

6.3.6.2 Mobiles and smartphones

A mobile device ID is a unique customer identifier used to distinguish a mobile device. GSMA takes care of the IMEI (International Mobile Equipment Identifier) and for the GSMA Device Database.

It could be an IDFA (Identifier for Advertisers) or an Android ID (Definition Google). See Reference [63] for more information.

6.3.6.3 Device fingerprint

A device fingerprint or machine fingerprint is information collected about the software and hardware of a remote computing device for the purpose of identification. The information is usually assimilated into a brief identifier using a fingerprinting algorithm. A browser fingerprint is information collected specifically by interaction with the web browser of the device. Each firm uses its own standard to identify the fingerprints of users.

6.3.6.4 PCs and laptops

A computer ID is a 16 character, alphanumeric code based on a computer's network device and other attributes of the computer. The Computer ID is generated to identify a computer for licensing purposes only. There is no industry standard available and each PC or laptop manufacturer has its own proprietary standard. Every IP capable network device has a unique MAC address (see 6.3.6.1). More information is available on the websites of the PC manufacturers involved.

6.3.6.5 ISO 8583-1 Financial transaction card originated messages — Interchange message specifications — Part 1: Messages, data elements and code values, Section Point of Service terminals (POS terminals)

ISO 8583-1 [151] specifies the 8 characters required to recognize uniquely the Terminal ID of a POS terminal in card networks. The term “Card Acceptor Terminal Identification” is used for POS terminals by some card schemes. Each acquirer issues its identifier number for the POS terminal that is connected to its card network. A Terminal ID is always connected to one Merchant ID. Terminal IDs are based on proprietary standards. The user of a POS terminal is informed on the place, time and currency a payment has taken place with his/her card or mobile.

6.3.6.6 Automatic Teller Machine terminals (ATM)

The ITU has defined a default numbering plan for ATM networks under ITU-T Recommendation E.164 based on the INICs (international Network Identification Codes). The INIC consists of the E.164 country coded follow by a national network identifier (with a maximum of 8 digits). For each ATM network the ATM s have an unique (proprietary) identifier. The user of ATMs is informed on the place, time and currency of the cash withdrawal that has taken place with his/her card or mobile. See Reference [192] for more information.

6.3.6.7 Security devices

The IETF (Internet Engineering Task Force) is reviewing how devices (such as security devices, cameras, CCTV (closed circuit television), etc. can be connected in an uniquely and in a secure way to the internet (at least to an IP network). See Reference [193] for more information.

6.3.6.8 Energy devices

The EAN code (European Article Numbering) is a unique identifier for a supply point for electricity and gas linked to a specific address. It is a unique 18 figures code for each form of energy. It is not the same as the meter number that identifies an appliance. The EAN numbers are used in several countries and are used for among more services and invoicing to customers that own or rent the building of a specific address. See Reference [194] for more information.

6.3.7 Automotive industry

6.3.7.1 ISO 3779 Road vehicles — Vehicle identification number (VIN)

ISO 3779 [195] specifies the content and structure of a vehicle identification number in order to establish, on a worldwide basis, a uniform identification numbering system for road vehicles. ISO 3779 applies to motor vehicles, towed vehicles, motorcycles and mopeds as defined in ISO 3833.[196] See Reference [197] for an overview of the industry standards.

6.3.7.2 ISO 3780 Road vehicles — World manufacturer identifier (WMI) code

ISO 3780 [198] specifies the content and structure of an identifier in order to establish, on a worldwide basis, the identification of road vehicle manufacturers. See Reference [197] for an overview of the industry standards.

6.3.7.3 ISO 4100 Road vehicles — World parts manufacturer identifier (WPMI) code

ISO 4100 [199] specifies the content and structure of an identifier in order to establish, on a world-wide basis, the identification of the manufacturers of parts for road vehicles. This identifier can serve, at the manufacturer's option, as a substitute of an addition for various national or international systems which already exist. It applies only to manufacturers of parts to be used on road vehicles as defined in ISO 3833. See Reference [197] for an overview of the industry standards.

6.3.7.4 Vehicle registration

All countries require registration plates for road vehicles such as cars, trucks and motorcycles. The registration identifier is a numeric and/or alphanumeric identifier that uniquely identifies the vehicle or vehicle owner. Whether the identifier is associated with a vehicle or subject (natural person or legal entity) varies by the issuing government agency of the jurisdiction. The UNECE WP 29 for Harmonization of Vehicle Regulations of the United Nations offers a platform for further cooperation for globally harmonized regulations on vehicles also including identifiers (number plates) and registrations for vehicles. See Reference [200] for more information.

6.3.7.5 Component/Part Identifier (CPID)

A Component/Part (C/P) is an item that is intended to undergo at least one further transformation process to create finished goods for the purpose of downstream consumption. C/P examples can include:

- Drive motor for washing machine;
- Fan assembly for a jet engine;
- Pipe/tube;
- Printed circuit board for television;
- Starter motor for vehicle;
- Magnetic coil for a Magnetic Resonance Imaging (MRI) machine;
- Wheel axle.

See Reference [52] for more information.

6.3.7.6 Global Document Type Identifier (GDTI)

The Global Document Type Identifier is the GS1 identification key used to identify documents, electronic messages and digital files for the purposes of document control. Any aspect of referenced modification, version control, specific instance recording would fall into the process of document control, either internal or externally with trade partners, where unique identification is required.

The word “document” is applied broadly to cover any paper(s) or digital file(s). The Global Document Type Identifier (GDTI) can be used to identify any type of document including but not limited to:

- Commercial documents (e.g. invoice, purchase order);
- Documents that infer a right (e.g. proof of ownership);
- Documents that infer an obligation (e.g. notification or call for military service);
- Identification documents (e.g. driver’s licence, passport);
- Digital files;
- Electronic messages.

See Reference [50] for more information.

6.3.7.7 Driving permits

All countries require driving permits and issue Domestic Driving Permits (DDP) or International Driving Permits (IDP) to their citizens that meet the criteria for the different categories of driving permits. Countries do not have the same approach to the identifier of the driving permit that can be (or not) attached to the citizen number. The United Nations’ Working Party 1 (Global Forum for Road

Traffic Safety)^[201] cooperates with the Fédération Internationale de l'Automobile (FIA),^[202] ISO and ICAO^[203] on further standardization also including identifiers, IDP cards, etc.

6.3.8 Mining industry

6.3.8.1 Commodities

Commodities are raw materials used in the production processes of economic goods. The following categories of mining commodities are distinguished;

- Hard commodities that are mined such aluminium, copper, coal, etc.
- Energy commodities such as gas and oil.

Commodities are traded bilateral and at commodities exchanges such as the London Metal Exchange. ^[156] Commodities exchanges use their own proprietary identifiers (tickers) for the traded commodities (spot and derivatives) at their exchange.

Bloomberg published with the use of the FIGI standard^[158] a comprehensive overview of the available identifiers for commodities and their commodity exchanges (exchange codes) involved. See Reference ^[159] for more information.

Traded energy future, option and physical contracts inclusive for carbon trading to reduce carbon emissions are cleared by clearing houses such as ICE. Clearing houses use their own identifiers for their clearing members, contracts and ISO 10383 to identify for the exchanges where the contracts are traded. See Reference ^[204] for more information.

6.3.8.2 Metals

6.3.8.2.1 ISO 4217 Precious metals (Currency Codes)

The precious metals gold, silver, platinum and palladium have an ISO code.

- Gold: XAU;
- Silver: XAG;
- Platinum: XPT;
- Palladium: XPD.

See Reference ^[146] for the standard and Reference ^[205] for the register.

6.3.8.2.2 Rare earth metals

Rare earth metals are a group of set of nearly indistinguishable lustrous of heavy metals. The earth metals have diverse applications in electrical and electric components, lasers, glass, magnetic processes and industrial processes. An overview of the identifiers (a symbol) of the 17 earth metals is available. See ^[206] for more information.

6.3.9 Chemical industry

6.3.9.1 IUPAC Identifier

The IUPAC^[207] Chemical Identifiers is a non-proprietary identifier for chemical substances used in electronic (or printed) data sources.

6.3.10 Land administration and real estate

The United Nations published its Guidelines on Real Property Units^[208] with a chapter on Identifiers where the following identifiers are distinguished:

- Cadastral identifiers;
- Building and apartment identifiers;
- Cadastral plans;
- Street addresses and postcodes;
- Geographic references.

The UN Guidelines describe that there are many ways in which a reference can be given to land and real estate. The UN mentions that the identification systems of countries are mostly products of national history and geography and were not designed for the computer age.

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Annex A (informative)

Identifier standards as issued by government agencies and SDOs

Overview of (public or private) organizations that publish identifier standards of subjects and/or objects and take care or mandate other organizations for the register of the identifiers (and attributes) involved.

Government agencies

Governments have defined the identifiers (including the attributes) standards of their subjects (citizens and legal entities) and objects (landmarks, vehicles, licences etc.). As the issuer of those identifiers the governments are usually maintaining the registers of the identifiers involved.

Standard Development Organizations

- ISO^[4]. Several Technical Committees have defined identifier standards of subjects and objects. ISO has mandated Registration Authorities (or Maintenance Agencies) to take care of the registration based on an ISO contract with the mandated organization^[222];
- GS1^[9]. GS1 has a broad suite of identifier standards for the (international) supply chain;
- ITU^[161];
- GSMA^[187];
- IEFT^[191];
- W3C^[220];
- OMG^[221].

Annex B (informative)

Identifier categories

To better understand the relationships between identifier types, [Tables B.1](#) and [B.2](#) are presented. They illustrate a broad view on identifier types making a clear distinction between subjects (natural persons and legal entities) and categories of objects included in this document.

Table B.1 — High-level structure of identifier categories

		Subjects	
		Natural persons	Legal entities
Objects	Products (raw materials, WIP, finished goods)		
	Assets (devices, containers, vehicles etc.)		
	Locations		
	Documents		
	Legal rights (shares, patents, licences)		
	Messages		

Object identification standards for blockchain applications can serve multiple industries. While some identifier standards are clearly designed for only one industry (vertical industries), others are intentionally designed to be cross-industry. Identification standards have one general purpose to provide interoperability for the organizations using them. [Table B.2](#) illustrates this relationship between object standards for identification and their relative sector-specific or sector-agnostic application.

Table B.2 — Object identification standards mapped to industry verticals and horizontals

Object identifiers											
Horizontal industries	Vertical industries										
	Logistics	Agriculture & food	Financial	Healthcare	Pharmaceutical	Media	Electronic devices	Automotive	Mining	Chemicals	Land administration
Supply chain											
Telecom											
Internet											
Patents and trademarks											
Postal services											

Annex C (informative)

List of agricultural vocabularies published by ISO

International standards play an integral part in the implementation, oversight and emergence of new information systems to meet current and future global business requirements. As a transversal provider, the technology sector can gain insights into the current state of industry and sectoral provisioning; for example understand those terms, processes, hard and software commonly deployed within that industry. Scoping existing standards is one way to familiarize with a sector. [Table C.1](#) provides an overview of existing industry standards relevant to the agri-food sector that can benefit information systems design processes.

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Table C.1 — Agriculture-related ISO technical committees

	Title	Examples of relevant standards
ISO/TC 23	Tractors and machinery for agriculture and forestry Standardization of tractors, machines, systems, implements and their equipment used in agriculture and forestry as well as gardening, landscaping, irrigation and other related areas in which such equipment is used.	ISO 5681 Equipment for crop protection — Vocabulary This document defines terms commonly used in relation to equipment for applying plant protection products for crop protection.
		ISO 17989-1 Sustainability Guidance to integrate sustainability principles into the whole life cycle of products. The standard applies specifically to equipment used in the production of food, fibres, fuel and lumber for humans and livestock.
		ISO 24631-1 Radiofrequency identification of animals Sets forth the conditions for the granting and use of the manufacturer code related to a transponder and the associated rights and obligations of the parties involved in the issuance of the code. Test procedures specified in this document are recognized by the Federation of European Companion Animals Veterinary Association (FECAVA) and World Small Animal Veterinarian Association (WSAVA) and, as such, can be applied also to companion animals.
		ISO 12188-2 Test procedures for positioning and guidance systems in agriculture Specifies the process for evaluating and reporting the performance of agricultural vehicles equipped with automated guidance systems based on a global navigation satellite system (GNSS) when operating in an automatic steering mode.
ISO/TC 34	Food products Standardization in the field of human and animal foodstuffs, covering the food chain from primary production to consumption, as well as animal and vegetable propagation materials.	ISO 23418 Microbiology of the food chain Requirements for generating and analysing whole-genome sequencing (WGS) data obtained from foodborne bacteria. These requirements are applicable to any sequencing platform or chemistry. Next generation sequencing (NGS) provides rapid, economical and high-throughput access to microbial whole genome sequences (WGS) and is being applied to an expanding number of problems in food microbiology. WGS are digital representations of the biological potential of the sequenced organism at single base resolution.
		ISO /TS 34700 Animal welfare management - General requirements and guidance for organizations in the food supply chain Guidance for the food and feed industry to develop an animal welfare plan that is in line with the principles of the World Organization for Animal Health (OIE) Terrestrial Animal Health Code (TAHC) to ensure the welfare of farm animals in livestock production systems.
		ISO/TS 22002-3 Prerequisite programmes on food safety specifies requirements and guidelines for the design, implementation, and documentation of prerequisite programmes (PRPs) that maintain a hygienic environment and assist in controlling food safety hazards in the food chain.
ISO/TC 147	Water quality Standardization in the field of water quality	ISO 5667-11 Water quality — Sampling — Part 11 Informs the user of the necessary considerations when planning and undertaking groundwater sampling to survey the quality of groundwater supply, to detect and assess groundwater contamination and to assist in groundwater resource management, protection and remediation.

Table C.1 (continued)

	Title	Examples of relevant standards
ISO/TC 190	Soil quality Standardization in the field of soil quality	ISO 18400-205 Soil quality — Sampling — Part 205 Guidance for the design of sampling programmes, field procedures and subsequent treatment of samples for transport and storage prior to sample pre-treatment. It is intended to be used in conjunction with the other parts of the ISO 18400 series, in particular, the requirements concerning collection, handling and storage of soil for assessment of biological functions in ISO 18400-206.
ISO/TC 207	Environmental management systems, auditing, verification/validation investigations	ISO 14055-1 Environmental management – Guidelines Guidelines providing good practices to combat land degradation and assist in the rehabilitation of land that has been depleted.
ISO/TC 211	Geographic information/ Geomatics Standardization in the field of digital geographic information.	ISO 19165-2 Geographic information — Preservation of digital data and metadata — Part 2 Long-term preservation of digital geospatial data to provide details about content describing the provenance and context specific to data from missions that observe the Earth using spaceborne, airborne or in situ instruments.

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