TECHNICAL REPORT

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Application of blockchain-based traceability platform for cold chain food

Application d'une plate-forme de traçabilité basée sur la chaîne de blocs

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Foreword

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This document was prepared by Technical Committee ISO/TC 154, *Processes, data elements and documents in commerce, industry and administration*.

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Introduction

With the outbreak of the epidemic since 2019, the safety of cold chain food is drawing more and more attention. Due to that fact that the coronavirus (COVID-19) is cold-resistant, there are high risks that the cold chain food be infected or contaminated by the coronavirus during the circulation of the cold chain link, which can further exacerbate people's panic. Therefore, how to guarantee the safety of cold chain food is a primary and urgent issue expected to be resolved.

Traceability in the cold chain for food is essential in ensuring food safety, through which continuous tracking of the whole lifecycle is realized, including cold chain food production, storage, purchase, sales, and transportation, etc. In this document, a blockchain-based traceability platform is proposed, which links the required data series throughout the circulation of the cold chain food. By applying such a platform, the following benefits are expected:

— anti-counterfeiting: on this platform, each batch of cold chain food in the container is identified by a unique code, which can enable identification of each distinct batch of cold chain food;

— trusted lifecycle tracking: the information throughout the circulation of the cold chain food is written into the blockchain, which is tamper-resistant; and identity cannot be denied;

— supply chain collaboration: the traceability data are shared among the supply chain by leveraging distribution databases/records/ledgers to achieve unified credentials and reduce logistics costs;

— effective regulation: the platform provides credentials for regulatory agencies, and the most important information about cold chain food safety for consumers.

Application of blockchain-based traceability platform for cold chain food

1   Scope

This document addresses a blockchain-based traceability platform for cold chain food which realizes continuous and effective tracking of the cold chain food. The following aspects are included:

— it explores issues and considerations for cold chain food traceability, especially during the epidemic outbreak;

— it describes scenarios and stakeholders for effective tracking of the cold chain food using the platform;

— it describes data elements and processes for the platform;

— it presents the platform capabilities such as data tamper resistance, sustainability;

— it gives relevant use cases based on the platform.

2   Normative references

There are no normative references in this document.

3   Terms and definitions

For the purposes of this document, the following terms and definitions 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
cold chain
temperature-controlled supply chain

Note 1 to entry: An uninterrupted series of storage and distribution activities which maintain a given temperature range. It is used to help extend and ensure the shelf life of products such as fresh agricultural produce, seafood, frozen food, photographic film, chemicals, and pharmaceutical drugs.

[SOURCE: ISO 26683-3:2019, 3.7]

4   Overview

To ensure the traceability of the cold chain for food, stakeholders encounter many problems in the current processes, including but not limited to the following.

— Data integrity cannot be guaranteed for traceability of cold chain food among a large number of parties on the supply chain, such as a massive flow of documents, inefficient manual verification.

— Enterprises are concerned about the risk of core business data leakage when traceability data are made available.

— There is a lack of long-term food safety regulatory mechanisms.

To solve these problems, a blockchain-based traceability platform is proposed for cold chain food in this document, which aims to link all trusted data series of food, people, places during the whole lifecycle of cold chain food circulation and uses international standardized data elements and/or processes for their traceability.

This document assumes that the traceability platform uses a consortium blockchain. Clause 5 describes the traceability process and gives the minimum required data elements for data sharing and data transfer. Clause 6 gives the whole platform architecture of blockchain systems which are provided by stakeholders. At last, Clause 7 summarizes the benefits by utilizing such a platform.

5 Traceability process and data elements for cold chain system

5.1 Stakeholders

The main stakeholders involved in the traceability process of the cold chain system include:

— traceability platform providers;

— source warehouses/suppliers;

— subordinate warehouses;

— logistics providers;

— retailers and distributors;

— catering enterprises;

— government regulators;

— inspectors;

— consumers.

5.2 Traceability process at key links

Figure 1 shows the key links for the cold chain food traceability process. The data generated at the key links throughout cold chain food circulation, for example, origin, dock, port warehouse, city warehouse, supermarket, until cold chain food arrives at consumers, are encrypted and identified via a unique traceability code to form a traceability record/data/block, and are stored and connected into a blockchain.

At each of the key links, the cold chain food traceability process can be divided into 4 stages..

a) Cold chain food receipt process

— The logistic provider delivers the customs-related documents, such as customs declaration form, inspection and quarantine certificate, disinfection treatment report, to the documenter.

— The documenter, for example, the customer officer, creates a receipt, scans and uploads the customs-related documents, and applies for the traceability code on the traceability platform. When applying for traceability code, the required information includes the applicant, product name, manufacturer, number of packaging layers, whether to generate code according to product packaging scale, etc.

— The platform automatically prints the traceability code and sends it to the warehouse operator.

— The warehouse operator counts the received quantity of the cold chain food and other related information and registers it in the tally sheet.

— The warehouse operator uses terminal programs such as mobile applications, applets, websites, to scan the traceability code as well as his/her employ number and binds the information of the cold chain food and the warehouse operator to each other.

— After receiving the cold chain food, the warehouse operator hands over the traceability code and tally sheet to the documenter.

— At this stage the initial data of cold chain food firstly join the blockchain based traceability platform.

b) Cold chain food shipment-initiation process

— The documenter creates and prints the delivery order.

— The documenter sends the traceability code of the cold chain food and the delivery order to the warehouse operator.

— The warehouse operator picks the cold chain food at the location based on the delivery order, scans the traceability code and delivery order number for delivery.

— The warehouse operator uses an applet to scan the traceability code as well as his/her employ number and binds the information of the cold chain food and the warehouse operator to each other.

— The warehouse operator and the logistics provider hand over the documents to each other and sign for delivery.

— The logistic provider scans and uploads his/her driving license using the applet and starts loading.

c) Transaction

— The logistic provider delivers the cold chain food to the next link and scans the traceability code.

— The transaction code is generated via scanning the traceability code. When the cold chain food arrives at consumers, they confirm the transaction by scanning the transaction code in the application.

d) Inquiry

Consumers or government regulators uses terminal programs to check required traceability data, e.g. product name, origin, cold storage ID.

NOTE   The traceability process described in Figure 1 can be further extended, where more links can be added to the traceability process and more traceability data are involved.

b)c)
Origin

a)b)c)
Dock

a)b)c)d)
Port
warehouse

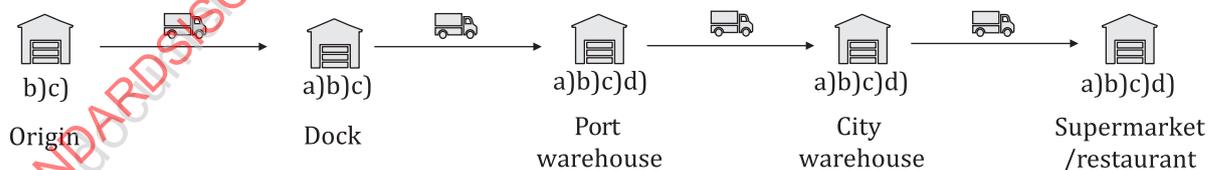a)b)c)d)
City
warehouse

a)b)c)d)
Supermarket
/restaurant

Figure 1 — The key links for cold chain system

5.3   Data elements

Data elements related to the processes listed in 5.2 are collected. See Tables 1 to 4.

a) Cold chain food receipt process

Table 1 — Data elements for cold chain food receipt process

Name	Variable name	Type	Compulsory /Optional	Note	Reference to UN Core Component Library (CCL)
Cold storage ID	ID	String	C	Identifier of warehouse storing the cold chain food (e.g. GS1 GLN)	
Origin	type	String	C	Original place where the cold chain food come from, either domestic or abroad (e.g. GS1 GLN)	
In-bound date	operateDate	Date	C	Date that the cold chain food is delivered into the warehouse	Transport_ Event. Occurrence. Specified_ Period/End. Date Time
Product code	productCode	String	C	Code of the cold chain food (e.g. GS1 GTIN)	
Product name	product-Name	String	C	Name of the cold chain food	Supply Chain_ Trade Line Item. Specified. Trade_ Product//Trade_ Product. Name. Text
Product batch number	productNo	String	C	Batch number of the cold chain food	Supply Chain_ Trade Line Item. Specified. Trade_ Product/Trade_ Product. Batch_ Identification. Identifier
Storage method	storageWay	String	C	The method of storing the cold chain food, such as freezing, refrigeration	
Production date	production-Date	Date	C	date that the cold chain food is produced	Supply Chain_ Trade Line Item. Specified. Trade_ Product/Trade_ Product. Individual. Trade_ Product Instance/Trade_ Product Instance. Production. Supply Chain_ Event/Supply Chain_ Event. Occurrence. Date Time
Number of in-bound pieces	productUnit	Decimal	C	Number of pieces delivered into warehouse	
Country	countryName	String	C	Name of original country if original is abroad	
Customs ID	customsNo	String	C	Identifier of customs	
Nucleic acid test report ID	nucleicAcidNo	String	O	Identifier of nucleic acid test report	Supply Chain_ Trade Line Item. Specified. Trade_ Product/Trade_ Product. Inspection_ Reference. Referenced_ Document/ Referenced_ Document. Issuer Assigned_ Identification. Identifier plus document type code
Key					
GLN global location number					
GTIN global trade item number					

b) Cold chain food shipment initiation process

Table 2 — Data elements for cold chain food shipment initiation process

Name	Variable name	Type	Compulsory /Optional	Note	Reference to UN Core Component Library (CCL)
Cold storage ID	ID	String	C	Identifier of warehouse storing the cold chain food (e.g. GS1 GLN)	
Product code	productCode	String	C	Code of the cold chain food (e.g. GS1 GTIN)	
Product batch number	productNo	String	C	Batch umber of the cold chain food	Supply Chain_ Trade Line Item. Specified. Trade_ Product/Trade_ Product. Batch_ Identification. Identifier
Out-bound date	operateDate	Date	C	date that the cold chain food is delivered out of the warehouse	Transport_ Event. Occurrence. Specified_ Period/End. Date Time
Destination	productDirection	String	C	Place where the cold chain food is expected to be delivered (e.g. GS1 GLN)	
Owner type	ownerType	String	O	Type of owner who ordered the cold chain food, either people or organization	Header_ Trade Agreement. Buyer. Trade_ Party/Trade_ Party. Type. Code
Organization name or ID	subjectName	String	O	When the owner is an organization, this field must be filled (e.g. GS1 GLN)	Header_ Trade Agreement. Buyer. Trade_ Party/Trade_ Party. Name. Text
Contact	contact	String	C	Name of the contact person	Header_ Trade Agreement. Buyer. Trade_ Party/Trade_ Contact. Person Name. Text
Contact telephone	contactTel	String	C	Mobile number of the contact person	Header_ Trade Agreement. Buyer. Trade_ Party/Trade_ Contact. Mobile_ Telephone. Universal_ Communication/Complete Number. Text
Key					
GLN global location number					
GTIN global trade item number					

c) Transaction

Table 3 — Data elements for transaction

Name	Variable name	Type	Compulsory /Optional	Note	Reference to UN Core Component Library (CCL)
Product name or ID	product-Name	String	C	Name of the cold chain food (e.g. GS1 GTIN)	Supply Chain_ Trade Line Item. Specified. Trade_ Product//Trade_ Product. Name. Text
Product batch number	productNo	String	C	Batch number of the cold chain food	Supply Chain_ Trade Line Item. Specified. Trade_ Product/Trade_ Product. Batch_ Identification. Identifier
Seller type	subjectType	String	C	Type of seller who sale the cold chain food, either people or organization	Header_ Trade Agreement. Seller. Trade Party/Trade_ Party. Type. Code
Seller name or ID	subjectName	String	C	Name of seller (e.g. GS1 GLN)	Header_ Trade Agreement. Seller. Trade_ Party/Trade_ Party. Name. Text
Contact telephone	contactTel	String	C	Telephone number of the contact person	Header_ Trade Agreement. Seller. Trade_ Party/Trade_ Contact. Telephone. Universal_ Communication/Complete Number. Text
Latitude	latitude	String	O	Latitude that the cold chain food is located	Logistics_ Location. Physical. Geographical Coordinate/Geographical Coordinate. Latitude. Measure
Longitude	longitude	String	O	Longitude that the cold chain food is located	Logistics_ Location. Physical. Geographical Coordinate/Geographical Coordinate. Longitude. Measure
Transaction time	createdAt	Date-time	C	Occurred time of the transaction	
Key					
GLN global location number					
GTIN global trade item number					

d)   Inquiry

Table 4 — Data elements for inquiry

Name	Variable name	Type	Compulsory /Optional	Note	Reference to UN Core Component Library (CCL)
Cold storage ID	ID	String	C	Identifier of warehouse storing the cold chain food (e.g. GS1 GLN)	Supply Chain_ Consignment. Storage. Transport_ Event/ Identification. Identifier
Name or ID of supplier, consignor or consignee	condition	String	O	Name of supplier, consignor or consignee (e.g. GS1 GLN)	
Key					
GLN global location number					
GTIN global trade item number					

Table 4 *(continued)*

Name	Variable name	Type	Compulsory /Optional	Note	Reference to UN Core Component Library (CCL)
Product name or ID	product-Name	String	C	Name of the cold chain food (e.g. GS1 GTIN)	
Warehousing starting time	operateDate-From	Date-time	O	Time that the cold chain food is delivered into warehouse	Transport_ Event. Occurrence. Specified_ Period/Start. Date Time
Warehousing ending time	operateDate-To	Date-time	O	Time that the cold chain food is delivered out of warehouse	Transport_ Event. Occurrence. Specified_ Period/End. Date Time
Warehousing type	type	String	O	1 for being delivered out of warehouse, 2 for being delivered into warehouse	
Storage type	storageType	String	O	List of cold chain food in storage	
Place	place	String	O	the place where the cold chain food is located (e.g. GS1 GLN)	
Origin	coldSource	String	O	The origin of the cold chain food (e.g. GS1 GLN)	
Storage method	storageWay	String	O	The method of storing the cold chain food, such as freezing, refrigeration	
Product batch number	productNo	String	O	Batch number of cold chain food	
Key					
GLN global location number					
GTIN global trade item number					

6 System architecture of blockchain based traceability platform
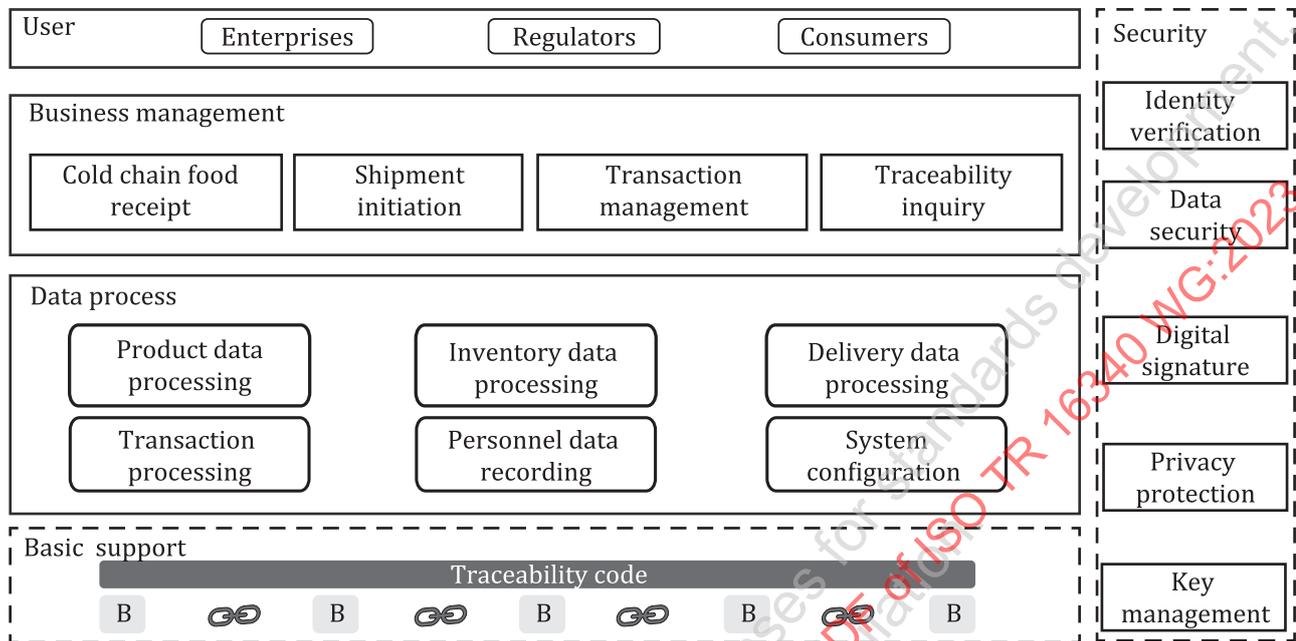
6.1 General

Figure 2 — Framework of the blockchain based traceability platform

A blockchain-based traceability platform is maintained by the platform manager, which is designed to realize accurate traceability of the cold chain food for the users. On this platform, a unique traceability code is used to identify each batch of cold chain food. On basis of that, business management provides effective management related to the food, people, places throughout the circulation of cold chain food. Via traceability data recording and inquiry, relevant business data and transaction data are recorded and can be queued by users.

The blockchain based traceability platform mainly consists of 5 parts, as shown in Figure 2.

6.2 User

a) Enterprises: the relevant enterprises which are involved in the cold chain traceability system, mainly divided into source warehouse, subordinate warehouse, logistics provider, retailer and distributor, catering enterprise, etc.

b) Regulators: regulatory users performing regulatory tasks, mainly consists of government regulator, cold chain food inspector, etc.

c) Consumers: users who purchase the cold chain food.

6.3 Business management

a) Cold chain food receipt: assign the traceability code for each batch of the cold chain food and manage the on-chain data when the cold chain food arrives.

b) Shipment initiation: create the delivery order and manage the delivery document.

c) Transaction management: mange the transaction and provide transaction order service for users.

d) Traceability inquiry: manage the traceability data throughout the circulation of the cold chain food and provide inquiry access for users.