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Internet of things (IoT) – IoT applications for electronic label system (ELS)

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CONTENTS

INTERNET OF THINGS (IoT) – IoT APPLICATIONS FOR ELECTRONIC LABEL SYSTEM (ELS)

FOREWORD

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ISO/IEC 30169 has been prepared by subcommittee 41: Internet of Things and Digital Twin, of ISO/IEC joint technical committee 1: Information technology. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
JTC1-SC41/277/FDIS	JTC1-SC41/287/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1, available at www.iec.ch/members_experts/refdocs and www.iso.org/directives.

INTRODUCTION

The development of information technology has brought a lot of changes in daily life, especially with the invention and emergence of IoT technology. IoT technology makes things connected with each other, in order to enhance the efficiency, provide effective monitoring and reduce the cost for all the regular management, maintenance, and other business events for those things.

Because of the information explosion era, there is rapid replacement of information, along with the rich variety of the information and the extremely short life cycle of the information. It is very difficult for traditional labels (the paper labels) to adapt to such a quick pace of information updates. Affected by the IoT technology, traditional labels began the process of becoming digitalized and interconnected.

However, the process of promotion and distribution of the electronic label system (ELS) is much faster than the formation of the worldwide marketing regulation system for such a newly emerging IoT application. To help the marketing maintain the operation under a healthy, sustainable, and controllable condition, it is urgent to develop the ELS focused standard(s) to accelerate standardization for the ELS design and distribution. At the same time, the ELS focused standard(s) will actually support the relevant global marketing regulation.

This document is in response to the demand described above. To achieve this goal, the first step is to provide a general design guide, and the overall technical requirements. This document briefly defines the system framework and IoT application model for ELS, which will firstly specify the components of ELS, duties of each component, regulations for business access logic and data flow between adjacent components. Then, the overall requirements in terms of system functions, system interfaces and system performances are specified in this document to simplify and unify the design of ELS. In conclusion, the purpose of this document is to help ensure the quality of service (QoS) and design conformance of ELS in the retail industry.

In order to avoid some unnecessary confusion regarding this document and to distinguish this document from other publications, the core concepts of this document are focused only on the overview and general requirements (discussed above) of the ELS itself.

For example, typical things out of the scope of this document include, but are not limited to,

a) electronic product labelling,

b) RFID-specified applications, and

c) health informatics.

INTERNET OF THINGS (IoT) – IoT APPLICATIONS FOR ELECTRONIC LABEL SYSTEM (ELS)

1 Scope

This document specifies the system framework, IoT application model and overall technical requirements for electronic label system (ELS).

This document applies to the design and development of the IoT applications for ELS.

The IoT applications for ELS specified in this document are mainly applicable to the retail industry, and can also provide reference for the design and development of the IoT applications for ELS in other industries.

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 terminological databases for use in standardization at the following addresses:

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

3.1
electronic label
EL
<in retail industry> IoT device which attaches to a physical item having a display for the information about the item and its perceived environment and also having information transmission via an RF data link

Note 1 to entry: Examples of the information about the item and its perceived environment include, but are not limited to, prices, stock status, promotional advertisement, barcode, two-dimensional code, temperature, humidity, ambient light conditions.

3.2
electronic label system
ELS
<in retail industry> system with a few to a large number of electronic labels designed for IoT applications

3.3
ELS backend system
subsystem intended to realize the business service functions and the equipment control functions of ELS

Note 1 to entry: The ELS backend system provides unified planning and management services for business activities that utilize the ELS, and it also provides a centralized equipment monitoring service.

3.4
IoT gateway
entity of an IoT system that connects one or more proximity networks and the IoT devices on those networks to each other and to one or more access networks

[SOURCE: ISO/IEC 20924:2021, 3.2.8]

4 Abbreviated terms

AES advanced encryption standard
GUI graphic user interface
IoT Internet of Things
LAN local area network
MRC machine-readable code
NFC near field communication
QoS quality of service
SSL secure socket layer
TLS transport layer security

5 Motivation

5.1 Background

In the retail industry, paper labels have a long history of being used to show consumers key information about merchandise. Obviously, with paper labels, all the maintenance work (including, but not limited to, information update, label inspection, label replacement) will be done by humans. In addition, in traditional retail activities, there are many other tasks that need to be done manually besides the maintenance of labels, including, but not limited to, inventory inspection, replenishment of goods, payment and settlement. The drawbacks of using paper labels include, but are not limited to, rising labour costs, inefficient business activities, error-prone, service and management is not timely. Such drawbacks are attracting more and more attention from the retail industry.

To address these issues, the retail industry needed to introduce an innovative business mode. Therefore, the ELS was invented, which has been adopted by the retail industry since 1993. According to relevant research, ELS has a global market size of over $15 billion and market penetration of over 10 %; in other words, more than 100 retail chains in more than 55 countries are covered (with more than 12 000 stores in total). Annex B gives some information about the application scenarios and use cases of ELS.

At present, the display technology of electronic label in the global market is at a mature stage, mainly using two display technologies: liquid crystal display (LCD) and electronic paper (including monochrome display and multi-colour display). In terms of system related technologies, ELS manufacturers are actively developing and distributing the system to promote its popularity in the global market.

In recent years, with the rapid evolution and iteration of IoT technology, the application of IoT has been gradually promoted and adopted in various industries. At the same time, this means that the ELS also coincided with a good opportunity – its advantages include, but are not limited to, convenient template design for display contents, fully automatic data update mode, the highly effective operation management, lightweight devices, low power consumption, support for the sensing and monitoring of target object. The application of ELS is being gradually accepted by and popularized in other industries besides the retail industry (the core application field), including, but not limited to, health services, public transportation, logistics, financial transactions, advertising. In terms of the core application field, ELS has been globally and widely used in places including, but not limited to, mainstream shopping malls, supermarkets.

In terms of other application fields, the application of ELS in global markets shows a quick growth trend. Therefore, ELS has great market potential, and ELS is the mainstream of future development.

5.2 Purpose and significance

At present, ELS has rapidly and globally penetrated into our daily life. When an innovative technology is rapidly promoted and deployed, the problems and potential risks are revealed gradually. These problems and potential risks are mainly raised from the technical level and business consistency level.

a) In terms of technology, the technologies to realize the ELS have diversified forms. The problems caused by the lack of standardization and uniformity will mainly focus on the following four points:
   1) uncertainty of ELS system framework and IoT application model;
   2) uncertainty of ELS functions;
   3) uncertainty of the necessary interfaces;
   4) uncertainty of ELS performance.

b) In terms of business consistency, when some businesses need to extend ELS in parallel to integrate two or more ELSs (ELSs are from different manufacturers or different series) into a larger ELS, a unified requirement for ELS design and distribution is the key.

In conclusion, normalization and standardization are the optimal solution to address the above problems. Therefore, applications for ELS has been proposed as the subject of a future International Standard. The follow-up development of this standard project will be researched and reviewed closely related to the above issues, in order to make this International Standard implementable. In addition, this solution will also contribute to the standardization of ELS product acceptance and ensure the QoS for consumers.

6 System framework and IoT application model

6.1 General

Clause 6 specifies the system framework and IoT application model for ELS.

6.2 System framework

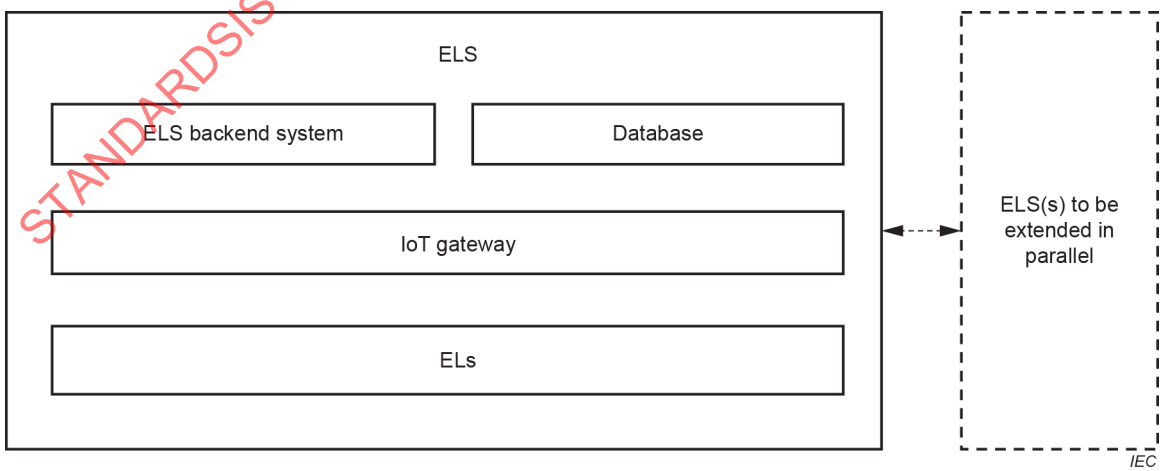

Figure 1 – System framework of the IoT applications for ELS

As shown in Figure 1, the system framework of the IoT applications for ELS shall be based on a complete ELS. It shall be able to extend with a single ELS or multiple ELSs in parallel (via third-party bridging service or services) according to the actual business requirements.

Each complete ELS shall be composed of ELS backend system, database, IoT gateway and ELs.

a) The backend system shall include two functions: business service, equipment management and control.

b) The data categories in the database shall include business data and equipment data.

6.3 IoT application model

6.3.1 General

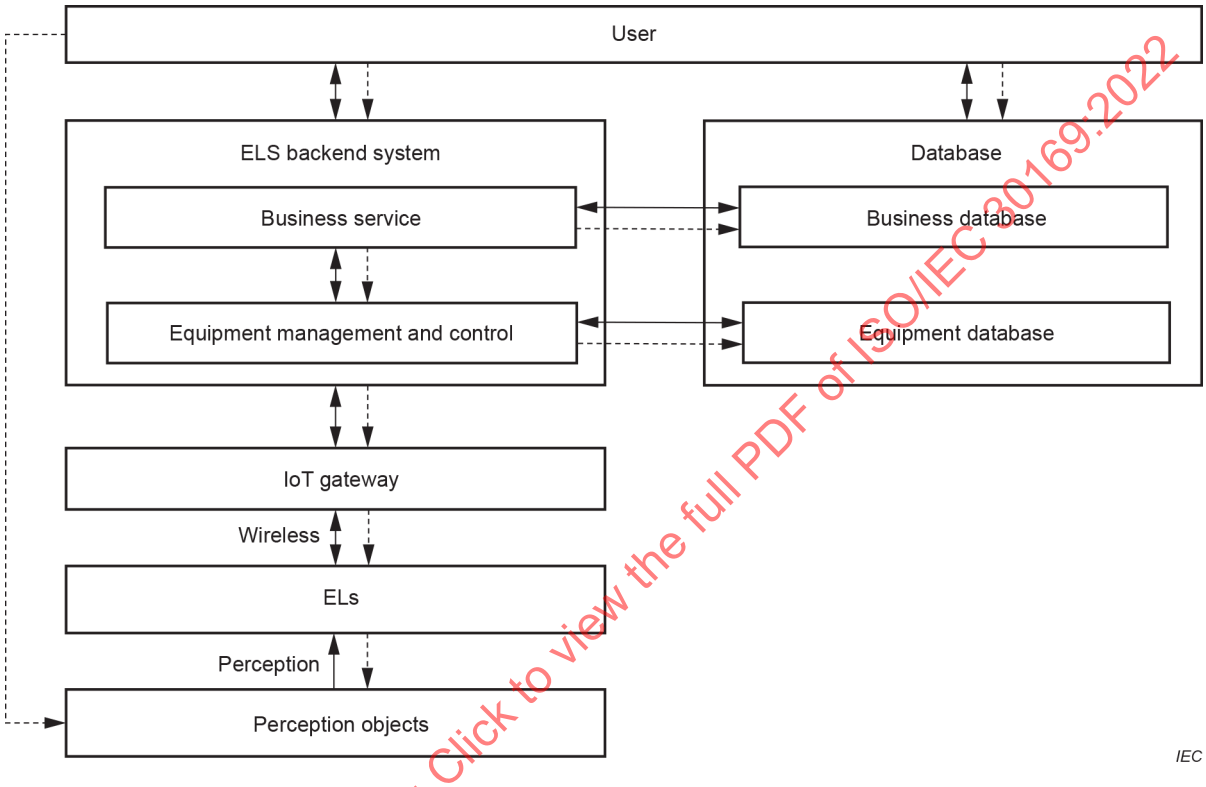

Figure 2 – IoT application model of the IoT applications for ELS

As shown in Figure 2, the IoT application model of the IoT applications for ELS shall be able to be divided into five levels. The order of authority from top to bottom is user, ELS backend system and database, IoT gateway, ELs, perception objects.

The data flow direction and business access logic in Figure 2 have been marked with solid arrows and dash arrows, respectively.

Access between all levels shall be performed downward/upward level-by-level; no cross-level access(s) is allowed, except from the user to the ELs.

Subclauses 6.3.2 to 6.3.7 provide the description how each part relates to the domain-based reference model in the IoT Reference Architecture.

6.3.2 User

This level relates to the user domain of the domain-based reference model, but more focuses on human user.

Specified in ELS, this level is the top of the IoT application model, which shall be able to provide user entities (ELS owners, operation and maintenance personnel, and consumers) with access interfaces of ELS, including, but not limited to, the direct access to the ELs via MRC scanning, NFC. The access purpose shall include, but is not limited to, information query, payment, and information within certain authority.

Consumers shall only be able to perform basic actions, including, but not limited to, public information access, suggestions and advice feedback.

Operation and maintenance personnel shall only be able to perform regular maintenance for the ELS backend system and database via the account with proper authorities. The maintenance activities shall strictly follow the requirements of the ELS owners.

The ELS owners shall have the maximum access authorities and shall be able to monitor all of the data in the ELS backend system and database, excluding payment information and customer personal data.

The business access logic of this level to the ELS backend system, database, and ELs shall be unidirectional. The data flow between this level and ELS backend system shall be bidirectional; the data flow between this level and database shall be bidirectional; the direct data flow between this level and ELs shall be prohibited. This level should be able to actively access the ELS backend system, database, and ELs; such business access logics are irreversible.

6.3.3 ELS backend system

This level has a hybrid relation to the domains of the domain-based reference model, which includes the operations and management domain, the application and service domain.

Specified in ELS, this level shall be able to support the IoT applications for ELS in terms of business service, equipment management and control, and data exchange within the system.

The authority level of business service function in the ELS backend system shall be higher than the authority level of equipment management and control function. The equipment management and control function is controlled by the business service function.

NOTE 1 The authority levels of the business service function and equipment management and control function, and the relationship between those two functions described here can confuse. The ELS can be thought of as a factory, the business service function as a chief manager, and the equipment management and control function as an executor. The chief manager will arrange necessary works for the executor according to the input business instructions from users. Next, the chief manager will receive the execution results from the executor and then feedback the desired results to the user. Both the business service function and the equipment management and control function are function collections, they contain a variety of business purpose functions and equipment relevant functions, respectively, according to different actual business demands.

For instance, the functions contained in the equipment management and control function are more fundamental than the functions contained in the business service function. To realize a function in the business service function, it is possible that the cooperation of multiple functions is needed in the equipment management and control function; functions in the business service function can call functions in the equipment management and control function, but the reverse call is not supported and is forbidden. In general, the data received by the equipment management and control function are not raw data from users, but processed data from the business function service instead.

NOTE 2 The detailed classification of those functions is out of scope.

The business access logic between the business service function, the equipment management and control function in the ELS backend system, and the business database in the database shall be unidirectional for all. The corresponding data flows shall be bidirectional for all. The business service function shall be able to actively access the equipment management and control function, and the business database in the database. Such business access logic is irreversible.

The business access logic between the device control function in the ELS backend system and the device database in the database shall be unidirectional, and the corresponding data flow direction should be bidirectional. The equipment management and control function shall be able to actively access the device database in the database, and the business access logic is irreversible.

The business access logic between this level and the IoT gateway shall be unidirectional, except the situation when the IoT gateway joins the ELS network for the first time. The corresponding data flows shall be bidirectional. This level shall be able to actively access the IoT gateway, and this business access logic is irreversible.

6.3.4 Database

This level relates to the resource access and interchange domain of the domain-based reference model, with little modification, to which the access will be gated by the ELS backend system.

Specified in ELS, this document considers the business level requirements of functions and performances only, which means this document does not consider the technical design for the database and associated data format.

The level of database is parallel to the ELS backend system. It shall be able to provide support for the centralized management and data exchange of all business data and equipment data within ELS.

The database shall be composed of business database and equipment database; the two databases shall be independent of each other.

Business database and equipment database shall only be accessed by the user and corresponding functions in the ELS backend system. They shall process immediately for the data access instructions and related operations that are initiated by user or corresponding functions in the ELS backend system.

This level shall not actively access the user and ELS backend system, but it shall ensure that the corresponding data flows between this level and the user and ELS backend system are bidirectional.

6.3.5 IoT gateway

This level has hybrid relation to the domains of the domain-based reference model, which includes the sensing and controlling domain (focuses on controlling), and the physical entity domain.

Specified in ELS, this level shall be able to ensure the channel of the equipment management and data exchange between the ELS backend system and the ELs, in order to provide support for the control of ELs and the monitoring of the perception objects.

IoT gateway shall only be controlled by the ELS backend system that it belongs to. Multiple IoT gateways in the same ELS are allowed.

The business access logic between this level and the ELs shall be unidirectional, except when the ELs join the internal network for the first time. And the corresponding data flows shall be bidirectional. This level shall be able to actively access the ELs, and the business logic is irreversible (except the situation described above).

When this level joins the internal networking for the first time, it shall make an exception to access the ELS backend system actively, in order to complete the registration and authorization of this level within ELS; otherwise, it shall not actively access the ELS backend system. However, the data flows between this level and the ELS backend system shall be bidirectional.

6.3.6 ELs

This level has hybrid relation to the domains of the domain-based reference model, which includes the sensing and controlling domain (focuses on sensing), and the physical entity domain.

Specified in ELS, this level shall be able to display business data, record equipment status, and collect the data of perception objects, in order to provide support for daily retail business activities, equipment control and monitoring of perception objects.

The ELs shall only be controlled by the IoT gateway that they belong to. Multiple grouped ELs in the same ELS are allowed.

The business access logic between this level and the perception objects shall be unidirectional. The corresponding data flow shall be unidirectional as well with opposite direction to the business access logic. This level shall be able to actively detect perception objects, and this business logic is irreversible.

When this level joins the internal networking for the first time, it shall make an exception to access the IoT gateway actively, in order to complete the registration and authorization of this level within ELS; otherwise, it shall not actively access the IoT gateway. However, the data flows between this level and the IoT gateway shall be bidirectional.

6.3.7 Perception objects

This level is the bottom of the IoT application model, which is the data source for perceptual data collecting by the ELs.

This level shall not access the ELs; only the upward data flow from this level to the ELs shall be guaranteed.

7 General technical requirements

7.1 General

Clause 7 specifies the general technical requirements of the IoT applications for ELS in terms of functions, interfaces, and performances.

Annex A gives further testing requirements which are important to ELS.

7.2 Function requirements

7.2.1 ELS backend system

7.2.1.1 General

In order to ensure the ability of ELS to support the daily retail business activities (described above), the ELS backend system shall have responsibility for the overall management and control of the display data update, customization-friendly perceptual data collection, data management, network monitoring, and operation status monitoring.

7.2.1.2 Business display

It shall switch automatically for display templates according to the actual business demands. Typical display template categories should include, but are not limited to, the pre-designed templates in the ELS backend system:

a) Generation and distribution of general merchandise display. According to the actual business demands, information related to the regular sales of commodities shall be generated and distributed to corresponding ELs.

b) Generation and distribution of promotion/feature display. According to the actual business demands, information related to the promotion activities or featured commodities shall be generated and distributed to corresponding ELs. Such a template shall be able to distinguish them from general commodities.

c) Generation and distribution of out-of-stock/out-of-inventory display. The status of the real-time store/warehouse stock shall be generated and distributed to corresponding ELs, according to the actual business needs so that users can make timely response for different storage status. The categories of such stock status should be able to classify as sold out, insufficient remaining, in transit, and normal.

d) Generation and distribution of merchandise backtrack entrance. It shall ensure the ELs have display template and NFC response of merchandise backtrack entrance, so that consumers can scan the MRC of such entrance on the EL screen or use NFC to obtain such entrance, in order to be redirected to the corresponding merchandise information website to review the merchandise information.

e) Generation and distribution of electronic payment entrance. It should adopt third-party electronic payment entrance in the EL display template and NFC response, according to the actual demands of ELS owner. In this way, consumers can scan the MRC of commodities on the EL screen directly or can use NFC to make payment and settlement via mobile phones or mobile terminals; the electronic payment entrance can also redirect consumers to the online mall for payment and settlement of commodities they want to buy.

7.2.1.3 Data management

The ELS backend system shall be able to design the display template of business data for EL display purpose and manage the business data uniformly for non-EL display purpose.

The data to be sent to the ELs for display shall be designed in picture format with incremental conception. Display templates shall be able to customize according to different business demands including, but not limited to, the business purposes described in 7.2.1.2.

Unified management of non-EL display business data shall include, but is not limited to, the distribution of equipment operation instructions, business data and perception objects data processing.

a) Distribution of equipment operation instructions. It shall be able to realize the distribution routing selection for designated display-purpose business data (based on the equipment registry) and collecting necessary data from the equipment and users under its jurisdiction (perception data, equipment operation status).

b) Business data and perception data processing. It shall be able to process the collected perception data and business data, including, but not limited to, data classification, statistics, analysis and maintenance. And it shall be able to generate archived data for the result of data process based on actual business requirements, including, but not limited to, the following.

   1) Monitoring logs. The log type shall include, but is not limited to, system operation log, equipment binding log, data docking log and system task log.

   2) System report. It shall be able to make statistics/analysis (including, but not limited to) of the distribution of all types of ELs within its authority range, update frequency of data in each historical period, statistical analysis of the operation to ELs in each historical period, and statistical analysis of data docking in each historical period.

3) Equipment data management. It shall centralize and unify the control, operation and maintenance of the registry and operation status for all IoT gateways, ELs and other controllable equipment within the authority range of the ELS backend system.

4) Merchandise data management. It shall be able to make statistics on the record changes of merchandise data for the ease of query by ELS owner, operation and maintenance personnel.

7.2.1.4 User management

The IoT authentication is a model for building trust in the identity of IoT involved in the IoT applications for ELS to protect data and control access. It shall be able to centralize and unify the management of authorized users and their corresponding authorities, including, but not limited to, create user groups, permission distribution, in order to optimize, prevent, and control some problems and risks caused by fragmented management (e.g. poor/unstable user access efficiency and incomplete authority management), and strengthen the security and efficiency of the system.

7.2.1.5 Data transmission

The ELS backend system shall only provide access services to the data transmission connections that have been registered with proper authorities (which shall conform to the data flow direction and the business logic between each level in Figure 2); otherwise, the data transmission connection will be shielded as invalid connection.

The ELS backend system shall be able to perform data transmission (data access, data collection, data report/distribution) for user, database and IoT gateway within the corresponding authority range of different user types.

7.2.1.6 Incremental update for display contents

It is focused on the incremental update for display contents of ELs in order to improve the update efficiency and reduce the data bandwidth as much as possible.

The incremental update for display contents of ELs shall support the partial updating, that is, the ELS backend system shall only uniformly distribute the relevant data for the part to be updated, and the corresponding ELs shall carry out the information replacement and integration, in order to display the updated part correctly.

The process of incremental data updating shall be fully automated, in order to improve the data updating efficiency.

7.2.2 Database

It shall be able to access (save/load) business data and equipment data by strictly following the instructions of the ELS backend system.

7.2.3 IoT gateway

It shall only be controlled by the ELS backend system that it belongs to, and it shall be able to accurately distribute/collect data to/from each targeted EL in the ELs by strictly following the instructions of the ELS backend system.

7.2.4 ELs

7.2.4.1 Perception function

Each EL shall be able to collect and locally record the perception data from perception objects, and provide feedback for them in real-time/periodically according to actual demands of the ELS owner, so as to help the ELS owner, operation and maintenance personnel to monitor the surrounding environment of corresponding ELs.

The types of perception objects should include ambient temperature, ambient humidity, ambient light, and other factors that relate to retail business activities.

7.2.4.2 Status feedback

Each EL shall locally record its own status (including, but not limited to, residual power, operating state, chip temperature), and each EL shall be able to provide upward feedback for relevant data, according to the regularly distributed data query instructions, in order to ensure the ELS backend system can monitor the operation status of each EL easily.

7.2.4.3 Data transmission

To ensure the thinness and mobility of the EL, the EL shall only support wireless access, wireless control and wireless data transmission.

Each EL shall also support NFC, which can be detected by equipment with NFC enabled. If the detecting equipment owner is consumer, only the public information of the corresponding EL shall be available for access; If the detecting equipment owner is ELS owner or operations personnel, it shall be able to access the restricted information and shall be able to write information into the corresponding EL.

7.2.4.4 Display function

Each EL shall be able to display the incremental business data correctly, which are forwarded from the IoT gateway. And each EL shall be able to perform multi-colour display for some special categories of merchandise information, including, but not limited to, promotional discounts, featured goods.

7.3 Interface requirements

7.3.1 ELS backend system

ELS backend system shall only provide access interfaces to the user, the IoT gateway, and the database. It shall be able to provide the user with GUIs.

If the current ELS needs to perform parallel extension (bridging additional ELS(s) and make them co-operate as a whole), the ELS backend system shall provide access interfaces to the third-party bridging service. The choice of the third-party bridging service and the corresponding access authorities of the interfaces shall be determined by the ELS owner only.

According to the actual business demands, the ELS backend system shall be able to be cloud-based or local-based; the corresponding data transmission interface requirements are as follows.

a) Cloud-based. The Internet access interface shall be supported. The authority control scheme for the access shall be ensured, in order to block unauthorized access requests.

b) Local-based. The LAN access interfaces should be supported. The authority control scheme for the access shall be ensured, in order to block unauthorized access requests.

7.3.2 Database

Database shall only provide access interfaces to the user and ELS backend system. It shall be able to provide the user with GUIs.

According to the actual business demands, the database shall be able to be cloud-based or local-based; the corresponding data transmission interface requirements are as follows.

a) Cloud-based. The Internet access interface shall be supported. The authority control scheme for the access shall be ensured, in order to block unauthorized access requests.

b) Local-based. The LAN access interfaces should be supported. The authority control scheme for the access shall be ensured, in order to block unauthorized access requests.

7.3.3 IoT gateway

7.3.3.1 Between ELS backend system

Access interfaces to ELS backend system shall be supported.

If the ELS backend system adopts the cloud-based solution, the Internet access interface shall be supported. The authority control scheme for the access shall be ensured, in order to block unauthorized access requests.

If the ELS backend system adopts local-based solution, The LAN and WLAN access interfaces should be supported. The authority control scheme for the access shall be ensured, in order to block unauthorized access requests.

7.3.3.2 Between ELs

Access interfaces to ELs shall be supported.

Only short-distance wireless transmission interfaces shall be supported. Examples of short-distance communication interfaces are 2.4G private protocol and Sub1G.

7.3.4 ELs

Access interfaces to IoT gateway shall be supported.

The ELs shall only support short-distance wireless communication interfaces for the connection between themselves and IoT gateway. Examples of short-distance communication interfaces, are 2.4G private protocol and Sub1G.

The ELs shall support NFC interfaces.

The ELs shall support data acquisition interfaces (for perception purpose).

7.3.5 System scalability

ELS should support access interfaces for third-party bridging service, which should only be used for parallel extension of ELS, in order to provide connection authorization for third-party bridging service to establish bridge between ELS backend system of ELSs, so as to ensure coordinated operation and the conformance of data sharing scheme between the bridged ELSs.

7.4 Performance requirements

7.4.1 ELS backend system

In order to prevent and control the hidden danger of malicious theft and illegal tampering of the data being transmitted, the ELS backend system shall support TLS/SSL protocol.

7.4.2 Database

7.4.2.1 General

In order to ensure the reliability, security and the ease of maintenance for ELS databases, mainstream and mature database technologies or commercial database shall be adopted.

7.4.2.2 Storage reliability

In order to prevent and control the risks caused by network, software and hardware that can affect data quality in the whole life cycle of data storage, the database shall ensure the integrity and accuracy for data storage, the whole life cycle management for data storage, and shall monitor effectively.

7.4.2.3 Storage security

It shall ensure the data storage security for the whole life cycle of data storage.

It shall be able to perform security reinforcement operations for the storage management system, including, but not limited to, services, passwords, authorities of files and directories, kernel parameters.

It shall be able to perform security reinforcement operations for database itself, including, but not limited to, minimize installation, minimize access for non-core managers, authority protections for database files and directories. In addition, for the password of user account and database account, and other restricted data, information shall be saved after irreversible encryption algorithm has been applied, and it shall be able to prevent a rainbow table attack. Reversible encryption algorithms shall be supported for those passwords that need to be restored.

7.4.3 IoT gateway

7.4.3.1 Transmission security

In order to prevent and control the hidden dangers of malicious theft and illegal tampering of the data being transmitted, the data transmission function between IoT gateway and ELs shall support encryption protection.

7.4.3.2 Maintainability

Fully automatic firmware updates shall be supported. Firmware update instructions shall be distributed from the ELS backend system that it belongs to.

It should support anti-theft treatment on its physical equipment, including, but not limited to, add equipment lock, equipment missing alarm, to ensure that malicious theft and malicious transposition in daily use are not easy.

7.4.4 ELs

7.4.4.1 Display resolution

The MRC displayed on EL screen shall be recognized properly by mobile device scanning. This is the essential criterion for the display resolution.

7.4.4.2 Response time

The response time is the average time spent between the time that IoT gateway starts distributing instructions and the time that the EL starts processing those instructions, which shall be no more than 10 seconds.

7.4.4.3 Transmission reliability

In order to arrange time schedule to resend the business data that is not received. Each EL shall support the data receiving status feedback scheme. This scheme will provide real-time feedback of the data receiving status that is forwarded by the IoT gateway.

The feedback contents include receiving success and receiving failure.

7.4.4.4 Transmission security

In order to prevent the potential risks caused by malicious theft and illegal tampering of the data being transmitted, each EL shall support encryption protection.

7.4.4.5 Maintainability

Each EL shall support battery replacement and fully automatic firmware update.

a) Battery replacement. It shall support convenient battery replacement for ELs that indicate low power, in order to ensure that they can return to normal working state in the shortest time.

b) Firmware update. Firmware update instructions shall be forwarded to each EL by IoT gateway through the internal wireless network, and the entire update process shall be fully automatic without manual intervention.

Each EL should support anti-theft treatment on its physical equipment, in order to ensure that malicious theft and malicious transposition of each EL are not easy in daily use.

Annex A
(normative)

Reference testing requirements

A.1 General

In addition to the below listed testing requirements, all products and the peripherals in ELS shall be compliant with IEC 62368-1.

A.2 Mechanical testing of display devices

a) EL displays in their casing shall withstand a pressure impact higher than 150 kg m/s^2.

b) Drop test: drop testing from 1,5 m on all edges (10 sides: front, back, small sides and edges) of the EL shall leave no visible or functional damage on the device.

c) The ingress protection rating shall be not less than IP 51.

A.3 System performance testing

a) NFC function/tag shall be detectable with any mobile device.

b) Display update at lowest/mid/highest temperature of intended environment conditions and quality check of the updated display (e.g. 0 °C, 20 °C, 40 °C).

c) Image transmission test:

   1) Reference device: 2,6 inch black-white-red electronic paper display.

   2) Display resolution: 125 dots per inch (where the resolution of width and height are 296 and 152, respectively).

   3) Complete display update required (no partial image updates). For a reference image: uncompressed image size is 11 248 bytes.

   4) Minimum pass criteria: 2 000 updates per hour with one IoT gateway.

   5) System setup:

      i) core service testing for ELS backend system;

      ii) access point function testing for IoT gateway.

NOTE One inch equals 2,54 cm.

Annex B
(informative)

Application scenarios, and use cases of ELS

B.1 Application scenarios

B.1.1 Consumer-oriented representation of merchandise information

As the retail industry develops, merchandise labels are not enough to show consumers the common merchandise names, units and prices only. Instead, the consumer-oriented representation of merchandise information also needs to achieve the following two aspects.

a) Display other information that consumers might be interested in, including, but not limited to, merchandise source information, market monitoring information, merchandise introduction links, and coupon codes.

b) Keep timely and synchronized information update between online and offline businesses, such as the information of commodities, regular sale events and massive promotional activities.

Given the need of flexible business mode and the frequent change of merchandise information, the continued use of traditional paper labels and the manual maintenance of such labels would result in greatly increased labour costs, business complexity, and business error rate. To avoid such issues and help to improve the overall business efficiency, use of ELS can achieve the goal for the following reasons.

1) ELS can guarantee the timely information update for the merchandise information that consumers might be interested in by interacting closely between the electronic labels and the ELS backend system without manual operation.

2) Highly customizable information representation template can guarantee the different needs of merchandise information representation.

3) ELS can conduct the online and offline business activities synchronously for the ease of overall business monitoring and resource dispatching.

B.1.2 Staff-oriented representation of merchandise management information

In addition to the merchandise information representation to consumers, the staff-oriented representation of merchandise management information is also necessary. Because staff need to manage the merchandise – inventory status monitoring, merchandise replenishing and placing, etc. – such information can help staff to perform these tasks efficiently in the following aspects.

a) ELS can help staff to perform inventory monitoring and replenishment, expiration date monitoring and controlling, etc. by providing staff with the merchandise management information representation template to conveniently inquire about the current inventory status, expiration date, and other status of merchandise, for the ease of staff operations like replenishing merchandise, timely replacement of expired merchandise, etc.

b) ELS can simplify the procedure of the sorting and adjusting for the merchandise placement through the interaction between the staff and the ELS backend system, which can free staff from complicated location memorization of merchandise.