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

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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

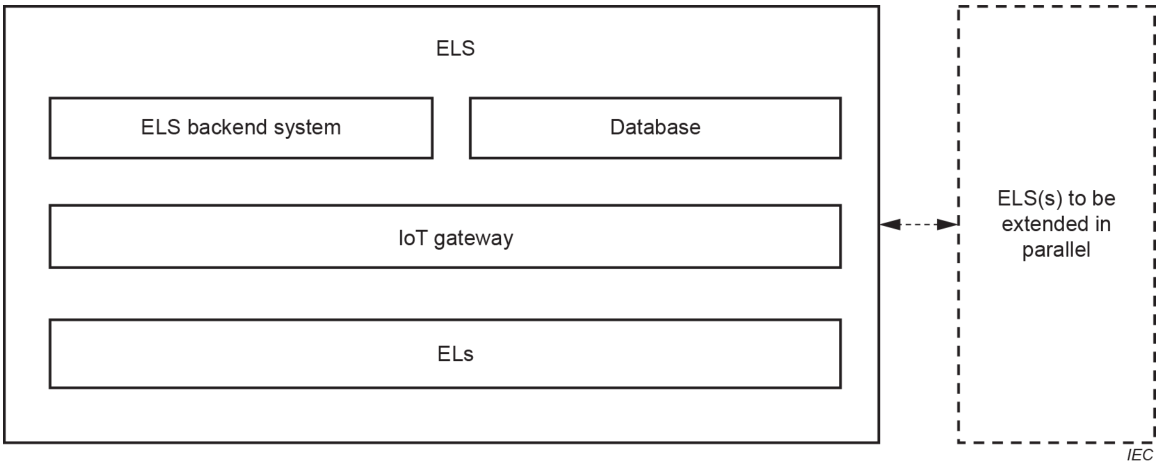

Figure 1 – System framework of the IoT applications for ELS

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

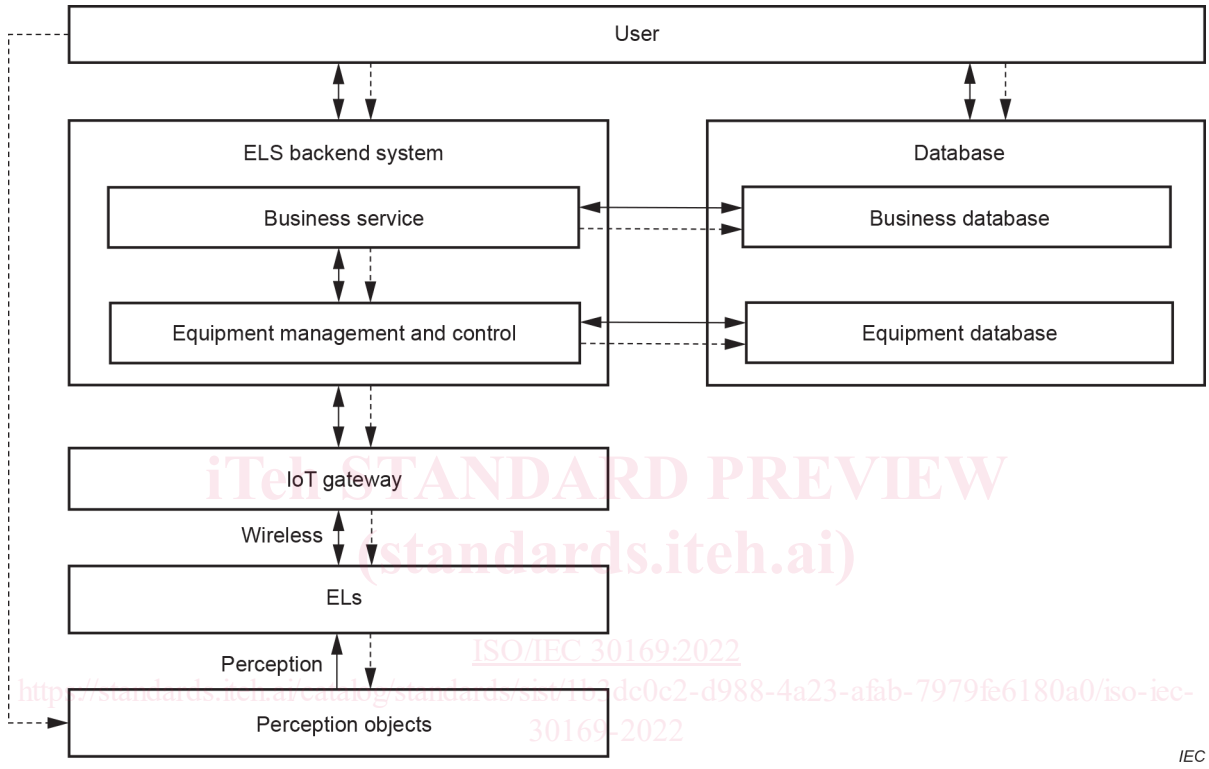

Figure 2 – IoT application model of the IoT applications for ELS

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.