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Smart community infrastructures — Data exchange and sharing for the lamppost network in smart community

Infrastructures urbaines intelligentes — Échange et partage des données pour le réseau d'éclairage public des communautés territoriales intelligentes

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Foreword

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This document was prepared by Technical Committee ISO/TC 268, *Sustainable cities and communities*, Subcommittee SC 1, *Smart community infrastructures*.

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

ISO 37156 and ISO 37170 give guidelines on principles and the framework for data exchange and sharing to entities having authority to develop and operate community infrastructure.

Guided by the principles given in ISO 37156 and ISO 37170, this document examines the needs and model of data exchange and sharing for the lamppost network as an important type of smart community infrastructure, which is of special importance to the general robustness of smart community infrastructures.

Smart community infrastructures — Data exchange and sharing for the lamppost network in smart community

1 Scope

This document examines the lamppost network as an important smart community infrastructure from the perspective of data exchange and sharing, guided by ISO 37156 and ISO 37170.

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
community infrastructure
systems of facilities, equipment and services that support the operations and activities of communities

Note 1 to entry: Such community infrastructures include, but are not limited to, energy, water, transportation, waste and information and communication technologies (ICT).

[SOURCE: ISO 37100:2016, 3.6.1]

3.2
data exchange
accessing, transferring and archiving of data

[SOURCE: ISO 37156:2020, 3.3.5]

3.3
data sharing
providing shared, exchangeable and extensible data to enable *community infrastructure* (3.1)

[SOURCE: ISO 37156:2020, 3.3.6]

3.4
data spectrum
differentiation of data assets on the basis of whether they are considered closed, shareable or open

[SOURCE: BSI PAS 183:2017]

3.5
smart community infrastructure
community infrastructure (3.1) with enhanced technological performance that is designed, operated and maintained to contribute to sustainable development and resilience of the community

[SOURCE: ISO 37100:2016, 3.6.2, modified — Notes to entry deleted.]

4 Overview

The lamppost network described in this document is based on the traditional physical structures of the streetlights system, which is definitely an important type of smart community infrastructure, visible and touchable in daily life, forming a widespread network of electrified points around a city with relatively close distances where traditional communication and internet of things (IoT) technology devices can be hosted and interconnected easily. The characteristics of the lamppost network give it great potential to become carrier of information flow cantered on data exchange and sharing across a community, apart from merely supporting street lighting.

Data exchange and sharing for the smart lamppost network generally contains three functional blocks, gathering, processing and sharing, as shown by Figure 1.

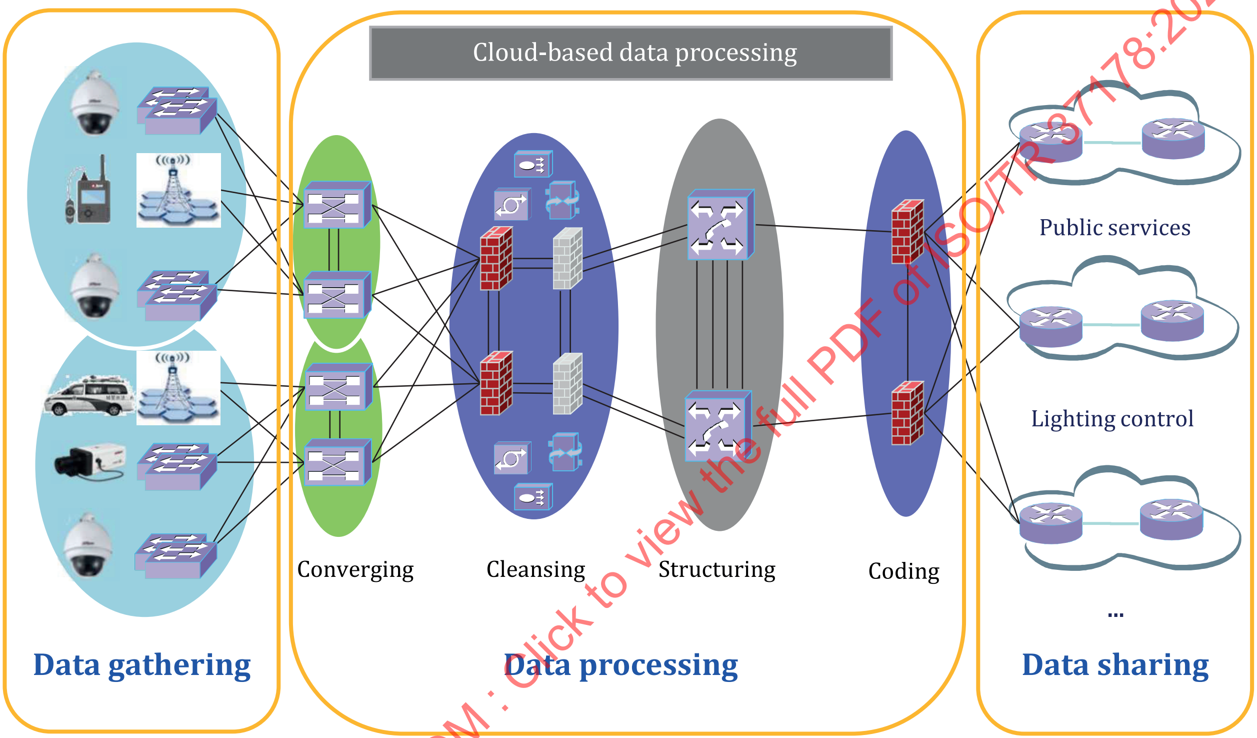

Figure 1 — Overview of data exchange and sharing of the smart lamppost network

The smart lamppost network gathers data through sensing devices built in luminaires, or attached to the supporting poles, which are a convenient choice for data gathering. In addition to this, data are also collected through other channels linked to the lamppost network. Collected by individual lampposts, the data are brought together into cloud-based data centre through a transmission network, and are cleansed, structured and coded before being exchanged and shared for multiples purposes. Some data can also be used locally or pre-processed locally.

According to ITU-T Y.4458[6], data exchanged and shared by the smart lamppost network supports a range of meaningful services, which includes:

a) weather-related sensing;

b) illumination intensity sensing;

c) traffic flow monitoring;

d) infrared sensing;

e) Wi-Fi services;

f) air quality sensing;

g) electric vehicle (EV) charging;

h) advertising platforms;

i) over-the-air (OTA) firmware upgrades.

See Annex A for examples of use cases in different regions.

5 Principles for data exchange and sharing

For the purposes of effective data exchange and sharing for the smart lamppost network, guided by relevant provisions given in ISO 37156, the following principles can be considered:

a) The data gathered by the smart lamppost network are accessible with sufficient security measures in place.

b) The operator in charge of the smart lamppost network maintenance and operation maintains a catalogue of the data types within its ownership that are available for exchange and sharing, and periodically updates this catalogue.

c) The integrity of the data meets minimum requirements for exchange and sharing.

d) The entire process of data exchange and sharing meets corresponding national and industrial regulations.

e) The entire process of data exchange and sharing ensures the interoperability and compatibility between hardware and software products that are developed under a common framework.

6 Data spectrum

The data spectrum for the lamppost network is determined by security, access and control requirements. It also depends on the nature of the entities providing data.

The majority of the data described by this document belong to the categories of shared data and open data, as given in ISO 37156.

7 Data transmission

7.1 Interfaces

The smart lamppost network combines a range of sensing facilities, supported by appropriate types of interfaces for the purpose of data transmission. Table 1 shows the mainstream interfaces and transmission manners applicable to transmission processes between lamppost terminals and a cloud platform at the local level.

Table 1 — Interfaces for data transmission

Functionality	Interface (recommended)	Transmission manner
Smart/adaptive lighting	DALI D4i, RS485, NEMA standard 0V to 10V, PWM output	Wired/wireless
Video surveillance	Ethernet/EMVA, GigE, USB, GeniCAM/JSON	Wired/wireless
WLAN	Ethernet /Wi-Fi/5G	Wired/wireless
Broadcast	Ethernet /Wi-Fi/5G	Wired/wireless
Radio detection	Ethernet /Wi-Fi/5G	Wired/wireless

7.2 Data transmission

As a common practice, data are transmitted in frames comprising a certain number of bytes as the basic units. Frames are generally transmitted in the Open Systems Interconnection (OSI) reference model defined by ISO/IEC 7498-1, characterized by a seven-layer stratification. In the case of the lamppost network, for the objective of acquiring a quick response with limited bandwidth, an enhanced performance architecture (EPA) is applied, which adopts a three-layer model containing only physical, data link and application.

7.3 Data format and content

Formats of data exchanged and shared related to the lamppost network include: character (C), numeric (N), time (T) and string (S), as shown in Table 2. The data are stored in XML.

The data structure is open source and standardized so it can be adopted and applied by all hardware and software manufacturers to ensure the interoperability of the smart city infrastructure.

Table 2 — Data formats

Type	Explanation
C	Value expressed in the form of a character. C plus a natural number (e.g. C6) refers to a long string of characters.
N	Value expressed in the form of a calculable decimal number. N plus a natural number (e.g. N4) refers to a fixed length number.
T	Expression of time. Typically in the form of YYYYMMDDhhmmss. T plus 4, 6, 8, 10, 12 refers to different timing precisions: T4 refers to year, T6 refers to year and month, etc.
S	S refers to text of unfixed length.
B	Binary

8 Security and privacy issues

8.1 Security risk landscape

The operators of lamppost networks in smart cities are expected to be aware of the risk landscape that amounts to security pitfalls if without effective mitigation measures. According to ISO 37156, the security risk is generally related to loss of confidentiality, availability, safety, resilience, possession, authenticity, utility and/or integrity of data, and requires sufficient security measures.

8.2 Security strategy

8.2.1 Accountability and responsibility

The data provider maintains a catalogue of the data types within its ownership that are available for exchange and sharing, and is held accountable for ensuring that data collection, exchange and sharing processes are implemented in a consistent manner across the lamppost network.

8.2.2 Privacy

Privacy issues are generally addressed as follows:

a) The acquisition, storage and utilization of data complies with the basic principles of national laws and regulations on the protection of residents’ personal information and data, processed in accordance with the rights of individual residents granted by the state.

b) The principle of minimum sufficiency of personal information is followed, with a corresponding data storage period established.

c) The collection of data in relation to personal information is not allowed for commercial purposes. The collected data are not transferred to other parties outside the applicable jurisdiction, country or region.

d) Desensitization technology can be used to protect the security of personal information, and technical means are used to ensure data traceability.

e) There is corresponding security processing of different levels of personal information data, such as obtaining authorization, encrypted storage and encrypted transmission, etc.

Annex A
(informative)

Smart lamppost network use cases — Integrated nodes of infrastructural data exchange and sharing

A.1 Use case for a smart lamppost network

A.1.1 Purpose

One of the basic features of a smart city is the provision of efficient and affordable services to create value for citizens. For this purpose, smart infrastructure integration is essential. In addition, the objective of building a low-carbon, environmentally friendly society must be supported by integrated infrastructures which serve as a foundation for smart governing, smart living and smart industry.

In this example, a smart lamppost network project transforms traditional lampposts from isolated physical structures into interconnected nodes of information exchange and sharing, integrating the lamppost network into the larger cloud computing system based on IoT technology. Through the network, many valuable services can be provided, including EV charging, data collection and analysis (e.g. people, traffic flow, air quality, temperature, humidity, noise), public information broadcasts and emergency responses.

A.1.2 Performance indicators or targets

The performance of the project hinges on the integration of the lamppost network into the cloud computing system run by the i-stack OS based on an open-stack framework. With this sort of integration, originally isolated information can be exchanged and shared among many more participants.

One important performance indicator is the availability of data, for example:

— for the government, data about public security surveillance;

— for citizens, data about daily life, such as traffic information, weather conditions and air quality

Another concern is the speed of the response of the network (i.e. the time span between sending a message and receiving the message through the network) in order to support services.

A.1.3 Relevance to smartness

A smart city must provide efficient and affordable service, and must be inclusive and benefit citizens, or it fails to be smart. This project creates value for citizens by integrating the lamppost network into the cloud system as a smart infrastructure, supporting interactive services through information exchange and sharing, and adding to the smartness of the city.

A.1.4 Profile

As shown in Figure A.1, the smart lamppost network provides eight functionalities: environmental monitoring, Wi-Fi antenna, public broadcasting system, multi-media display, lighting control, video surveillance, one-button SOS and EV charging.

Figure A.1 — Lamppost functionalities

These functionalities are not isolated ones, but an integral whole bound by the invisible cloud operated by an i-stack OS.

As shown in Figure A.2, the i-stack platform sits at the centre of the system, with the lampposts serving as nodes of information exchange and sharing. In other words, lampposts are networked as integrated infrastructures for the cloud.

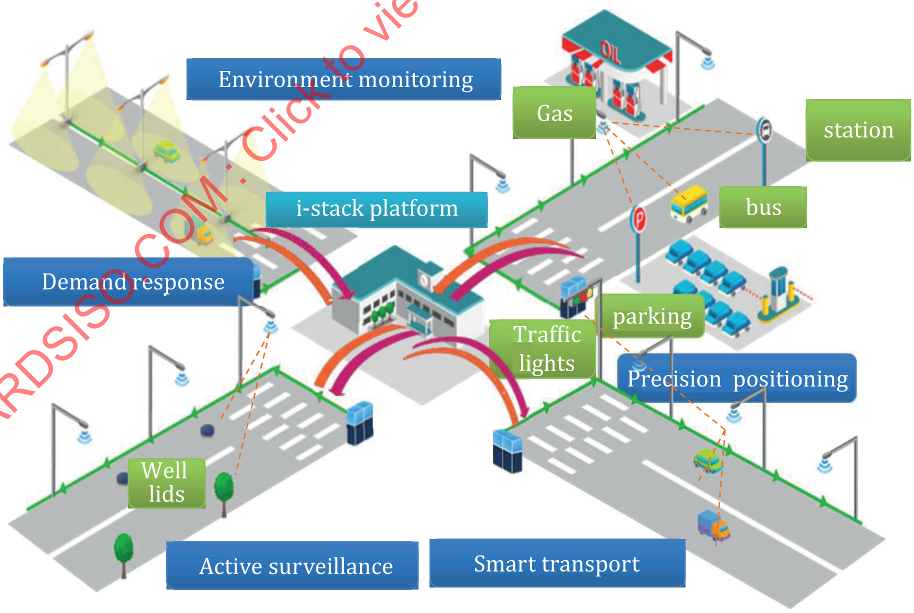

Figure A.2 — Cloud platform for the lamppost network

Some basic features of this smart lamppost network are as follows:

a) Energy savings: Based on data acquisition and analysis, the network can exercise real-time control over streetlamps based on environmental variation (daylight intensity, weather conditions) and emergencies. As a result, the streetlamps are adjusted to meet lighting needs, greatly reducing unnecessary electric power consumption and helping to realize the goal of energy saving.

b) EV charging: The structure of the lamppost network makes it ideal for charging EVs. Charging facilities linked to the power grid can be added to lamppost structures to respond to the surging demand for EV, while maintaining a metering communication network enforcing radio over fibre (RoF) technology.

c) Smart community: Lampposts are no longer merely “lampposts” but play a bigger part in upgrading to a smart community. They have great potential to add valuable information facilities to the physical network, transforming the lamppost network into tentacles of an enlarged smart community information infrastructure. Wi-Fi modules embedded in lampposts, with the support of service operators, provide citizens with ubiquitous internet access. Multi-media displays can be attached to the lampposts, as shown in Figure A.3, which can be used for public information broadcasts, advertising, etc.

Figure A.3 — Multi-media display attached to a lamppost

d) Video surveillance and communication: A batch of video probes with communication capabilities placed in a lamppost upload real-time surveillance information to the cloud, supporting a quick response. Lamppost-based surveillance can cover the fields of traffic monitoring, city security and behaviour analysis as well as crime detection and control. Lampposts can also contain microcells (a miniaturized base station for wireless base stations). In this way, the lamppost network serves as the infrastructural nodes of 4G or 5G area-wide communication.

e) Emergency management: The powerful information facilities carried by the lamppost network makes it an effective tool of emergency management for the city administration. The smart video surveillance system carried by lampposts is able to recognize a potential future emergency, such as a large crowd of people at big events or an extreme traffic jam. Smart street lighting systems can