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Smart community infrastructures — Guidance on smart transportation for allocation of parking lots in cities

Élément introductif — Élément central — Élément complémentaire

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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

In the development of this document, ISO Guide 82 has been taken into account in addressing sustainability issues.

Introduction

Every city has the same experiences or city issues, especially cities having a large area and those rapidly developed or being developed in a short time, that are difficulties in easily finding vacant parking lots when trying to park a car in a city. Although spaces for parking are limited in a city, the more popular and common it is for people to buy, own and drive a car, the larger the number of cars is. One of the reasons must be the reduction of car prices in recent years. Furthermore, people basically want to move by themselves at their convenience to anywhere they need or like to go. This is natural, as pointed out by ISO 37154: 2017 “Smart community infrastructures — Best practice guidelines for transportation” [1].

This background allows people to use a car more casually to commute, visit places necessary to go and enjoy driving. The limited number of parking lots in a city should be shared by more vehicles. Actually, as concerned, the low availability ratio of parking lots has caused unexpected city issues besides the direct issue of difficulties in finding vacant parking lots in cities. It has come to take drivers longer time to find vacant parking lots. This means that they consume more fuel. To successfully find such parking lots, drivers’ attention is caught up while seeking for. Collison accidents happen more frequently. The incidents and slow driving while looking for vacant parking lots bring about traffic congestion. In addition, staying inside a city by driving a car at a low speed leaves the vehicle emitting more pollutants, PMs and greenhouse gases into the air and the atmosphere becomes much more polluted. In any event, there is nothing good with running short of parking lots and the low availability ratio thereof in a city. Citizens including drivers and public road neighbors are just irritated with such situations.

Normally, a city has its own area available for living and business. However, the area of parking lots is limited, especially in the case with matured cities. Easy measures to overcome this city issue will be to increase the availability ratio of parking lots by effectively allocating and reallocating parking lots to more vehicles. Fortunately, thanks to ICT technologies that have been developed drastically for a short time, data sharing systems have also been organized and practically used, as described in ISO 37156: 20xx, Smart community infrastructures — Guidelines on data exchange and sharing for smart community [2]. By using information exchange networks, information on which parking lots are vacant or occupied, until what time they are available or occupied, where the location is and so on is easily collected and shared. This enables to effectively allocate parking lots to drivers, who want to park their vehicles, resulting in solving such city issues.

From the viewpoint of investments in city development, construction should be planned, designed, arranged and performed with limited scale budget. To dig up and activate unrecognized or unused/unoffered parking lots is still a realistic and easy way to increase the total capacity of parking lots in a city without any more construction thereof. This strategy leads to avoiding unnecessary parking lot construction that calls for capital costs.

This document describes the concept of smart transportation to efficiently allocate parking lots to drivers in cities and outline the services, which is supported by the data exchange and sharing platforms based on ISO 37156. To say nothing, this document also aims at satisfying some Sustainable Development Goals by United Nations, especially Goal 3 “ Good health and well-being,” Goal 7 “ Affordable and clean energy,” Goal 8 “Decent work and economic growth,” Goal 9 “Industry, innovation and infrastructure,” Goal 11 “Sustainable cities and communities,” Goal 12 “Responsible consumption and production,” Goal 13 “Climate action” and Goal 15 “Life on land.”

Smart community infrastructures — Guidance on smart transportation for allocation of parking lots in cities

1 Scope

This document describes to organize smart transportation to allocate parking lots to drivers in cities. It is intended to apply to cities, especially those running short of parking lots or having the low availability ratio thereof. This smart transportation does not necessarily aim at solution to a city issue of difficulties for drivers in finding vacant parking lots in a short time, but additionally leads to solution to other city issues caused by the difficulty.

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:

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

3.1
parking lot

area, to park all kinds of vehicles allowed to run on public roads

NOTE Normally, the vehicles are listed in 2.5.4 in ISO 37154, namely, buses, trucks, bicycles, motorcycles, automobiles as well as vehicles or systems and their additional instruments assisting mobility-impaired persons (e.g. scooters, Segways).

3.2
parking lot owner

person or organization possesses and offers parking lots

3.3
driver

person, who runs vehicles to park, which are listed in 2.5.4 in ISO 37154

3.4
parking lot allocation

action to suggest vacant parking lots to drivers by finding the best match of drivers' requests or preference on parking with availability of parking lot vacancy currently existing or expected in the immediate future

NOTE drivers' requests include access routes from current places, preferable places to park, preferable time to start parking, parking duration, the number of vehicles to be parked and vehicle's characteristics, limits of parking fees payable and payment manners

3.5
parking lot allocation system

arrangements for parking lot allocation by using data bases to exchange and share information including parking lot allocation, parking time recording, navigation to parking lots and suggestions on parking fee payment procedures and necessary services

4 Concept of smart transportation for parking lot allocation

4.1 General

This section describes the general criteria required for smart transportation to allocate parking lots in cities. The principle is just simple or to increase the availability ratio of parking lots in a city. By increasing the ratio, more vehicles can share the same number and area of parking lots resulting in reduction of time required for drivers to find vacant parking lots. The additional effects by smart transportation will be expected by facilitating the parking lot allocation as listed below:

- invitation of more visitors to a city from outside thereof;
- activation and introduction of business into a city by receiving more vehicles in a city;
- depression of the number of vehicle collisions and traffic accidents;
- reduction of traffic congestion;
- improvement of the atmospheric environment (e.g. depression of greenhouse gas, carbon monoxide, NOx/SOx, hydrocarbon, lead compound and PM emissions);
- provision of a good environment to public road neighbors (e.g. noise and vibration reduction);
- offer of ease to citizens (e.g. relief of irritation to drivers and public road neighbors).

These advantages would also be brought additionally besides solution to the target city issue of difficulties for drivers in finding vacant parking lots. Thus, this smart transportation has possibility to comprehensively relieve such city issues.

To successfully organize smart transportation, data exchange and sharing platforms and networks are indispensable. Through the communication based on the network, information required to immediately allocate parking lots appropriately to drivers is processed and shared among drivers, parking lot owners and parking lot allocation system. Drivers' requests should best match the conditions of parking lots that are currently vacant or will be available in the time frame requested or preferred by drivers. They run a variety of kinds of vehicles to their individual destinations at different current location in a city. Thus, to establish safe and steady data exchange and sharing platforms is a key to successfully organize parking allocation services.

To support the communication and data sharing, instruments and equipment should also steadily work, which are detectors or sensors, telecommunication devices, signboards, displays and so on. To ensure the

communication, data sharing and convenience for drivers, the services for parking lot allocation should satisfy the conditions below:

- communication directly from terminal to terminal;
- communication without time lag (e.g. less number of processing steps for users' identification);
- traceable communication;
- offers of large selections on parking lots;
- easy management of the services.

4.2 Applicable city issues and expected advantages

The criteria for smart transportation described in this document are appropriate to address the city issue of difficulties for drivers in finding vacant parking lots in a city. As expected in 4.1, by introducing smart transportation, other advantages would also be brought besides solution of the difficulty. The advantages can be the targets that smart transportation aims at but should not be the top priorities or intention to introduce smart transportation, because they are not directly solved thereby.

5 Planning to implement smart transportation

To properly implement smart transportation for allocation of parking lots in a city and have it perform successfully as planned, the parameters listed below should be confirmed in advance.

- traffic patterns in the target city/region;
- traffic volume in the target city/region;
- traffic capacity on the public road in the target city/region;
- number of currently existing parking lots available;
- location of currently existing parking lots available;
- area or capacity of currently existing parking lots available;
- number of parking lots planned;
- location of parking lots planned;
- capacity of parking lots planned.

6 Adoption of smart transportation

6.1 Objectives

As mentioned in 4.2, smart transportation described in this document can help directly address the issue of difficulties for drivers in finding vacant parking lots in a city. The adoption and implementation of this smart transportation should be performed by following 6.3.

6.2 Target vehicles

All vehicles that are able or allowed to be parked in parking lots in cities.

6.3 Procedure to adopt smart transportation

Smart transportation for allocation of parking lots can be adopted into a city by following the procedure.

6.3.1 Data to be collected

To allocate parking lots to drivers, basic information is needed for the arrangement. The contents of the information to be collected are listed below:

a) Parking lots

− parking lot location;

− parking lot formation or structures (e.g. on the ground, underground, inside a building, on a bridge, on a public road);

− parking lot sizes or capacity (i.e. sizes or capacities large enough for common private cars, buses and trucks);

− allowable parking time (e.g. 15 min, 30 min. 1 h, a half a day, one full day, one week, one month, a half a year, one year);

− parking service time frame (e.g. only during day time, even at night, overnight);

− parking frequencies (e.g. just one time, temporally for a limited period, regular interval use);

− parking lot ownership (e.g. public, exemption, private, shared);

− parking lot facilities (e.g. roofed, power-rechargeable, refuelable, car washing services-available);

− map of the area serviced with smart transportation;

− parking fees (e.g. amounts, discount/cooperative programs).

b) Drivers

− driver’s genders;

− driver’s age;

− driver’s specific conditions (e.g. disabilities, with babies or small children);

− driver’s current location;

− driver’s destinations;

− driver’s vehicle characteristics (e.g. common private cars, buses and trucks);

− requested or expected parking time duration (e.g. 15 min, 30 min, 1 h, a half a day, one full day, one week, one month, a half a year, one year);

− driver-preferable payment procedures (e.g. in cash, with credit cards, through bank transfer).

c) Others

− current weather conditions on the way to the parking lot and at the place thereof (e.g. sunny/cloudy/rainy/snowy, wind speed, wind directions, humidity, visibility, specific weather conditions).

6.3.2 Data collection

To collect data designated in 6.3.1, the instruments and equipment listed below should be installed and operated:

− car sensors in parking lots (e.g. car existing/absence, parking lot vacancy/occupancy);

− monitors for security in parking lots;

− traffic congestion monitors (e.g. on the way to the parking lot, areas around the parking lot);

− air pollution sensors (e.g. SOx/NOx, carbon monoxide, PMs);

− atmospheric condition sensors (e.g. ambient temperature, humidity)

− weather monitors (e.g. rain/snow falls, wind speed, illumination);

− software to collect the data and process (e.g. data collection, data transfer, data processing, parking charge, parking fee collection);

− apps (e.g. for drivers, for parking lot owners, for traffic departments, for related services).

6.3.3 Data transfer

To transfer the data collected by following 6.3.1 and 6.3.2 to parking lot allocation system data bases, drivers and parking lot owners, the communication should be organized by securing requirements listed below:

a) Between parking lot owners and parking lot allocation data bases

− mobile or smart phones;

− apps applicable to mobile and smart phones;

− security gateways (e.g. identified authentication, data encryption, access control and restriction);

− internet;

− offline communication (e.g. local area networks, ad-hoc networks, near-field communication).

b) Between drivers and parking lot allocation data bases

− mobile or smart phones;

− apps applicable to mobile and smart phones;

− security gateways (e.g. identified authentication, data encryption, access control and restriction);

− internet;

− offline communication (e.g. local area networks, ad-hoc networks, near-field communication);

− identification and tracking using tags (e.g. radio-frequency identification, ultra high frequency).

6.3.4 Information provided to drivers

In order to help drivers decide where, what time and how long to park their vehicles, the information listed below should be provided to drivers:

− location of the parking lot best matching drivers' requests or preference;

− available time frame of the parking lot best matching drivers' requests or preference (e.g. from what time to what time or to which day);

− allowable parking time in the parking lot best matching drivers' requests or preference (e.g. 30 min, 1 h, a half a day, one day, one week, one month, a half a year, one year);

− access routes to the parking lot best matching drivers' requests or preference;

− time taken to drive to the parking lot best matching drivers' requests or preference from the driver's current location;

− parking fees of the parking lot best matching drivers' requests or preference (e.g. per hour, day, week, month or year);

− available day and time in the parking lot best matching drivers' requests or preference (e.g. workdays, weekend/holidays, daytime or night);

− road conditions on the way to/around the parking lot best matching drivers' requests or preference (e.g. congestion degrees, weather conditions, accident occurrences, road work implemented);

− additional information helpful to drivers (e.g. shops, restaurants, public bathrooms, gas stations);

− parking fee payment manners (e.g. in cash only at a site, credit cards acceptable, bank transfer applicable, on-/off-line payment).

6.3.5 Allocation of parking lots

To successfully allocate parking lots to drivers, the conditions to compare their requests or preference and parking lot availability are listed below. The option suggested to drivers on the best matched parking lot will be kept until the confirmation of the parking lot reservation.

a) Drivers' requests or preference

− current place;

− preferable places to park;

− preferable time to start parking;

− parking duration (e.g. for how many minutes, hours or days);

− the number of vehicles to be parked (e.g. only one vehicle, more than one vehicle);

− vehicle's characteristics (e.g. common personal-use cars, common size cars but for business, buses, trucks);

− parking fee payment manners (e.g. in cash only at a site, credit cards acceptable, bank transfer applicable, on-/off-line payment).

b) Parking-lot-offered services

− location;

− number of parking lots available;

− available parking time frames (e.g. from what time to what time);

− available parking duration (e.g. less than 30 min, 1 h, a couple of hours, a half a day, one full day, a few days, one week, two weeks, one month, a half a year, one year);

− additional services in the parking lots (e.g. power rechargers, gas stations, bathrooms, convenience stores);

− available facilities around the parking lots (e.g. shops, restaurants, banks/ATMs, hospitals/clinics, stations, bus stops, ferry terminals, airports, hotels, post offices, police departments);

− parking lot security (e.g. guards watching, no guards working, TV monitors enforced);

− parking costs;

− parking fee payment manners (e.g. in cash only at a site, credit cards acceptable, bank transfer, on-/off-line payment).

6.3.6 Collection of parking fees

To collect parking fees, the instruments and equipment listed below should be installed and operated:

− barrier gates;

− signboards/displays to notify drivers of the parking fee amount estimated or determined;

− signboards/displays to notify drivers of the rest of time allowed for parking;

− signboards/displays to instruct the manner to pay the parking fee;

− instruments to collect parking fees (e.g. for cash, for e- or digital money, receipt printers).

6.3.7 Provision of information helpful to parking lot allocation management

To properly manage the system for parking lot allocation and organize it, the information listed below should be provided:

− illegal parking vehicles (e.g. overtime parking, oversize parking, parking fee evasion);

− vehicles unregistered with parking lot allocation services;

− parking fee arrearages;

− frequent users (e.g. discount, priorities for the next reservation);

− current instruments and equipment conditions;

- instrument and equipment maintenance states and records.

7 Data exchange and sharing management

To properly manage and operate parking allocation systems with data exchange and sharing platforms and networks, based on or referred to ISO 37156, all the data collected by following 5, 6.3.1 and 6.3.7 should be safely stored and fairly and exactly processed. The data to be transferred by following 6.3.2, 6.3.3 and 6.3.4 should be safely and steadily carried out.

8 Data security control with smart transportation

By following ISO 37156 guidance to organize smart transportation for allocation of parking lots in cities and protect private or personal information from use for other purposes besides parking lot allocation system management, all information collected, used, exchanged and shared shall be protected from illegal or unauthorized access, especially by or for action listed below. In contrast, drivers legally registered with parking lot allocation systems by using an app are accessible to authenticated information on parking lots.

- information duplication;
- pretention;
- taming;
- information repudiation.

Based on the security, drivers' personal information identified can be combined/related to an authenticated vehicle information through registration with an app. The information shall be encrypted and authenticated to protect from illegal access. The access to the information shall also be limited.

9 Maintenance of the quality of smart transportation for parking lot allocation

9.1 General

To keep the performance of smart transportation for allocation of parking lots in cities in conditions planned and confirm the effectiveness thereof, observe the parameters below periodically. If the effectiveness of smart transportation is not confirmed or not clear, modify the current services by smart transportation by changing the parameters described in 5 and 6, where possible and reasonable.

9.2 Parameters to be observed

To make sure of the performance of smart transportation, observe parameters indicated below to compare:

- time in average taken to park a car in the target city/area after starting looking for vacant parking lots;
- absolute number of parking lots available in the target city/area;
- number of parking lots available per unit time in the target city/area (e.g. hour, day, week, month, year);
- parking lot availability ratio in the target city/area.

NOTE For reference, the parameters listed below can be monitored, which would indicate advantages obtainable indirectly through smart transportation, as expected in 4.1.

- number of visitors from outside of the target city/area;

- indicators on economy in the target city/area;

- number of vehicle collisions and traffic accidents occurring in the target city/area;

- indicators on traffic congestion in the target city/area;

- indicators on atmospheric pollution in the target city/area (e.g. greenhouse gases, carbon monoxide, NOx/SOx, hydrocarbons, lead compounds and PMs);

- indicators on the environment, except atmospheric pollution, which are designated in ISO 37120: 2014, Sustainable development of communities — Indicators for city services and quality of life [3] and ISO 37122: 20xx, Sustainable Development in Communities — Indicators for Smart Cities [4];

- indicators on ease for citizens, which are designated in ISO 37120 and ISO 37122.

9.3 Modification of smart transportation

When identifying unwanted changes in the value of the parameters designated in 9.2, modify the contents of bullet points itemized in 6.3, where possible. To correct the transportation conditions, analyze any unexpected or irregular occurrences in operation and services of smart transportation. Modify the irregular conditions of the smart transportation system in case the irregular conditions are not acceptable.

Mapping the parameters observed by following 9.2 would give information on changes in parking lot utilization in the target city/area that is helpful in planning and improving further traffic management.

Annex A
(informative)

Example of parking lot allocation systems using data exchange and sharing platforms

Figure A.1 provides an example of parking lot allocation systems with data bases to exchange and share information including parking lot allocation, parking time recording, navigation to parking lots and suggestions on parking fee payment procedures and necessary services [5].

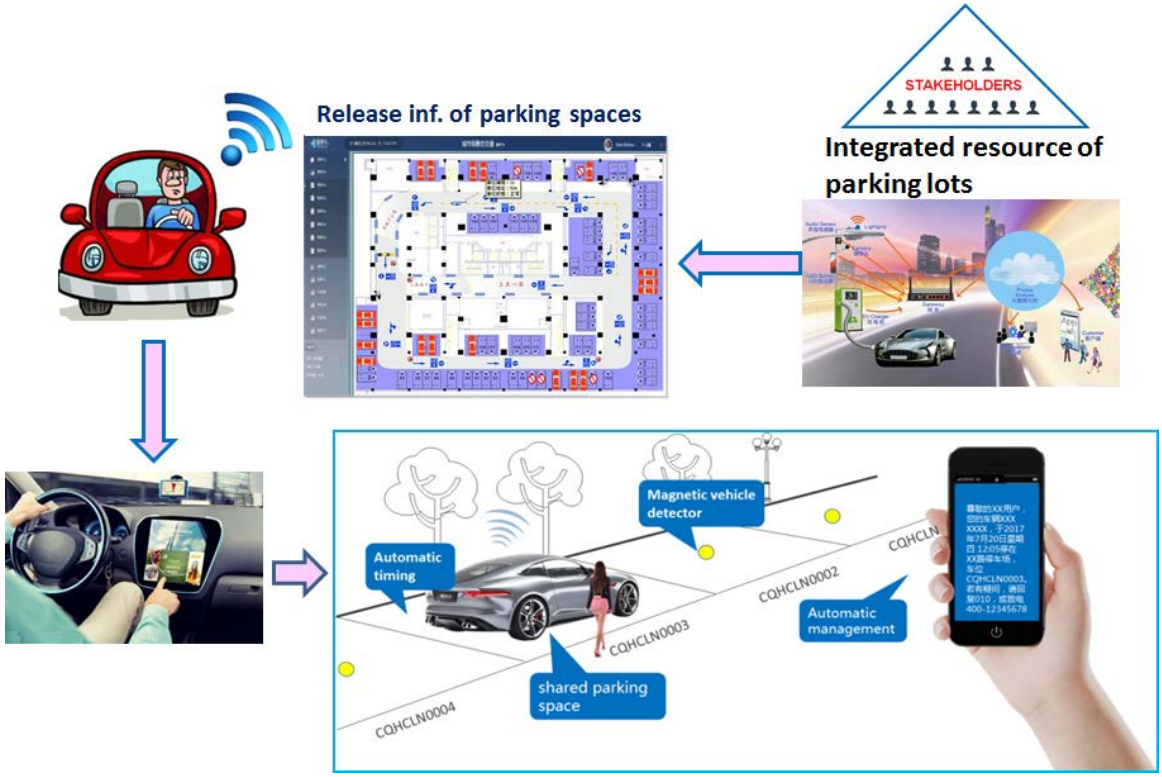

Figure A.1 — An example of parking lot allocation systems using data exchange and sharing platforms.

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