# Quality of Intelligent Truck Parking Services (ITPS)

# Quality package

## EU EIP SA 4.1: Determining Quality of European ITS Services

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## Document Information

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## Preface

The European ITS Platform (EU EIP) set out to provide a recommendation on quality criteria and requirements for Intelligent Truck Parking Services (ITPS) in Europe as well as the data content of them. EU EIP also aims to provide a recommendation for the quality assessment methods to be used in evaluating the services against these evaluation criteria and requirements specified by EIP. For the most part, these recommendations have been based on evidence from a limited set of conditions and operating environments in combination with the expert knowledge of the public and private stakeholders involved in the EU EIP quality work.

This document describes the results of the efforts to define quality criteria, requirements and assessment methods for ITPS, as determined and agreed by EU EIP. In a next step, the criteria, requirements and assessment methods for ITPS will be validated with data suppliers such us parking operators and/or their national access points (NAP) or a Traffic Information Centre (TIC) in the different member states.

The document is prepared as part of the sub-activity 4.1 of the EU EIP project.

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# 1. Introduction

To enable efficient and interoperable deployment of Intelligent Parking Services across Europe, the quality of such services and the data therein need to be commonly defined and agreed. The goal of this document is to present a quality framework including definitions for ITPS quality description, assurance and assessment. The use of such framework is likely to serve the objectives of both the European Commission (EC) as well as the EU member states, because they relate to the delegated regulation of the EC concerning priority action e) of the ITS Directive[1]. While the delegated act does not set any detailed requirements concerning ITPS service quality, it requires the member states to consider and manage the quality of these services. The definitions in this document are intended to be used for such purposes and towards validation of the requirements and assessment methods proposed.

This chapter describes the scope and objectives of the EU EIP sub-activity 4.1 as well as the description and objectives of its Task 2 (Propose European minimum quality requirements and quality assessment practices for all ITS Directive's priority services involving road authorities/operators in a major role) according to the Grant Agreement signed with INEA.

The interest in Intelligent Truck Parking solutions has been growing for years due to increasing HGV traffic load in many parts of the trans-European road network. A main element of such solutions is the provisioning of information on the conditions of truck parking facilities along the driver's routes via digital services. Principles for data provision and exchange in this context have been further leveraged by Commission Delegated Regulation (EU) No 885/2013 on safe and secure parking places for trucks and commercial vehicles. It is an obvious matter of emphasis for European ITS corridors with a focus on freight traffic.

## 1.1. EU EIP context

### 1.1.1. ACTIVITIES AND SUB-ACTIVITIES

The EU ITS Platform (EU EIP) focuses on cooperation within five activities:

- Activity 1: EU ITS Platform Governance and Management
- Activity 2: Monitoring and Dissemination (including ITS Deployment Guidelines)
- Activity 3: Feasibility study East-West Corridor and first pilot implementation

[1] https://ec.europa.eu/transport/themes/its/road/action_plan/intelligent-truck-parking_en

- Activity 4: Harmonization Cluster
- Activity 5: Evaluation.

The scope of **Activity 4** is to define the specifications to be followed for Directive implementation and it is sub-divided into seven sub-activities, which can be developed simultaneously. Sub-activities of Activity 4 "Harmonization Cluster" are the following:

- ✓ Sub-activity 4.1: Determining Quality of European ITS Services
- ✓ Sub-activity 4.2: Facilitating automated driving
- ✓ Sub-activity 4.3: ITS Deployment Road Map Update
- ✓ Sub-activity 4.4: Cooperative ITS Services Deployment Support
- ✓ Sub-activity 4.5: Liaison and harmonization on interfaces for data exchange
- ✓ Sub-activity 4.6: Monitoring and harmonization of Single Point of Access
- ✓ Sub-activity 4.7: Provision of updates of ITS spatial road data.

The quality definitions in this document were developed under Sub-activity 4.1, which is briefly described below.

### 1.1.2. Scope and objectives of EU EIP sub-activity 4.1: Determining Quality of European ITS Services

The scope of sub-activity 4.1 is the development of quality requirements and quality assessment practices for all ITS Directive priority services involving the transport and road authorities and operators in a major role, building up on results from EIP and EIP+, widening the scope to all EU EIP priority services.

To pursue the sub-activity scope definition, four tasks have been identified to be developed to achieve the objectives of the sub-activity. The sub-activity 4.1 tasks are the following:

- Task 1: Identify stakeholders, value chains, recommended work processes, quality assurance, and introduction paths for road operator relevant ITS Directive priority services.
- Task 2: Propose European minimum quality requirements and quality assessment practices for all ITS Directive's priority services involving road authorities/operators in a major role.
- Task 3: Validate and improve the quality criteria, requirements and assessment practices proposed.
- Task 4: Work towards specifying optimum quality for selected priority services.

The quality definitions in this document were drafted as part of Task 2, proposing minimum Quality Requirements and Quality Assessment methods for Priority action e), i.e. the provision of EU-wide Intelligent Truck Parking Services (ITPS).

## 1.2. Document structure

In Chapter 2, the quality criteria recommended to be used for ITPS services and the related data are described.

In Chapter 3, the quality requirements for the different types of ITPS services are compiled.

In Chapter 4, the methods currently available for quality assurance and assessment are described, indicating their applicability for different uses and feasibility for studying different quality criteria.

Chapter 5 contains conclusions on the scope and use of this quality package for reference in the next phase of sub-activity 4.1, the validating and improving of the quality criteria, requirements and assessment practices proposed (Task 3).

## 1.3. Quality basics

### 1.3.1. WHY MEASURE ITPS QUALITY?

Intelligent Truck Parking Services (ITPS) are evolving quickly with the main element providing information on the conditions of parking facilities along the driver's route. There are many concepts and deployments how to detect, process and disseminate related information via digital services. However, providers of such services need common concepts how to handle the quality of those services and the data therein, in order to enable efficient and interoperable services to drivers.

For example, many of the current technical proposals provide a system that can automatically detect dynamic parameters – in order to publish them in real-time – but seem to have some intrinsic error margin that grows over time, so they need periodic "calibration". Intelligent Truck Parking Calibration is done by staff, and the required calibration interval is a dominant factor for operational cost of dynamic truck parking data.

Consequently, ITPS providers are required to:

- know and to monitor the quality of data,
- set goals for the quality,
- report quality levels, and

- analyse problems and eventually improve the data provision.

In order to be able to do this:

- it must be specified, where to measure quality,
- quality parameters must be defined,
- quality levels must be defined,
- it must be specified, how to measure quality, and
- quality requirements must be set.

These specifications, definitions and requirements (described in the following chapters) should be applicable for different types of ITPS and data therein, thus allowing transparent and comparable quality assessment.

### 1.3.2. WHERE TO MEASURE ITPS QUALITY?

This document considers the quality of ITPS information within a specific part of the information process.

This information process can be illustrated by the Value Chain borrowed from SRTI (Safety Related Traffic Information) and RTTI (Real Time Traffic Information) services, as shown in Figure 1 below.

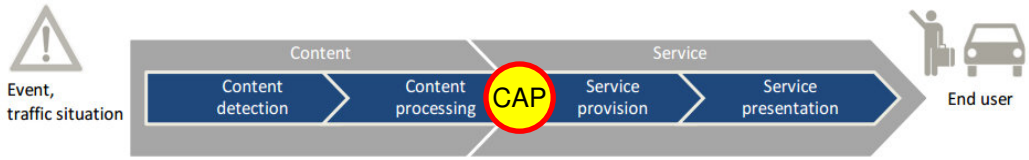


**Figure 1: Value Chain of SRTI and RTTI services with CAP indicated**

This document focusses on the Content part of the Value Chain for ITPS. The Content part, which is typically the responsibility of a data supplier, covers processes between the detection of a real event or an entity, the occurrence of a situation, or (in case of e.g. static map data) of the initial recording of related static information, until the provision of related information in a Content Access Point (CAP). At a CAP, the information is (typically) made available to many service providers via e.g. a data portal. In the context of the ITS Directive's priority services, this point is also often called a National Access Point (NAP). This document focuses on the quality of the data provisioning up to this point.

On the other hand, aspects on the Service part of the Value Chain have been covered by the Traveller Information Services Association (TISA). TISA has published a Position

paper on this[2], describing quality aspects as being important for the end users and to be met by service providers.

Further details about Value Chains specific for ITPS can be found in the Task 1 deliverable on this topic.

### 1.3.3. WHAT DEFINES ITPS QUALITY?

Firstly, certain so-called Service level parameters are considered to apply to all relevant information:

- Geographic coverage
- Availability

Then, as mentioned above, information related to ITPS has a good quality when it provides the right and complete travel information at the right time. Thus, the following items must be covered by the quality parameters or criteria:

- Time
- Right information

For **time**, two quality parameters have been defined:

- Timeliness (update)
- Reporting period

For **right information**, three quality parameters have been defined:

- Error rate
- Report coverage
- Completeness of data

Definitions and elaborations of these quality parameters are provided in paragraph 2.3.

## 1.4. Delegated Regulation on ITPS

Short descriptions of the ITS Directive and the relevant Delegated Regulations are given below.

[2] http://tisa.org/wp-content/uploads/QWG16001_TISA_Position_paper_Quality_Of_Traffic_Information_v12a_final.pdf

### 1.4.1. ITS DIRECTIVE 2010/40/EU

Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010, establishes a framework in support of the coordinated and coherent deployment and use of Intelligent Transport Systems (ITS) within the European Union.

For the purpose of this Directive, there are some areas considered as priority for its development. Those priority areas are the following:

i. Optimal use of road, traffic and travel data.
ii. Continuity of traffic and freight management ITS services.
iii. ITS road safety and security applications.
iv. Linking the vehicle with the transport infrastructure.

Within previous priority areas, six priority actions for the development and use of specifications and standards have been defined:

a) The provision of EU-wide multimodal travel information services.
b) The provision of EU-wide real-time traffic information services.
c) Data and procedures for the provision, where possible, of road safety related minimum universal traffic information free of charge to users.
d) The harmonised provision for an interoperable EU-wide eCall.
e) The provision of information services for safe and secure parking places for trucks and commercial vehicles.
f) The provision of reservation services for safe and secure parking places for trucks and commercial vehicles.

For each priority action, the Commission can develop delegated acts in order to adopt the specifications. For the moment Commission Delegated Acts for priority actions (a), (b), (c), (d) and (e) have been developed.

### 1.4.2. COMMISSION DELEGATED REGULATION

The Delegated Regulation, related to this Quality Package, is the following:

"Commission Delegated Regulation (EU) No 885/2013 of 15 May 2013 supplementing ITS Directive 2010/40/EU of the European Parliament and of the Council with regard to the provision of information services for safe and secure parking places for trucks and commercial vehicles" [3]

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013R0885

The Delegated Regulation defines different levels of data elements to be provided within such information services.

- Static data related to parking areas, including (if applicable)
  - identification information of the parking area (name and address of the parking area);
  - information on the location of the entry point in the parking area (latitude / longitude);
  - the main road 1 / directional marker, the main road 2 / directional marker, if the same parking can be accessed from two different roads;
  - if necessary, indication of the output to be used / distance from the main road in km or miles;
  - total number of free parking spaces for trucks;
  - parking price and currency used.
- Safety information and equipment in the parking area
  - Description of security, safety and parking facilities, including national classification, if applicable;
  - number of parking places for refrigerated vehicles;
  - information on special equipment or services for certain cargo vehicles and other.
  - Contact details of the parking operator
- Dynamic data on the availability of parking spaces, including where a car park is occupied or closed, or the number of available seats available.

In addition to the Delegated Regulation, there is a general Guidance Document, explaining the data elements above in more detail[4].

[4] https://ec.europa.eu/transport/sites/transport/files/themes/its/doc/safe-and-secure-parkings/guidance_document_truck_parking_regulation_885_2013_v1_1.pdf

# 2. Quality criteria for ITPS

## 2.1. Questionnaire for selecting quality criteria

### 2.1.1. GOAL AND DESIGN OF THE QUESTIONNAIRE

A questionnaire among EU EIP partners was organised, in order to identify which ITPS are currently in operation and how the related information is provided. Also, existing quality approaches were examined. A template for the questionnaire is shown below.

**Table 1: Template for EU EIP questionnaire for selecting quality criteria**

**EU EIP A4.1**
**Truck Parking Information Services**
**Questionanire**

| General information | |
|---|---|
| Name of service/system/project | |
| Name of operator/organisation | |
| Service delivery | ☐ Public<br>☐ Private |
| Service in accordance to ... | ☐ Delegated Regulation 885/2013 and its Guidance Documents<br>☐ Other relevant Deployment Guideline(s): _____ |
| Unique national identification number (if applicable) | |
| Is the data delivered to a central data access point? | ☐ National Access Point (according to the Delegated Regulation)<br>☐ European Access Point<br>☐ other public access point: _____<br>☐ other private access point: _____ |
| Contact for more information | |

| Geographical Aspects | |
|---|---|
| Country | |
| Region of implementation | |
| Corridor(s) or Network(s) concerned | |
| Approx. number of covered parking areas | |

→ *In the following fields, please give us an overview on any existing quality approaches within your service!*

| **Quality Assurance** | |
|---|---|
| Is there a quality assurance process to analyse and manage the quality of data? | ☐ Yes<br>☐ No |
| If "Yes", please answer: | |
| Who is responsible for the quality assurance? | ☐ data provider (self-assessment)<br>☐ another party |
| Which quality parameters are applied? | ☐ completeness<br>☐ correctness<br>☐ other : _____ __ |
| What are the (minimum) levels to be achieved for those parameters? | ☐ for "completeness": _____<br>☐ for "correctness": _____<br>☐ for "other" : _____ |
| What are the methods applied for the quality assurance? | ☐ ground truth testing<br>☐ other : _____ |
| How do you document the measured quality? | ☐ regular Quality / KPI reports<br>☐ other : _____ |
| If "No", please answer: | |
| Do you get any other feedback on the quality of your data, maybe from comments by your data users? | ☐ Yes, please explain: _____<br>☐ No |
| Are you planning to install some kind of quality assurance in the future? | ☐ Yes, please explain: _____<br>☐ No |

→ *Feel free to give us further remarks below!*

| **Further remarks** |
|---|
| |

### 2.1.2. SUMMARY OF RESULTS OF THE QUESTIONNAIRE

Responses to this questionnaire were received from the following partners:

- Netherlands/ NDW
- Europe/PTV Truckparking BV

Conclusions drawn from these responses include:

- Almost all services are operational at national level in at least 1 country.
- The suggested criteria are considered as applicable.
- The interpretation of the criterion correctness is not uniform among the responders. Therefore, it might not be a useful criterion for defining ITPS quality.

## 2.2. Stakeholder interviews

As a further baseline, several stakeholder representing existing ITPS solutions were interviewed, in order to explore their perspective on service and data quality. The interviews are summarised as follows:

### 2.2.1. INTELLIGENT TRUCK PARKING IN BAVARIA[5]

The Bavarian Road Administration operates a system for Intelligent Truck Parking in Bavaria, consisting of:

- access and detection technologies at several parking lots along motorways,
- intelligent measures to improve space efficiency at parking lots, and
- information services on the availability of parking spaces via a guidance system (road-side), own communication channels (website and app) and the MDM (National Access Point in Germany).

The general goals for this system are to reduce park-searching traffic, balance out occupancies among individual parking lots and to disseminate up-to-date information on parking availability to road users.

The operators of this system state that all quality criteria, as defined by previous EU EIP-activities, also apply to this system. There also some agreements on specific quality requirements as well as some approaches for quality methods:

- “Availability” may be either understood as “geographic coverage” or as the “service availability” for the information service on available parking spaces. The “service availability” refers to all data processes from the initial detection up to the delivery to the MDM. Besides minor downtimes (e.g. for maintenance), this availability is

[5] https://www.its-platform.eu/filedepot_download/2276/6385

expected to be nearly at 100%. As a method, an automated quality assessment tool is planned. This tool will monitor the service availability at individual data processes, based on pre-defined Service Level Agreements.

- "Timeliness" is mainly referred to the update cycle of the service, which is currently at 1 minute. This cycle is sufficient to provide up-to-date information to road users.
- "Correctness" describes how system data on current parking availability matches the reality. Due to the detection technologies and algorithms, the availability number may deviate from reality. For this reason, operators at the traffic management centre verify regularly (every 10 days) the actual availabilities and correct the system data, if necessary.
- "Accuracy" is mainly referred to the detection equipment. For the tender process of this equipment, specific requirements are set, e.g. as "Classification accuracy" with 80% for delivery vehicles and cars with trailer, and 99% for all other vehicle categories.
- The goal of "Completeness" is to cover all parking lots along the Bavarian motorways. However, the system started as a pilot for one specific motorway section and will be expanded step-by-step to other motorway sections.
- "Consistency" (in relation to the data model) is assured by transmitting the system data towards the MDM via the standardized DATEX II format.

### 2.2.2. BOSCH SECURE TRUCK PARKING[6]

The Bosch company provides a commercial service to truck drivers and logistic dispatchers, enabling:

- Real-time information about available parking lots,
- Cashless payment,
- Live notification from dispatchers about parking facilities, and
- Detailed information on the security conditions.

The covered parking facilities may be along public road infrastructure, but also in semi-public places (e.g. truck stops) or at logistical hubs. Some of the parking facilities are exclusively available of registered users of the system. The system retrieves its information from data platforms, such as the National Access Points, but also directly from connected parking facilities (e.g. via occupancy detectors). The resulting information service is integrated into truck navigation devices.

[6] https://www.bosch-secure-truck-parking.com/

Quality criteria relevant for the system deployers include some of the generic criteria from the data quality domain, such as 'Availability', 'Correctness' and 'Consistency'. One interesting fact from the interview was that correct information is more important than complete information, so "gaps" in the data base are rather accepted than incorrect information.

Looking at assessment methods, the main responsibility for the quality of data base is seen at the data provider's side, e.g. the facility operators. However, there are own quality assurance procedures to check the goodness of the data base, e.g. by own staff at the parking facilities.

### 2.2.3. BUNDESVERBAND WIRTSCHAFT, VERKEHR UND LOGISTIK (BWVL) E.V.[7]

The BWVL is an association of freight transport and logistics businesses in Germany. It represents the positions of its member towards policy makers and the economy.

Efficient information services about truck parking facilities is seen very important, having today' s heavy work load of truck drivers in mind. However, it is also stated that information services can only optimise existing capacities on individual truck parking facilities, but do not solve the permanent problem of lacking truck parking capacities, especially along German motorways.

Looking at relevant quality criteria for related information services, "Completeness" of the data base is mentioned among others, having the entire motorway network as a goal. As an assessment method, a promising way is seen via driver's feedback to the service providers about the perceived information quality.

## 2.3. Proposal for Quality Criteria

Originally, quality criteria were defined in previous EU EIP work phases for the domains of Real-Time Traffic Information / Safety-Related Traffic Information (RTTI / SRTI) services[8], as well as of Multimodal Travel Information Services (MMTIS)[9]. Where possible, these existing definitions were reused to the domain of ITPS. The reason for this is that quality definitions, as developed previously, have been intensely discussed and validated with various stakeholders, resulting in a fairly proven concept. However, it has been

[7] https://www.bwvl.de/

[8] https://eip.its-platform.eu/highlights/update-eu-eip-quality-package-srti-and-rtti

[9] https://eip.its-platform.eu/highlights/multimodal-travel-information-services-mmtis-quality-framework-published-stakeholders

recognised that the specifics of ITPS data may require some adoptions of the previous quality definitions.

Based on discussions with EU EIP partners, a first proposal of quality criteria and definitions has been elaborated, see Table 2 below.

**Table 2: EU EIP definitions for service and quality criteria for information in the field of ITPS**

| Service and Quality Criteria for ITPS | | |
|---|---|---|
| Level of Service | **Geographical coverage** | Percentage of the transport system infrastructure covered by the (content provision) service. |
| | **Availability** | Percentage of the time that the (content provision) service is available. |
| Level of Quality | **Reporting period** | *Time interval for refreshing information (data)* |
| | **Timeliness (update)** | Time interval between a change of any data entity and the moment that change is reflected in the service |
| | **Error rate** | *For static data*<br>Percentage of data entities for which the values are different from the ground truth out of the total data entities which are included in the service provision. Measured as the arithmetic mean of the percentages for all parking places covered by the service.<br><br>*For dynamic data*<br>Absolute relative error (Err) of the provided number of free spaces (Np) compared to the ground truth (Nr) calculated as:<br>$Err = \frac{\lvert N_r - N_p \rvert}{N_r} \times 100$<br>Measured as the arithmetic mean of the errors for all parking places covered by the service. |
| | **Report coverage** | The percentage of data entities which were updated out of the total data entities for which changes occurred since the previous update period |
| | **Completeness of data** | Percentage of data elements available in the service provision with respect to the total data elements of that service or data type for which quality criteria have been defined.<br>More precisely, for a given service or data type, are all the data elements foreseen in the Regulation provided? |

Additional information on the individual quality criteria is provided below:

- 'Error rate' serves as a quality criterion especially for data entities for which a ground truth can be established.
- 'Completeness of data' serves as a criterion especially for static data entities. A missing data entity in this context can mean that either information cannot be provided or validation is impossible.

## 2.4. Mapping quality criteria to services

In the process of assessing the specific relevance of quality criteria, as introduced above, to individual ITPS data categories, several experts among the project partners were asked to map the quality criteria to ITPS data categories. The ITPS data categories correspond to the categories listed in the Delegated Regulation, see section 1.4.2

Keeping in mind the distinction between event or entity related and status-oriented information and their pertinent quality criteria, a set of applicable quality criteria per ITPS data categories and its relevant data content was agreed upon.

The resulting full set of selected services and data entities and their applicable quality criteria is represented in Annex 1.

# 3. Quality requirements for ITPS

As a next step, a first proposal of quality requirements for individual ITPS data categories was elaborated by EU EIP partners. These requirements are understood as initial target values, which have to be further discussed and evaluated with ITPS stakeholders at a later stage. This proposal is accompanied by "interpretation examples" which explain how each quality criterion can be interpreted and handled for an individual ITPS data category.

The most important quality requirements are the minimum ones, denoted as the * Basic quality level. This level should be met by the services in all member states, because if the service would be provided at a lower level of service or quality, the user benefits would likely be negligible or even negative according to current knowledge and EU EIP expert experiences. In addition to the Basic level, tentative quality requirement recommendations are also given for two higher levels (** Enhanced and *** Advanced) for reference and assistance to users.

The proposed quality requirements and the 'interpretation examples' are represented in tables separated by quality criteria. While the definitions for the Level-of-service requirements (Table 3) are defined generally for any ITPS data category, the definitions for the Level-of-quality requirements (Table 4 etc.) are defined separately for each relevant ITPS data category. ITPS data categories for which a criterion isn't relevant have been left out of the tables.

**Table 3: Initial Target Values for ITPS Level-of-Service Criteria**

| | Criterion | ★ (Basic) | ★★ (Enhanced) | ★★★ (Advanced) |
|---|---|---|---|---|
| ITPS Level-of-Service Criteria | **Geographical coverage** | **90%** | 95% | 99% |
| | **Availability** | **95% (347 days/year)** | 99% (361 days/year) | 99,5% (363 days/year) |
| | **Geographical coverage**<br>*This quality criterion is interpreted as* percentage of truck parking stations within a given network covered (% of all stations).<br>**Availability**<br>*This quality criterion is interpreted as* Server availability. | | | |

**Table 4: Initial Target Values for ITPS Level-of-Service Criterion "Reporting period"**

| | ITP Service | Interpretation | ★ (Basic) | ★★ (Enhanced) | ★★★ (Advanced) |
|---|---|---|---|---|---|
| ITPS Level-of-Quality Criterion "Reporting period" | The provision of dynamic data on availability of parking places including whether a parking is: full, closed or number of free places which are available | *Time interval for refreshing information (data)* | 15 min | 10 min | 5 min |

**Table 5: Initial Target Values for ITPS Level-of-Quality Criterion "Timeliness (update)"**

| | ITP Service | Interpretation | ★ (Basic) | ★ (Enhanced) | ★★★ (Advanced) |
|---|---|---|---|---|---|
| ITPS Level-of-Quality Criterion "Timeliness (update)" | The provision of static data related to the parking areas<br>Data entities: Identification information of parking area, Location information of the entry point in the parking area, Primary road identifier1/direction, Primary road identifier2/direction, The indication of the Exit to be taken, Total number of free parking places for trucks, Price and currency of parking places | *Time interval between a change of any data entity and the moment that change is reflected in the service* | 1 month | 1 week | 1 day |
| | The provision of information on safety and equipment of the parking area<br>Data entity: Description of security, safety and service equipment, Number of parking places for refrigerated goods vehicles, Information on specific equipment or services for specific goods vehicles and other, Name and surname, Telephone number, E-mail address, Consent of the operator to make his contact information public | *Time interval between a change of any data entity and the moment that change is reflected in the service* | 1 month | 1 week | 1 day |

**Table 6: Initial Target Values for ITPS Level-of-Quality Criterion "Error rate"**

| | ITP Service | Interpretation | ★ (Basic) | ★★ (Enhanced) | ★★★ (Advanced) |
|---|---|---|---|---|---|
| ITPS Level-of-Quality Criterion "Error rate" | The provision of static data related to the parking areas<br>Data entities: Identification information of parking area, Location information of the entry point in the parking area, Primary road identifier1/direction, Primary road identifier2/direction, The indication of the Exit to be taken, Total number of free parking places for trucks, Price and currency of parking places | *Percentage of data entities for which the values are different from the ground truth out of the total data entities which are included in the service provision. Measured as the arithmetic mean of the percentages for all parking places covered by the service.* | 10% | 5% | 1% |
| | The provision of information on safety and equipment of the parking area<br>Data entity: Description of security, safety and service equipment, Number of parking places for refrigerated goods vehicles, Information on specific equipment or services for specific goods vehicles and other, Name and surname, Telephone number, E-mail address, Consent of the operator to make his contact information public | *Percentage of data entities for which the values are different from the ground truth out of the total data entities which are included in the service provision. Measured as the arithmetic mean of the percentages for all parking places covered by the service.* | 10% | 5% | 1% |

| | ITP Service | Interpretation | ★ (Basic) | ★★ (Enhanced) | ★★★ (Advanced) |
|---|---|---|---|---|---|
| | The provision of dynamic data on availability of parking places including whether a parking is: full, closed or number of free places which are available | *Absolute relative error (Err) of the provided number of free spaces ($N_p$) compared to the ground truth ($N_r$) calculated as:* $$Err = \frac{\lvert N_r - N_p \rvert}{N_r} \times 100$$ *Measured as the arithmetic mean of the errors for all parking places covered by the service.* | 15% | 10% | 5% |

**Table 7: Initial Target Values for ITPS Level-of-Quality Criterion "Report coverage"**

| | ITP Service | Interpretation | ★ (Basic) | ★★ (Enhanced) | ★★★ (Advanced) |
|---|---|---|---|---|---|
| ITPS Level-of-Quality Criterion "Report coverage" | The provision of static data related to the parking areas<br>Data entities: Identification information of parking area, Location information of the entry point in the parking area, Primary road identifier1/direction, Primary road identifier2/direction, The indication of the Exit to be taken, Total number of free parking places for trucks, Price and currency of parking places | *The percentage of data entities which were updated out of the total data entities for which changes occurred since the previous update period* | 80% | 90% | 95% |
| | The provision of information on safety and equipment of the parking area<br>Data entity: Description of security, safety and service equipment, Number of parking places for refrigerated goods vehicles, Information on specific equipment or services for specific goods vehicles and other, Name and surname, Telephone number, E-mail address, Consent of the operator to make his contact information public | *The percentage of data entities which were updated out of the total data entities for which changes occurred since the previous update period* | 80% | 90% | 95% |

**Table 8: Initial Target Values for ITPS Level-of-Quality Criterion "Completeness of data"**

| | ITP Service | Interpretation | ★ (Basic) | ★★ (Enhanced) | ★★★ (Advanced) |
|---|---|---|---|---|---|
| ITPS Level-of-Quality Criterion "Completeness of data" | The provision of static data related to the parking areas<br>Data entities: Identification information of parking area, Location information of the entry point in the parking area, Primary road identifier1/direction, Primary road identifier2/direction, The indication of the Exit to be taken, Total number of free parking places for trucks, Price and currency of parking places | *Percentage of data entities available in the service provision with respect to the total data elements of that service or data type for which quality criteria have been defined.*<br>*More precisely, for a given service or data type, are all the data elements foreseen in the Regulation provided?* | 50%<br>(at least ½) | 80%<br>(at least ¾) | 100%<br>(all) |
| | The provision of information on safety and equipment of the parking area<br>Data entity: Description of security, safety and service equipment, Number of parking places for refrigerated goods vehicles, Information on specific equipment or services for specific goods vehicles and other, Name and surname, Telephone number, E-mail address, Consent of the operator to make his contact information public | *Percentage of data entities available in the service provision with respect to the total data elements of that service or data type for which quality criteria have been defined.*<br>*More precisely, for a given service or data type, are all the data elements foreseen in the Regulation provided?* | 50%<br>(at least ½) | 80%<br>(at least ¾) | 100%<br>(all) |

# 4. Quality assessment methods

## 4.1. Descriptions of quality assessment methods

The quality assessment methods in this chapter have been derived largely from the 'Quality definitions for Multimodal Travel Information Services (MMTIS)' (version 0.9, 05.06.2018).

However, quality assurance and assessment procedures in ITPS are often still non-existent and in other instances still not fully mature. Further validation and development efforts, with stakeholders in the field, are required. For this, the methods listed in the following sub-chapters may be considered as a reference for possible, adapted assessment methods.

### 4.1.1. METHOD 1: CONTINUOUS MONITORING OF EQUIPMENT PERFORMANCE AND AVAILABILITY

Method description

The method is intended for continuous monitoring of the functioning of existing detector networks. It may also be applied to detectors monitoring occupancy and/or availability at intelligent truck parking facilities. The aim is to get timely alerts of the malfunctioning equipment in order to fix or replace it. The monitoring process may be automated or be performed by a human user. The monitoring of equipment performance may include:

- Verifying the availability of the data the equipment is supposed to produce
- Checking of consistency between the data values measured by the same equipment
- Comparison of the measured data to other equipment in adjacent or to the same geographical area
- Monitoring of error messages and alerts generated by the equipment.

The methods used to detect failures are more or less specific for the type of equipment.

Data requirements

The method requires access to real-time data generated by the equipment under monitoring and the possible error messages or alerts. Some tests may also require data which can be used for testing the data under analysis. In addition to the application layer, access to lower layers of data transmission may be needed for example when monitoring the status of the data link between site equipment and back-office system.

Applicability

*Quality assurance*

The method is used for quality assurance. It is used for following-up the monitoring systems deployed by the Parking Management System.

*Parts covered value chain*

This method could be used in the different phases. It is mainly used in the Content detection phase (Figure 2), but it could also be used in the Content processing and Service provision phase.

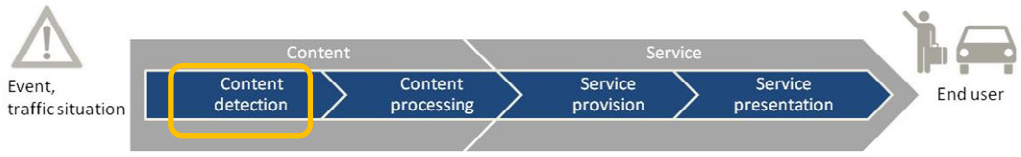


**Figure 2: Parts of value chain covered by the method – Continuous monitoring of equipment performance and availability**

*Type of service aspect / service equipment*

This method could be used to monitor different types of equipment. It is not only focused on monitoring systems - loops, parking sensors (also visual) etc. - but also other equipment involved in the ITS service provision chain (for example VMS).

*Covered criteria*

Criteria that can be assessed are: Availability, Error Rate and Event coverage.

Usage

*Objective*

This method could be used to determine the quality assessment of service, but it could be also used as an acceptance test (for example if the installed system has a minimum percentage of availability)

*What stage of the process*

This method is used during operation to assess if the system or the service responds to the expectations. It could be used as an acceptance test to assess the system.

*What rate of use*

It could be used in the three rates of use. Usually is used on single or individual spots when the system is just installed or when some deviations in the monitoring data are detected.

*Parts covered value chain*

This method could be used in the different phases. It is mainly used in the content detection phase, but it could also be used in the content processing and service provision phase.

*Type of service aspect / service equipment*

This method could be used to monitor different types of equipment. It is not only focused on monitoring systems but also other equipment involved in the ITS service provision chain (for example VMS).

*Covered criteria*

Criteria that can be assessed are: Availability and Error Rate.

### 4.1.2. METHOD 2: REFERENCE TESTING OF DATA COLLECTED

Method description

Reference testing of data collected includes practices that are used to verify that a certain method is correct. The data or information under analysis is compared against a source known to be reliable (ground truth). The comparison is made for a limited period of time or limited amount of data in the context of an existing truck parking service.

The choice of mathematical methods to be used for comparison depends on the characteristics of data to be evaluated (1), the data used as ground truth (2) and the objectives of the study (3). Suggestions for analysis approaches for continuous, multinomial or binomial data which is a function of time in one or two dimensional space can be found in Table 18.

**Table 9: Suggested analysis approaches for continuous, multinomial or binomial data which is a function of time in one or two dimensional space.**

| **Data types** (as a function of time and location) | | **Suggested analysis approach** |
|---|---|---|
| Data under analysis | Ground truth | |
| Multinomial or binomial | Multinomial or binomial | Create a mapping between the data types in the data set under analysis and the data set used as ground truth. Then use a time-space oriented reference testing method (comparable to QKZ or QRTTI) in analysis. |
| Multinomial or binomial | Continuous | Recode the ground truth data into categories that are used in the data set under analysis. Then use a time-space oriented reference testing method (comparable to QKZ or QRTTI) in analysis. |
| Continuous | Multinomial or binomial | Recode the data under analysis into categories used in the ground truth data. Then use a time-space oriented reference testing method (comparable to QKZ or QRTTI) in analysis. |
| Continuous | Continuous | • Analyse the distribution of error and absolute error (absolute error = \|ground truth – data under analysis\|) for example by visual plotting and calculating basic statistics such as mean, median, minimum, maximum and different percentiles (for example, 85th, 90th 95th and 99th).<br>• Alternative approach: Recode both the data under analysis and the ground truth data into categories and process as multinomial data. |

For data types with continuous values, there are at least two possible approaches for reference testing of data. First, continuous data values can be assigned into categories and then handled as binary or multinomial data using time-space oriented reference test methods. Second, it is possible to analyse the difference between the ground truth and the values in the data set under analysis. When analysing the difference – the error of the measured data – it can be possible to use the data quality attributes already defined in ISO technical report ISO/TR 21707 and the QUANTIS project and statistical methods available in textbooks.

It may be necessary to calculate confidence intervals for variables such as probability of detection or false alarm rate to obtain statistically conclusive results.

Reference testing of data collected is a method which can be applied to both services and data without restrictions related to position in the value chain (Figure 3).

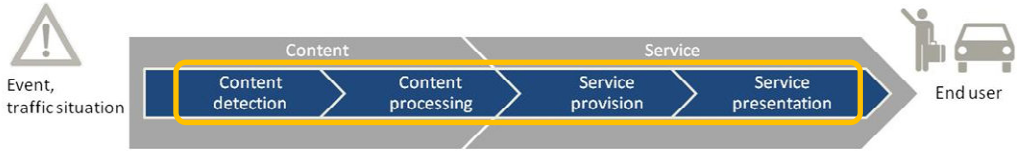


**Figure 3: Parts of value chain covered by the method – Reference testing of data collected.**

Data requirements

Reference testing of data requires a ground truth – data which can be considered to be correct with high probability. In addition to the ground truth, also other data sets may be used to support the conclusions of the analysis. The accuracy of analysis results is dependent on the quality of the data set used as a ground truth. If no data set considered suitable for ground truth is available, no reference testing can be performed. If the data set used as ground truth has substantial inaccuracies, the result of the whole analysis may be distorted.

The choice for ground truth also depends on the data that is used in the information service itself. The ground truth should always be an independent set of data, so the mapping is applicable only if the service is based on different data.

Expected results and scope of application

The method is applicable only in situations where it is possible to use data from an independent source as a ground truth. The data to be used as ground truth should be collected with means considered reliable and accurate. In other words, the ground truth data should be accurate and its possible weaknesses should be known at least on general level.

The application of the methods requires also that the ground truth data is representative of the conditions in which the system to be evaluated is supposed to be operating.

### 4.1.3. METHOD 3: MONITORING OF TIMELINESS AND DATA COMPLETENESS

Method description

The objective of this method is the automated monitoring of timeliness and data completeness information in the Central Access Point (CAP). It may also be implemented for other purposes. Automated monitoring of timeliness is typically implemented with software that automatically registers the time stamps of incoming/outgoing information related to a certain event within an organisation. This allows statistical analysis of the performance of the operator in the processing of the event and message provision.

The analysis can be divided into the following steps

1. Define the messages to be analysed and the part of service chain to be covered.
2. Describe the relation between messages at the input and messages at the output. Part of this are e.g. service requirements. The relation may be from one to one or from one to many. In the latter case, one has to define which of the messages at the output is chosen for analysis.
3. An automated system calculates the timeliness of messages observed at the output.
4. Aggregated key performance indicators are calculated and statistical analysis can be performed for the observed timeliness or completeness of individual messages.

Data requirements

Although for part of the messages monitored a system of manually triggered messages (see later examples) is conceivable, this is prone to human error. Therefore, to monitor any system that covers the whole value chain, it is desirable for equipment (e.g. vehicle transponder or sensor based) to be in place that automatically generates triggers and messages.

Furthermore, this method, too, requires an unambiguous relation between the messages at the input and output of the system to be analysed. The simplest case is the one to one relationship between input and output messages. Cases in which there is either one input message related to many output messages or many input messages related to one output message are more complex and require careful analysis. In these cases, there has to be objective criteria to determine which of the messages will be analysed.

The messages must also have reliable timestamp that is attached to a message when it enters or exits the system. This means that the software creating the input and output timestamps must be either using the same system clock or that the clocks used to create

input and output timestamps must be either synchronised to each other or to a common external time reference.

*Parts covered value chain*

The focus is on the content side (Figure 4).

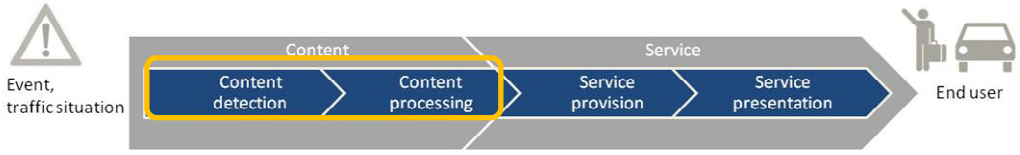


**Figure 4: Parts of value chain covered by the method – Monitoring of timeliness and completeness.**

*Type of service aspect / service equipment*

The monthly report can be used for all types of equipment and processes.

*Covered criteria*

Criteria that can be assessed are: Availability, Reporting period, Timeliness update, Error rate, Event coverage and Data completeness

Results related to the criteria:

- Quantitative
- Objective
- Direct
- Results do encompass criteria.

### 4.1.4. METHOD 4: SURVEYS OF PERCEIVED QUALITY BY USERS

Method description

The aim of a user survey is to measure how the end users experience/perceive the ITPS. Data collection may be performed periodically (e.g. once a year).

The degree of satisfaction, the degree of relevance, the user needs, and the perceived quality are covered by the questionnaire. Many other questions are also asked. A web

panel of a sufficient number active users are asked to participate in a survey (e.g. in Denmark, 1000 car users - each driving more than 8000 km a year). The services which can be covered by the method are: web sites and mobile applications.

Applicability

*Quality assurance/assessment*

The method is for Quality assessment.

*Event/status*

The method covers the services, which means both event and status information.

*Offline/online*

The method is an offline method.

*Parts covered in value chain*

All parts of the value chain are covered (Figure 5).

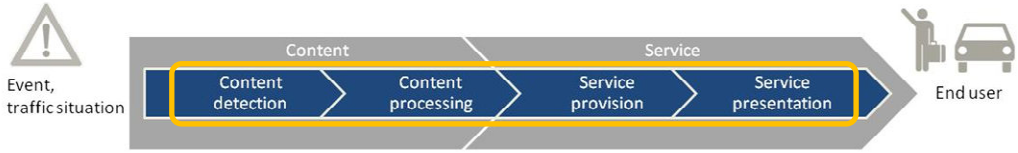


**Figure 5: Parts of value chain covered by the method – Surveys of perceived quality by users**

*Type of service aspect / service equipment*

User surveys can be used for all types of services.

*Covered criteria*

Mainly the following criteria are covered by the quality perceived by the end users: Availability, timeliness, error rate and geographical coverage.

*Results related to the criteria*

The results related to the criteria are:

- Quantitative

- Subjective
- Indirect
- Results do not encompass criteria.

Usage

*Objective*

The objective is assessment of the services.

*What stage of the process*

The operation of the services is assessed.

*What rate of use*

The user surveys could be performed once a year.

### 4.1.5. METHOD 5: COLLECTION OF DIRECT USER FEEDBACK

Method description

Collection of direct user feedback means using different channels established by the service provider to collect feedback from the users regarding the quality of the service in question.

In quality assessment, collection of direct user feedback is a relatively easy way to get information how the actual users of the service experience the service quality. The feedback can be collected via webpage or smart phone app, where the feedback can be classified by the user and directed to the responsible parties. The feedback can also be collected by telephone, which requires a bit more resources for registering the feedback. User feedback is a very important method considering consumer information services (end user services), but can also be applied to b2b-type of services such as Content Access Point.

Applicability

*Quality assurance / assessment*

The method can be used as a part of the quality assurance process. If no other means of quality assurance are possible, at least this method should be used. The method provides only qualitative type of information which limits its use in systematical quality assessment.

*Event / status*

Method can be used for both types.

*Offline / online*

Method can be used in online analysis.

*Parts covered in value chain*

The coverage of the method in the ITS value chain is described in Figure 6.

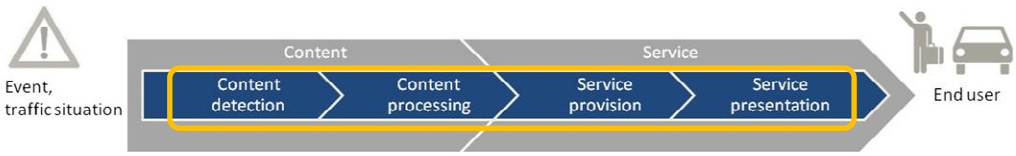


**Figure 6: Parts of value chain covered by the method – Collection of direct user feedback**

*Type of service aspect / equipment*

The method is as its best in the evaluation of service as a whole from end users' perspective. The feedback, and the encountered problems, can however be traced to different phases in the value chain.

It should be kept in mind that the method is important also for the quality assurance of services such as Content Access Point, even though the users are companies and organisations using the interface.

*Covered criteria*

The method can be used to collect information about availability, timeliness and error rate.

Also indications regarding poor report coverage can be achieved with this method.

*Results related to the criteria*

The collected feedback is qualitative in nature. Hence, if a lot of feedback is received concerning for example wrong available parking places, that is a signal to make deeper quantitative analysis of the quality in the value chain. So the method does not directly measure the quality in terms of the defined attributes, but it collects (indirect) indications about the quality.

Feedback is always subjective.

Usage

*Objective*

Collection of direct user feedback is used for quality assessment of a running service. Because the method provides only qualitative information about the quality, it is not recommended as an only assessment method.

The method could be used also in the acceptance testing phase with a limited test group.

*What stage of the process*

The method is used in the operational phase of the service.

The method is also beneficial in the test phase of a new service. In this case, a test group of users is formed and their opinions are collected with the help of different channels.

*What rate of use*

The method is used continuously. Method does not require special expertise, but there are some minor costs related to the handling and analysis of the received feedback.

*Experiences and actual use*

Most services targeted for the end users are already using this assessment method. Possibility to leave user feedback is also part of a good customer experience, so the method is not only used as a means of quality assessment.

In a good practice of this method, the service provider explains the user for what purpose the feedback is collected, how it is processed, what is the processing time of the feedback, and whether the user will be provided with an answer from the service provider. In best practices, the user actually receives a personal answer including an explanation to what actions the feedback has/will lead to.

Hence, the use of the method requires person(s) who takes responsibility of the management of the feedback. The volume of users and the resulting amount of feedback defines the needed resources for this method.

A good practice to decrease the amount of unnecessary feedback is to set up a Questions & Answers page, where the most common feedback and the related answers are already addressed. Explanation about how the information is collected and what factors affect the quality of the information may be a good way to reduce the amount of (unnecessary) feedback.

The use of telephone in the collection is not recommended in case of end user services, because that would tie staff and requires more resources in the registration (typing in) of the feedback.

In case of b2b type of services such as Content Access Point, the amount of users is usually quite limited, and the feedback can be collected also via telephone as part of the customer service offered to the users of the service.

### 4.1.6. METHOD 6: MONITORING OF SERVICE USE STATISTICS

Short description

Monitor amount of service use to assess effect of service content and quality by using counters of internet page visits, smartphone application downloads and use etc.

The method provides only indirect information of service quality but is important as the main purpose of service quality is to provide benefit to the user of the service. The users will only use a service if it provides such benefit, and thereby service use statistics are essential for the service providers.

Applicability

*Quality assurance / assessment*

Applies to both.

*Event / status*

Applies to both.

*Offline / online*

Primarily offline

*Parts covered value chain*

The method covers service provision and presentation, but indirectly all parts of the value chain (Figure 7).

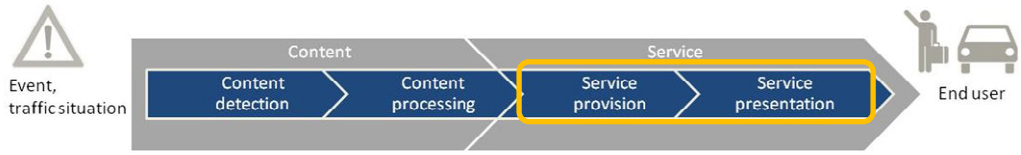


**Figure 7: Parts of value chain covered by the method – Monitoring of service use statistics.**

*Type of service aspect / service equipment*

Only the service as a whole, no possibility to differentiate between service aspects.

*Covered criteria*

Basically all as they all affect the whole service quality reflected in willingness to use service – it is very hard to establish link to availability, latency and timeliness criteria.

*Results related to the criteria*

- Quantitative / qualitative: qualitative for the criteria, but quantitative as such
- Objective / subjective: objective
- Direct / indirect: indirect
- Results do encompass criteria indirectly only

Usage

*Objective*

The objective is to assess the benefit and thereby quality to the users via monitoring how often and by how many the service is being used.

*What stage of the process*

Service operation, useful in both normal and abnormal situations of service operation.

*What rate of use*

Applicable to single/spot check, periodic, and continuous use

No special equipment is needed except for software solutions to provide usage counters at internet sites and pages, as well as willingness of application and app store providers to provide information of application download and use statistics.

The costs are expected to be very low.

*Experiences and actual use*

The practice is widely used globally.

# 5. Summary and conclusions

Commission Delegated Regulation (EU) No 885/2013 contains some principles how to provide and exchange data information in the in the field of Intelligent Truck Parking Services (ITPS). However, no agreements or definitions to describe and document the corresponding service and data qualities exist so far.

EU EIP has previously developed frameworks how to commonly describe and document quality in the context of other Delegated Regulations, specifically for Real-Time Traffic Information / Safety-related Traffic Information (RTTI/SRTI) services, as well as for Multi-Modal Traveller Information Services (MMTIS). EU EIP is now about to introduce and discuss a similar framework for ITPS.

In this document, a first proposal on quality criteria and definitions for ITPS and the underlying data has been elaborated EU EIP partners. This proposal includes:

- A set of quality criteria in the categories 'Level of Service" (describing the provision of data) and 'Level of Quality" (describing the data as such) → see chapter 2.3
- A mapping of relevant quality criteria to individual ITPS data categories → see chapter 2.4
- Quantitative quality requirements for individual ITPS services (as initial target values), accompanied by "interpretation examples" → see chapter 3
- A set of proposed quality assessment methods → see chapter 4

The main lesson learned from the activities defining quality criteria is that many definitions from the former EU EIP quality frameworks could be adopted for the ITPS domain. Further, the elaborated quality definitions could be easily related to ITPS data categories, as these have been pre-defined in the Delegated Regulation and specified via Guidance Documents[10]. Such specifications seem to be helpful also in the quality context, avoiding misunderstandings and heterogeneous data provisioning.

However, it as was also observed that quality assurance and assessment in ITPS is far from established and mature. Hence, further validation, research, and development efforts are required. Pragmatic validation studies, also involving stakeholders, of the proposed quality criteria and requirements for ITPS will be carried out as the next task in the EU EIP 4.1.

[10] https://ec.europa.eu/transport/themes/its/road/action_plan/intelligent-truck-parking_en

## Annex 1: Relation between quality criteria and ITPS data categories

| | | Quality criteria | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Data to be collected | Data entities | Geographic coverage | Availability | Reporting period) | Timeliness (update) | Error rate | Report coverage | Completeness of data |
| Static data related to the parking areas, including (where applicable) | Identification information of parking area (name and address of the truck parking area (limited to 200 characters)) | x | x | | x | x | x | x |
| | Location information of the entry point in the parking area (latitude/longitude) (20 + 20 characters) | x | x | | x | x | x | x |
| | Primary road identifier1/direction (20 characters/20 characters), and Primary road identifier2/direction (20 characters/20 characters) if same parking accessible from two different roads | x | x | | x | x | x | x |
| | If needed, the indication of the Exit to be taken (limited to 100 characters)/Distance from primary road (integer 3) km or miles | x | x | | x | x | x | x |
| | Total number of free parking places for trucks (integer 3) | x | x | | x | x | x | x |
| | Price and currency of parking places (300 characters) | x | x | | x | x | x | x |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Information on safety and equipment of the parking area | Description of security, safety and service equipment of the parking including national classification if one is applied (500 characters) | x | x | | x | x | x | x |
| | Number of parking places for refrigerated goods vehicles (numerical 4 digits) | x | x | | x | x | x | x |
| | Information on specific equipment or services for specific goods vehicles and other (300 characters) | x | x | | x | x | x | x |
| | Name and surname (up to 100 characters) | x | x | | | | | x |
| | Telephone number (up to 20 characters) | x | x | | x | x | x | x |
| | E-mail address (up to 50 characters) | x | x | | x | x | x | x |
| | Consent of the operator to make his contact information public (Yes/No) | x | x | | x | x | x | x |
| Dynamic data on availability of parking places including whether a parking is: full, closed or number of free places which are available | | x | x | x | | x | | |