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Electronic fee collection — Support for traffic management

Perception du télépéage — Aide pour la gestion du trafic

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Foreword

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

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

Electronic fee collection (EFC) systems have been introduced in many countries where collected revenue is mostly used for funding the construction or maintenance of roads. EFC is also used for traffic management to reduce congestion in urban areas, such as London and Stockholm, since tolling is closely related to travel demand elasticity.

Examples of EFC used for traffic management in other countries include:

— a new movement for traffic management, called smart route selection, in which EFC will be used for selecting a route in the Tokyo metropolitan area to divert traffic out of central Tokyo (see Annex D);

— Electronic Road Pricing in Singapore (see Annex E);

— Managed lanes [including services known as high occupancy vehicle (HOV) lanes and high occupancy tolls (HOT)] on interstate freeways in the USA (see Annex F).

Traffic management is becoming more important in urban areas for reduction of congestion and also for emissions control, and EFC schemes such as the smart route selection and managed lanes are some of the key EFC applications used to support traffic management.

Figure 1 shows the scope of this document in the data flow model.

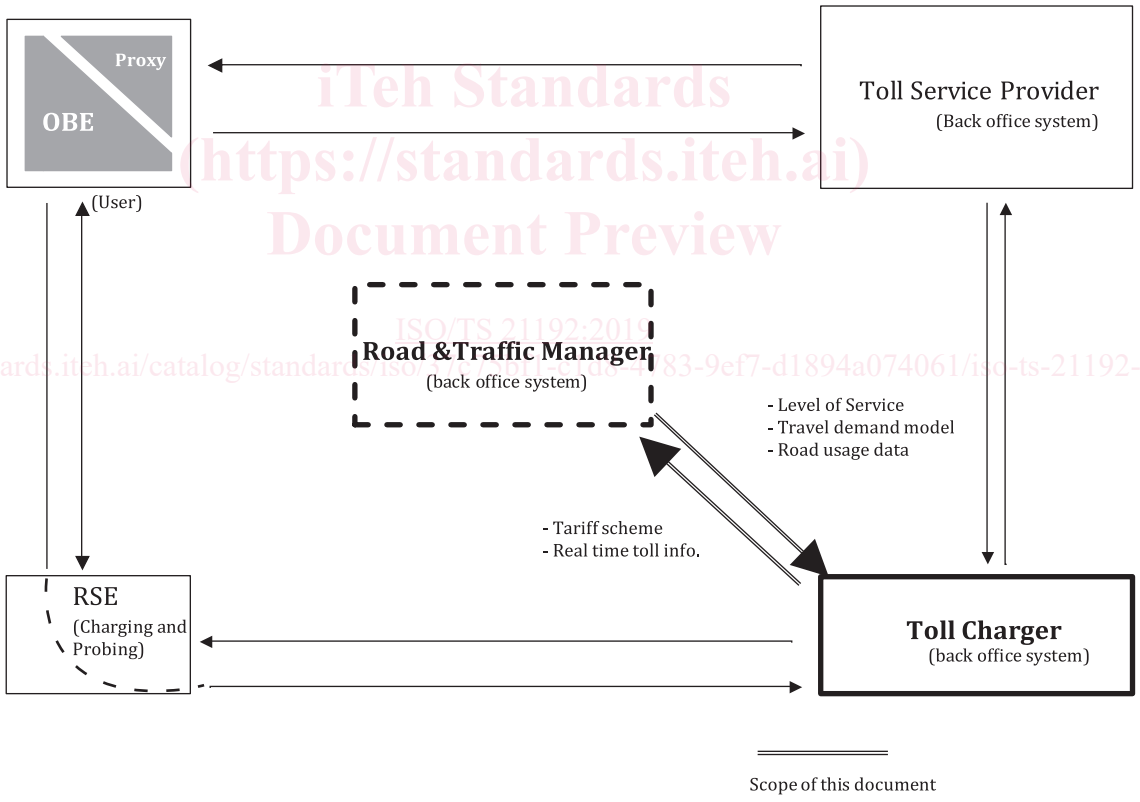

Figure 1 — Scope of this document in data flow model

Electronic fee collection — Support for traffic management

1 Scope

This document identifies the architecture of a toll system environment in which a toll charger (TC) can act to support traffic management with the use of a tariff scheme.

The scope of this document defines:

— the architecture related to the scope;

— a standard framework and data flow model;

— an exchange of information between a TC and a road and traffic manager (RTM), e.g.:

  — level of service (LOS);

  — tariff scheme;

  — data which is needed to support traffic management (vehicle probe and traffic flow data).

This document is a toolbox standard of application protocol data units (APDUs), which can be used for the assigned purpose. The detailed definitions of mandatory and optional elements in real implementation are outside the scope of this document. This document does not define communication stacks or timings.

Data types and associated coding related to the data elements described in Clause 6 are defined in Annex A, using the abstract syntax notation one (ASN.1) according to ISO/IEC 8824-1. This document allows the implementer to define suitable protocol procedures such as basic interaction, protocol mechanism, and choice of transfer protocol.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12855:2015, *Electronic fee collection — Information exchange between service provision and toll charging*

ISO 14827-1, *Transport information and control systems — Data interfaces between centres for transport information and control systems — Part 1: Message definition requirements*

ISO 14827-2, *Transport information and control systems — Data interfaces between centres for transport information and control systems — Part 2: DATEX-ASN*

ISO 14827-3, *Transport information and control systems — Data interfaces between centres for transport information and control systems — Part 3: Data interfaces between centres for intelligent transport sytems (ITS) using XML (Profile A)*

ISO 14906, *Electronic fee collection — Application interface definition for dedicated short-range communication*

ISO 17575-3, *Electronic fee collection — Application interface definition for autonomous systems — Part 3: Context data*

ISO 22837:2009, *Vehicle probe data for wide area communications*

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 https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
electronic fee collection
EFC
fee collection by electronic means

[SOURCE: ISO 17573-1:2019, 3.5, modified — Note 1 to entry has been deleted.]

3.2
level of service
LOS
rating of the quality of transportation facilities and services from the user perspective, with reference to speed, convenience and comfort, to evaluate problems and potential solutions

3.3
transport performance requirement
needed *level of service* (3.2) related to a set of operational goals and performance measures, e.g. speed, travel time, freedom to manoeuvre, traffic interruptions, comfort or convenience

3.4
probe data
vehicle sensor information, formatted as probe data elements and/or probe messages, that is processed, formatted, and transmitted to a land-based centre for processing to create a good understanding of the driving environment

[SOURCE: ISO 22837:2009, 4.3]

3.5
road and traffic manager
RTM
manager responsible for a road transport network operation including monitoring of the level of transport service

3.6
road usage data
travel data accumulated per road user, which is used to calculate the toll due

3.7
tariff scheme
set of rules to determine the fee due for a vehicle within a toll domain

[SOURCE: ISO 12855:2015, 3.12]

3.8
traffic flow information
traffic related data

EXAMPLE Average speed, traffic volume, level of congestion.

3.9
transit data
road usage data (3.6) necessary to calculate fees based on used road sections or passage of certain points

3.10
travel demand model
model for estimating travel demand and behaviour

3.11
dynamic toll
toll adjusted in real time in response to the actual traffic situation or other actual external conditions

3.12
fixed toll
toll applied according to a predefined tariff scheme

4 Abbreviated terms

EFC	Electronic Fee Collection (ISO 17573-1)
OBE	On-Board Equipment (ISO 14906)
LOS	Level of Service
RSE	Roadside Equipment (ISO 14906)
RTM	Road and Traffic Manager
TC	Toll Charger (ISO 17573-1)

5 Architectural concepts and information exchanges

5.1 General

This clause specifies the role model of EFC support for traffic management in terms of its roles and relationship with EFC and traffic management related roles. The information exchanges needed by a toll charger (TC) and an RTM to perform their roles are described in this clause.

5.2 Role model

ISO 17573-1 defines the four main roles in the toll charging environment. Figure 2 shows the role model expanded with one role to support for traffic management. Interactions between the management role of road and traffic operation environment and the charging role of the toll are both management and operational information flows, e.g. information flows regarding setting a tariff scheme, or daily operation of the tolling.

The role related to the management of road and traffic operation environment is identified to manage a road and traffic operation environment, i.e. defining and maintaining a set of rules that, taken together, defines the policy of traffic management. It should be noted that the role related to traffic management is not part of the EFC domain, but it belongs to the traffic management domain. Hence, this document describes the interface between the two domains, see Figure 2.

The responsibilities of the role allocated to the traffic management domain include:

— definition of the LOS, including required transport performance which is appropriate for a regional transportation network;

— provision of road usage data, including transit data to find the individual vehicle trace of the routes and to calculate the tolls;

— operation of a travel demand model, including requesting a new tariff scheme to improve traffic management.

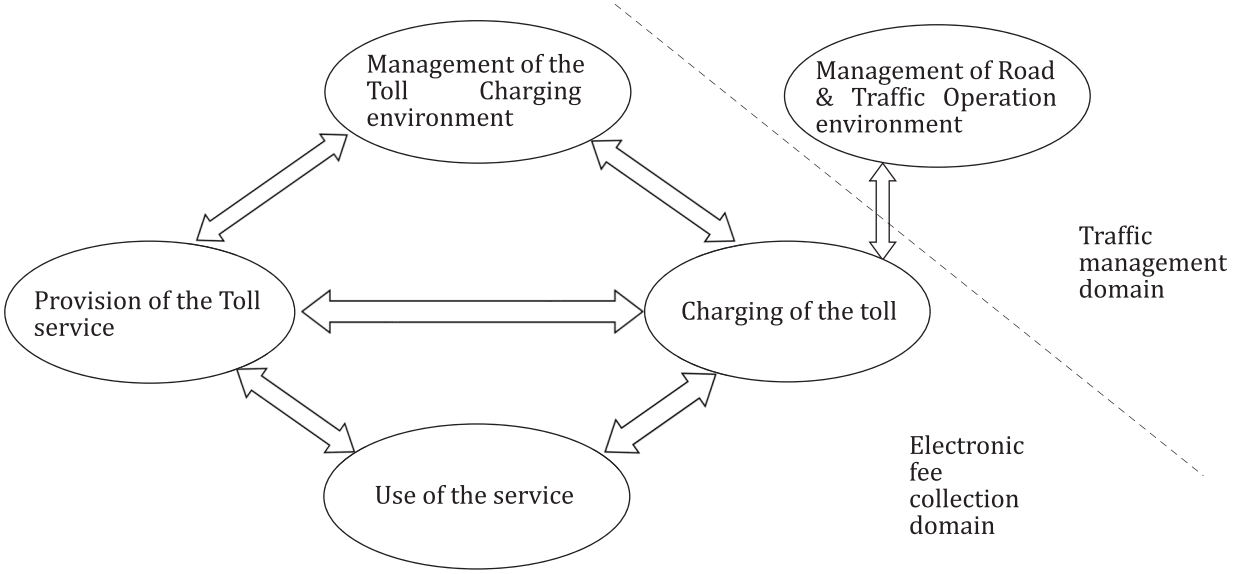

Figure 2 — Role model in the toll charging environment to support traffic management

5.3 Data flow model

The TC needs to establish and maintain close contact with the relevant RTM in order to use a tariff scheme for traffic management. In Figure 3, the data flow model for EFC support for traffic management is shown with RTM, which plays an important role for traffic management in a region, in the centre of the EFC architecture standard. The corresponding data flow of this document is shown in the double line arrows between TC and RTM.

The roles and tasks of TC and RTM to support traffic management are as follows:

— RTM is a manager responsible for a road transport network operation including monitoring of the level of transport service. RTM defines the LOS and sets transport performance requirements, based on the regional transport policy and traffic status, and sends them to TC.

— TC sets a tariff scheme, based on the transport performance requirements to optimize the toll revenue and the LOS, and sends it to RTM. TC levies tolls and sends real time toll information to RTM.

— RTM monitors the LOS by taking vehicle probe data and traffic flow data. RTM provides real time toll information for the users through the roadside information equipment, on-board equipment (OBE), in-car navigation devices, or web pages. RTM sends the road usage data required for tolling upon request from TC.

— RTM runs the travel demand model, to pursue better traffic management, and requests a new tariff scheme with the running data from the TC.

— TC evaluates and sets a new tariff scheme and sends it back to RTM.

— RTM activates the new tariff scheme, runs the travel demand model, and requests a new tariff scheme if necessary.

Upon considering the roles, the data flow model is depicted as Figure 3 with RTM in the centre of the basic EFC system architecture.

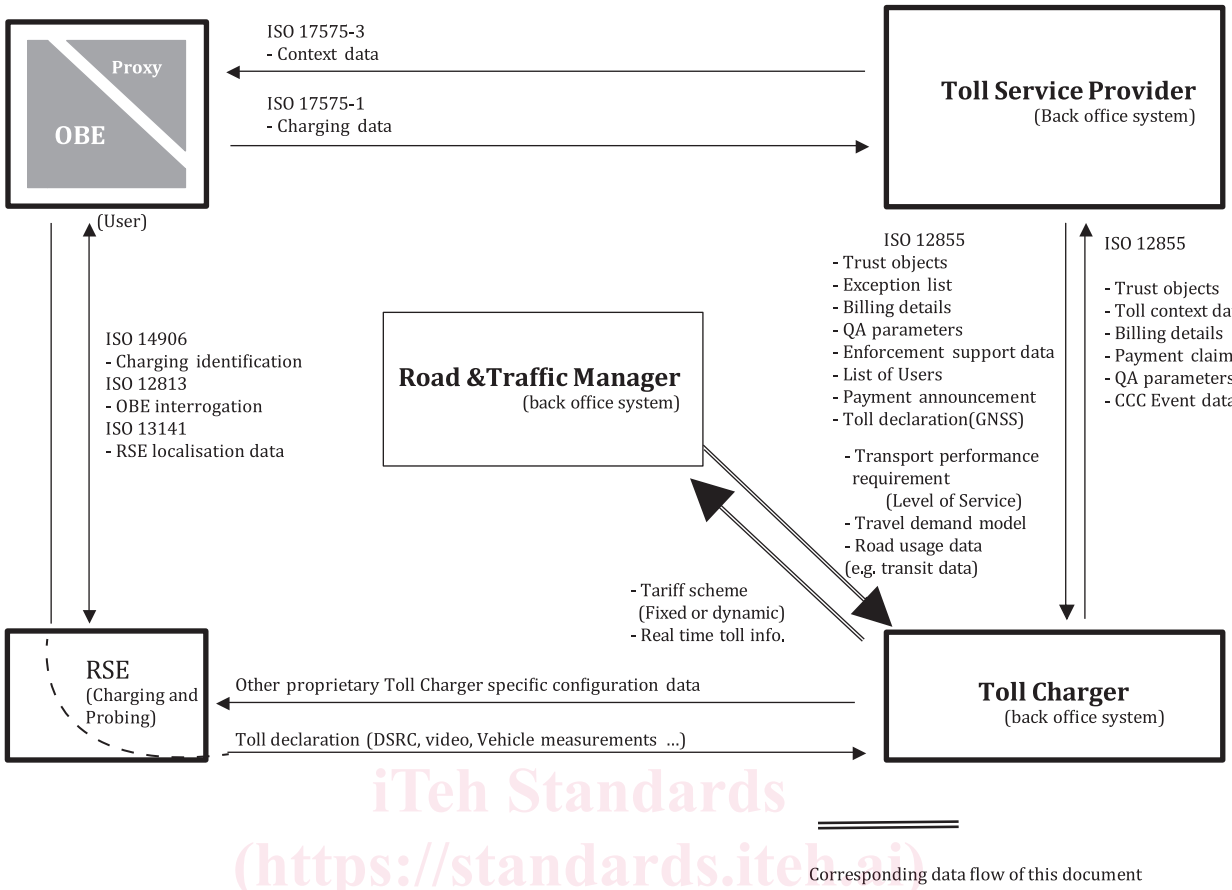

Figure 3 — Data flow model

5.4 Information exchanges between TC and RTM

The information exchanges between TC and RTM to support the traffic management with the use of EFC scheme shall be the flows with the time order of the exchanges, which are described as in Figure 4.

The first step is to define the LOS by RTM, then RTM shall send a performance request in terms of definition of LOS to TC. TC shall set a tariff scheme to satisfy the LOS and send it to RTM.

The second step is to levy the toll. The real time toll information shall be sent to RTM upon levying the toll to disseminate necessary tolling information to the road users, and RTM shall provide road usage data which are collected from OBE as vehicle probe data. The probe data is the vehicle data that is used to determine traffic conditions, time stamped unique identifiers, and to measure a vehicle's progress through the network, e.g. current position, speed, and heading and snapshots of recent events. This includes route information, starts and stops, speed changes, and other information that can be used to estimate traffic conditions. TC then calculates the tolls of individual vehicles. The vehicle probe data can also be transmitted to TC, where TC may calculate the tolls without the road usage data sent from RTM.

The third step is to run the travel demand model and evaluate the tariff scheme. When the tariff scheme is found to be not satisfactory with the LOS and a new tariff scheme is expected to meet LOS better by running the model, RTM shall request TC to evaluate and set a new tariff scheme. (See Annex I in detail including RSE and OBE.)

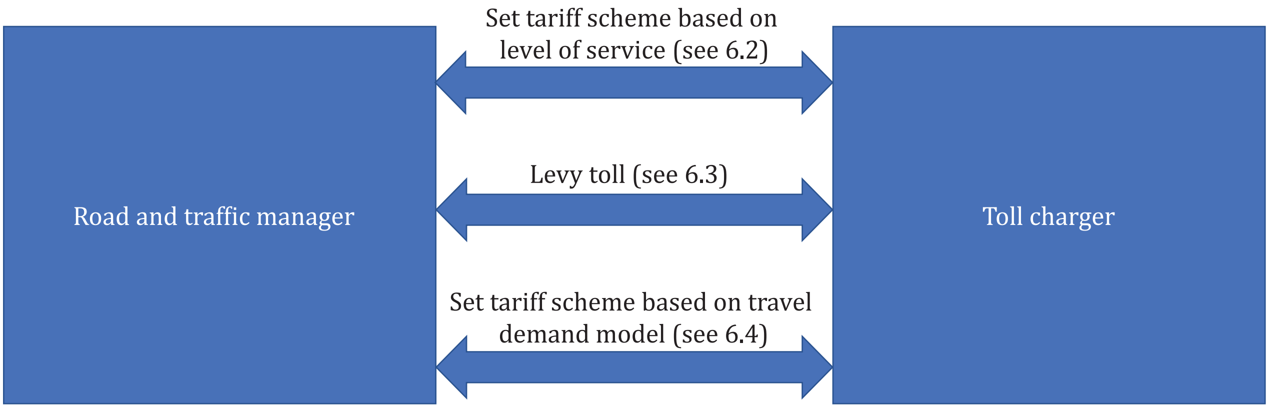

Figure 4 — Information exchanges between TC and RTM

6 General requirements for data exchange

6.1 General

Data to be exchanged for traffic management are categorized as traffic flow related, traffic incident related and tolling related data. The purposes of the data are shown in Table 1, together with the terms which are required to evaluate the performance of traffic management. The performance measures, which are required to set and evaluate the tariff scheme for supporting traffic management, should be classified as the categories of congestion management, tolling, safety, monitoring environmental impact, monitoring goods movement, and total management.

Table 1 — Exchanging data and purposes for evaluating the performance of traffic management

Exchanging data	Traffic management purpose					
	Congestion management	Tolling	Safety	Monitoring environmental impact	Monitor-ing goods movement	Total man-agement
Traffic speed	✓	✓	✓	✓	✓	✓
Traffic volume	✓			✓		✓
Traffic density	✓					✓
Vehicle type/fleet compo-sition	✓	✓		✓	✓	✓
Traffic incident data			✓			✓
Toll data (revenues and transactions)		✓				✓

The interface specifications of traffic centres and EFC centres are defined in ISO 14827 for traffic management and ISO 12855 for EFC, respectively. The interface between RTM and TC shall be defined in reference to the data exchange procedure in ISO 12855 and/or message exchange procedure in ISO 14827. The reference interface specification based on these standards is shown in Annex C. This document defines the data attributes as application data units (ADUs) for EFC supporting traffic management.

The description of data message in Clause 6 is ADU based on ISO 12855. Basic transaction flow including AckADU is described in ISO 12855:2015, Clause 6 also.

The following basic data attributes are described in 6.2 to 6.4:

— LOS;

