

TECHNICAL SPECIFICATION

ISO/TC 204

ISO/DTS 37444:2022-(E)

Date: 2022-12

Secretariat: ANSI

Electronic fee collection — Charging performance framework

Perception de télépéage — Cadre de performance d'imputation

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Published in Switzerland

STANDARD PREVIEW
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ISO/DTS 37444

<https://standards.iteh.ai/catalog/standards/sist/12998279-2009-4082-ac0f-cd9c98d5caa1/iso-dts-37444>

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Road Intelligent transport and traffic telematics systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition ~~of ISO/TS 37444~~ cancels and replaces the second editions ISO/TS 17444-1:2017 and ISO/TS 17444-2:2017, which have been technically revised.

The main changes are as follows:

~~re-numbering —~~ the resulting document ~~to has been renumbered as~~ ISO/TS 37444;

~~— various~~ editorial ~~and formal corrections, as well as~~ changes have been made to improve the readability; of the text;

~~applying —~~ a technology-neutral definition of metrics and examination tests has been applied, which ~~in particular~~ also includes ~~the~~ support for tolling systems based on automatic number plate recognition (ANPR-) technology; ~~and~~

~~updating —~~ terminology and references to other standards documents have been updated.

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.

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Introduction

0.1 General

Electronic tolling systems are complex distributed systems involving critical technology such as dedicated short-range communication (DSRC), camera-based ~~technology (e.g. automatic number plate recognition, ANPR)~~ and global navigation satellite systems (GNSS). ~~These technologies are~~ all subject to a certain behaviour that ~~may~~ can affect the computation of the charges. Thus, to protect the interests of the different stakeholders involved, ~~in particular~~ particularly toll service ~~user (SU)~~ users (SUs) and toll chargers (TCs), it is essential to define metrics that measure the performance of the system ~~as far as in terms of~~ computation of charges ~~is concerned~~, and ~~that~~ ensure that the potential resulting errors are acceptable. These metrics will be a ~~useful~~ tool ~~when for~~ establishing requirements for the systems and for ~~examination of~~ examining the system capabilities during acceptance and ~~throughout~~ the operational life of the system.

In addition, to ensure the interoperability of different systems, it ~~will be~~ is necessary to agree on common metrics ~~to be used for use~~ and on the actual values that define the required acceptable performances. However, ~~this is~~ these points are not covered in this document.

~~This~~ ~~Instead, this~~ document is defined as a toolbox standard of examination tests ~~plus, with~~ a method for defining and documenting ~~a~~ specific examination framework to meet specific needs. The detailed choice of the set of examination tests within an examination framework depends on the application and the respective context. ~~Compliance with~~ Conformance to this document means using the definitions and prescriptions laid out in this document whenever the respective system aspects are subjected to performance measurements, rather than using other definitions and examination methods.

0.2 Charging performance metrics

This document also defines a set of charging performance metrics with definitions, principles and formulations, which together make up a reference framework for the establishment of requirements for ~~EFC~~ electronic fee collection (EFC) systems and their later examination of the charging performance.

These charging performance metrics are intended for use with any toll scheme, regardless of its technical underpinnings, system architecture, tariff structure, geographical coverage, or organizational model. They are defined to treat technical details that ~~may be different among can~~ differ between technologies as a “black box”. They focus solely on the outcome of the charging process, i.e. the amount charged in relation to a pre-measured or theoretically correct amount, rather than intermediate variables from various components as sensors, such as positioning accuracy, signal range, or optical resolution. This approach ensures comparable results for each metric in all relevant situations.

The metrics are designed to cover the information exchanged on the front-end (FE) interface and the interoperability interfaces between toll service providers (~~TSPTSPs~~) and TCs, as well as information on the end-to-end level.

Metrics for the following information exchanges are defined:

~~Charge~~ — ~~charge~~ reports (including usage evidence);

~~Toll~~ — ~~toll~~ declarations;

~~Billing~~— ~~billing~~ details and associated event data;

~~Payment~~— ~~payment~~ claims on the level of user accounts;

~~Exception~~— ~~exception~~ lists;

~~End~~— ~~end~~-to-end metrics which assess the overall performance of the charging process.

The proposed metrics are specifically addressed to protect the interests of the actors in a toll system, such as TSPs, TCs and SUs. They can be used to define requirements (e.g. for requests for proposals) and for performance assessment.

Toll schemes take on various forms as identified in ISO 17573-1 and ISO 12855. In order to create a uniform performance metric specification, toll schemes are grouped into two classes based on the character of their primary charging variable:

— charging based on discrete events (charges associated to the fact that a vehicle is crossing or standing within a certain zone);

— charging based on a continuous measurement (duration or distance).

The following are examples of discrete (event-based) toll schemes.

— Single object charging: a road section, bypass, bridge, tunnel, mountain pass or even a ferry, charged per passage; ~~most tolled bridges belong to this category.~~

EXAMPLE 1 Most tolled bridges belong to this category.

— Closed road charging: a fixed amount is charged for a certain combination of entry and exit on a motorway or other closed road network.

EXAMPLE ~~1~~2 Many of the motorways in Southern Europe belong to this category.

— Discrete road links charging: determined by ~~usage~~use of specified road links, whether or not ~~they~~are used in their entirety.

EXAMPLE ~~2~~3 Heavy goods vehicle (HGV) charge in Germany.

— Charging for cordon crossing: triggered by passing in or out through a cordon that encircles a city core, for example.

EXAMPLE ~~3~~4 Congestion and infrastructure charging schemes in Stockholm and Gothenburg (Sweden).

The following are examples of continuous toll schemes.

— Charging based on direct distance measurement: defined as an amount per ~~kilometre~~km driven.

EXAMPLE ~~4~~5 HGV charge in Switzerland and US basic vehicle miles travelled toll systems concepts.

— Charging based on direct distance measurement in different tariff zones or road types: defined as an amount per ~~kilometre~~km driven, with different tariffs applying in different zones or on

different road types. This is a widely discussed approach, also known as time-distance-place charging, and is under consideration in European countries.

EXAMPLE 56 OReGO, the pilot programme in Oregon, North America.

— Time in use charge: determined by the accumulated time a vehicle has been in operation, or, alternatively, by the time the vehicle has been present inside a predefined zone.

In all of these toll schemes, tolls may additionally vary as a function of vehicle class characteristics (such as trailer presence, number of axles, taxation class, and operating function,) and depending on time of day or day of week, such that, for example, tariffs are higher in rush hour and lower on weekends.

With this degree of complexity, it is not surprising to find that the attempts to evaluate and compare technical solutions for SU charging have been made on an individual basis each time a procurement or study is initiated, and with only limited ability to reuse prior comparisons made by other testing entities.

The identification of different types of schemes as proposed in the ISO 17575 (all parts) series and their grouping in the mentioned two classes is described in Table 1, which Table 1. Table 1 also identifies the examples mentioned above.

Table 1 — Toll scheme designs grouped according to scheme categories

Examples	Scheme type	ISO 17575 <u>series</u> category
Single object charging	Discrete	Sectioned roads pricing
Closed road charging	Discrete	Sectioned roads pricing
Discrete road links charging	Discrete	Sectioned roads pricing
Charging for cordon crossing	Discrete	Cordon pricing
Time in use charge	Continuous	Area pricing — time
Cumulative distance charge	Continuous	Area pricing — distance
Charging for cumulative distance in different zones (or by road type)	Continuous	Area pricing — distance

0.3 Examination framework

The examination framework that is defined in this document is designed for measuring the metrics defined in 6-Clause 6. The general aim is to achieve a maximum comparability and reproducibility of the results without restricting the technological choices in system design. Specific examination frameworks may be defined for the Evaluation evaluation and Monitoring Phases monitoring phases of a project due to the differences in the availability of equipped vehicles.

a) Evaluation phase

~~This~~The evaluation phase encompasses system evaluation and selection, as well as commissioning and ramp-up during implementation. Important aspects of this phase are:

- relatively small sample sizes; and
- well controlled behaviour of test vehicles.

b) Monitoring phase

After the system has gone into operation, its behaviour needs to be monitored for several reasons, such as fine-tuning of the system performance, monitoring of service level agreements (SLAs) between contractual partners (supplier, TC, TSP, etc.). In this phase, the following system aspects can be expected:

- very large sample sizes possible, but with unknown behaviour of the vehicles;
- in principle all measurements from implementation phase possible, too.

Readers Guide

0.4 Reader's guide

To understand the content of this document, the reader should be aware of the methodology and assumptions used to develop the examination framework; therefore, a suggested reading order is given below.

- a) ~~Informative Annex Ba)~~ Annex B provides details of the underlying considerations for developing the examination framework.
- b) ~~Informative Annex Cb)~~ Annex C provides background statistical information which will enable the reader to determine sample sizes and confidence limits based on the defined performance requirements.
- e) ~~5c)~~ Clause 5 provides the definition of the examination framework for the evaluation of charging performance.
<https://standards.iteh.ai/catalog/standards/sist/12998279-2009-4082-ac0f->
- d) ~~6d)~~ Clause 6 provides definitions of charging ~~matrices~~metrics and their applicability to the scheme types described above.
- e) ~~7e)~~ Clause 7 contains the toolbox of examination tests for the evaluation of charging performance for the identified scheme types.
- f) ~~Informative Annex Af)~~ Annex A contains an example template for the documentation of examination tests and their results.
- g) ~~Informative Annex Dg)~~ Annex D contains methods which can be used to reduce the required sample sizes for metrics with high and low probabilities during the evaluation phase.
- h) ~~Informative Annex Eh)~~ Annex E provides examples of specific examination frameworks which have been developed in accordance with the methodology in 5.2.5.2.

Electronic fee collection – Charging performance framework

1 Scope

This document defines the charging performance metrics to be used during ~~the~~ evaluation or on-going monitoring of an electronic fee collection (EFC) system and the examination framework for the measurement of ~~said~~these metrics.

It specifies a method for the specification and documentation of a specific examination framework which can be used by the responsible entity to evaluate charging performance for a particular information exchange interface or for overall charging performance within a toll scheme.

The following scheme types are ~~in~~within the scope of this document:

- a) ~~Discrete~~discrete schemes;
- b) ~~Continuous~~continuous schemes (autonomous type of systems).

This document defines measurements only on standardized interfaces.

This document defines metrics for the charging performance of EFC systems in terms of the level of errors associated with charging computation.

This document describes a set of metrics with definitions, principles and formulations, which together make up a reference framework for the establishment of requirements for EFC systems and ~~their later~~the subsequent examination of ~~the~~ charging performance.

This document defines metrics for the following information exchanges:

~~Charge~~charge reports (including usage evidence);

~~Toll~~toll declarations;

~~Exception~~exception lists;

~~Billing~~billing details and associated event data;

~~Payment~~payment claims on the level of service user accounts;

~~End~~end-to-end metrics which assess the overall performance of the charging process.

~~They~~These metrics focus solely on the outcome of the charging process, i.e. the amount charged in relation to a pre-measured or theoretically correct amount, rather than intermediate variables from various components as sensors, such as positioning accuracy, signal range, or optical resolution. This approach ensures comparable results for each metric in all relevant situations.

The following aspects are outside the scope of this document.

- ~~—~~ Definition of specific numeric performance bounds, or average or worst-case error bounds in percentage or monetary units.
- ~~—~~ Specification of a common reference system which would be required for comparison of performance between systems.