Introduction to standards on electronic fee collection (EFC)

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Outline

1. Introduction to standards

2. Introduction to EFC standardization

- 1. Scope, principles and use
- 2. System architecture
- 3. DSRC-based EFC
- 4. GNSS-based EFC
- 5. Info exchanges between Toll Charger and Service Provider
- 6. Integrated circuits cards (ICC)-related standards
- 7. Security
- 8. Test suites for conformance assessment and examination frameworks
- 9. Summary

Annex – Published EFC CEN/ISO documents

1. Introduction to standards





1) Introduction to standards



What is a standard?

- A document approved by a recognized standardization body (CEN, ISO,..)
- Intended to be used repeatedly, creating synergies and reducing costs
- Transparency and broad consensus
- Rely mainly on voluntary contributions
- Maintained to keep abreast with market developments and technology advancements
- Voluntary in application, supports agreements





1) Introduction to standards

Role and benefits of standards





1) Introduction to standards

Development of standards follows structured and formal procedures



- Proceeds directly to publication if approved at the Enquiry stage
- Formal Vote version is technically identical to the approved published version



1) Standards, laws and specifications

Standards are not laws

- Facilitate agreements
- Sometimes referred in legislation (i.e. 8 CEN EFC standards are referred to in the EU legislation on the European electronic toll service (EETS))
- Sometimes referred to as part of legislation (i.e. 8 CEN EFC standards are referred to in the EU legislation on the <u>European electronic toll service (EETS)</u> respectively its <u>Delegated Act</u> and its <u>Implementing Act</u>)

Standards are more stable than (project) specifications

- Structured decision-making and voting procedures
- Clear ownership of documents
- Handling of comments, revision and corrections
- Often referred to in public procurements
- Test standards often complement "requirements standards" for conformity evaluation

2. Introduction to EFC standardization





2.1) Overall scope of EFC standardization

- Fee collection (as opposed to fare collection)
- 50+ published standards, technical specifications and technical reports
- EFC system architecture, vocabulary, data dictionary
- Information exchanges for charging and compliance checking
 - DSRC-based systems (DSRC ... Dynamic Short Range Communication)
 - GNSS-based systems (aka autonomous-based systems) (GNSS ... Global Navigation Satellite System)
 - Systems using automatic number plate recognition (ANPR) technologies
 - Systems using integrated circuit cards (ICCs)
- Security of EFC systems and interfaces
- Test standards for conformance assessment and examination frameworks certification and homologation
- For overview: <u>www.itsstandards.eu/25-2/wp-1/</u>



2.1) Principles for EFC standardization

- Goal
 - Create and ensure the long-term stability of the EFC ecosystem
 - Support agreement, open market and interoperability
- Mainly technical standardization (not services)
- Focusing on interfaces between roles and sub-systems (not on the internal interfaces)
- Main differences between DSRC-based and GNSS-based EFC
 - No fixed charging infrastructure (but fixed and movable enforcement systems)
 - Greater variety between GNSS-based schemes in the allocation of functionality between on-board equipment (OBE) and back-office systems
 - Greater variety between GNSS-based schemes in the use of communication media between OBE and backoffice systems



2.1) What kind of support do EFC standards provide?

Framework standards

• Common understanding, scoping, architecture, data dictionary, terms etc.

Technical toolbox standards

- Necessary but not sufficient basis for compatibility
- Why? Changing needs, technological developments, lack of common view, different needs of stakeholder
- E.g. EN ISO 14906 "Application interface definition (AID) for DSRC"

Profile standards

- Coherent selection of choices in underlying toolbox standards for compatibility and interoperability
- Based on common policies and services agreed by key stakeholders
- E.g. EN 15509 "Interoperability application profile (IAP) for DSRC"
- Test standards
 - Conformity evaluation of implementation to standard specification
 - E.g. EN 15876 test standard "Evaluation of on-board and roadside equipment for conformity to EN 15509"
- Maintenance of standards



2.1) Who is involved in EFC standardization?





All key stakeholders actively involved

- Involved stakeholders: TCs, TSPs, Technology Providers and Public Authorities
- Active: Europe, Japan, South Korea, South Africa
- Ad-hoc : Singapore, India, China, Russia, US, ... with different agendas
- 35 active experts, 17 countries



2.2) EFC system reference architecture - the 17573 series

Objectives

 Reference architecture to ensure a common understanding and consistent usage across EFC standards

Parts

- Part 1: Reference architecture model; Enterprise viewpoint, service action diagrams, identification of interfaces and information exchanges subject to EFC standardization
- Part 2: Vocabulary of 230+ terms
- Part 3: Data dictionary with 100+ data types and semantics in accordance with ASN.1



3.35 charge report

information containing road usage and related information originated at the *front end* (3.85)

Table 4 —Axles

| Subtype | Parent type | Semantics |
|---------|-------------|---|
| - | INTEGER | Axles provides the number of axles of either the tractor or trailer including drop axles. |



2.2) EFC system architecture (17573-1)

Objectives

- Overall system reference architecture for EFC systems
- Common technical understanding

Scope

- System architecture and interfaces, roles and responsibilities
- Use diagrams for typical scenarios (mngt of charges, claim and payment settlement ...)





2.2) EFC system architecture – Enterprise objects



2.2) EFC system architecture – Enterprise viewpoint

2.2) EFC system architecture – Engineering viewpoint

2.3) DSRC-based EFC

2.3) EFC AID for DSRC (14906)

Scope

- Transaction model
- 16 functions (e.g. "read", "write")
- 46 data sets (contract, vehicle, payment, receipt etc)
- Basis for defining transactions, with one example from the CARDME project

Impact

- Harmonized OBE, basis for national / international tolling service
- 150 million compliant OBE and 70 thousand RSE

2.3) CEN DSRC 5,8 GHz suite

Complete set of <u>DSRC 5,8 GHz standards</u>

- Single and high-speed multi-lane tolling
- High reliability, fast connection and low latency
- Small service areas to facilitate compliance checking
- Inexpensive end-user technology

Impact: single open market

Adopted in EU regulations

- European electronic toll service (EETS, <u>Directive 2019/520</u>)
- Tachographs in road transport (Regulation No 165/2014)
- Max authorized dimensions and weights for road motor vehicles (Directive 2015/719)

2.3) ETSI DSRC test standards

Electromagnetic compatibility and radio spectrum matters - DSRC transmission equipment operating in the 5.8 GHz band (EN 300 674)

- Part 1: General characteristics and test methods for RSU and OBU
- Part 2: Harmonised EN for RSU (sub-part 1) and OBU (sub-part 2) under the "Spectrum article" of the Radio Equipment Directive (RED)

Impact

- DSRC equipment must meet the "essential requirements" to be placed on the European market (indicated by CE marking)
- Compliance to part 2 gives presumption to conformity to the "essential requirements"

| | CEN DSRC Standards / ETSI test specifications |
|-----------|---|
| Toolboxes | CEN EN 12834 Application layer |
| | CEN EN 12795 Data link layer |
| | CEN EN 12253 Physical layer |
| Profiles | CEN EN 13372 Profiles |
| Tests | ETSI TS 102 486-2 Tests against 12834 Application layer [Protocol Implementation Conformance Statement] [Test Suite Structure and Test Purposes] [Abstract Test Suite] |
| | ETSI TS 102 486-1 Tests against 12795 Data link layer [Protocol Implementation Conformance Statement] [Test Suite Structure and Test Purposes] [Abstract Test Suite] |
| | ETSI EN 300 674-1 Physical layer tests against 12253 |
| | ETSI 300 674-2-1/2 Physical layer tests covering the essential requirements of the European Radio Directive [RSU] [OBU] |

2.3) European interoperability application profile (15509)

Objectives

- Interoperability, equipment compatibility, best industry practice
- Support the European Electronic Toll Service (EETS) legislation

Scope

- DSRC requirements
- EFC functions, data and security
- Implementation conformance statement (ICS) proforma
- Use of this standard for the EETS, incl relationship to the requirements of EETS legislation

2.3) IAP for DSRC

2.4) GNSS-based EFC

2.4) AID for GNSS-based EFC (17575 suite)

Objectives

- Support collection of charges for road usage section, areas and cordon-based schemes modulation of fees
- Support different scheme architecture (thin and smart OBE clients)

Parts

- Part 1: Charging
- Part 2: Communication and connection to the lower layers
- Part 3: Context data

Limited relevance for the EETS as it specifies a Toll Service Provider "internal interface"

2.4) Compliance checking of the user (12813)

Objectives

- Compliance checking of the user
 - whether the OBE is mounted in the correct vehicle
 - the vehicle classification data transmitted by the OBE
 - the OBE working condition (technical and contractual)
- Support the EETS

Scope

- Data definitions according and in addition to the "EFC data dictionary" (17573-3)
- Security concept same as in "IAP for DSRC" (15509)
- Supports CEN DSRC, CALM, UNI DSRC and IEEE Wave comm standards
- Implementation conformance statement (ICS) proforma

The 13143-test standard can be used to evaluate the conformance of an implementation to 12813

2.4) Localisation augmentation support (13141)

Objectives

- Localisation augmentation support
- Support the EETS

Scope

- Location reference data
- Data origin authentication, integrity and non-repudiation
- Supports CEN DSRC, CALM, UNI DSRC and IEEE Wave comm standards
- Implementation conformance statement (ICS) proforma

The 13140-test standard can be used to evaluate the conformance of an implementation to 13141

2.4) Secure monitoring - Compliance checking (16702-1)

Objectives

 Support for the Toll Charger to check the trustworthiness of the toll declarations from the Toll Service Provider whilst respecting the privacy of the user

Scope

- Secure monitoring concept
- Transactions and data
- Uses and builds onto other EFC standards (12813, 12855, 17575-1...)

2.4) Secure monitoring - Trusted recorder (16702-2)

Objectives

 Support for the Toll Charger to check the trustworthiness of the toll declarations from the Toll Service Provider whilst respecting the privacy of the user

Scope

- Secure monitoring concept and stake holder requirements
- Transactions and data
- Uses and builds onto other EFC standards (16702-1, 19299, 12813, 12855, 17575-1...)

2.5) Info exchanges between Toll Service Provider (TSP) and Toll Charger (TC) (12855, toolbox)

Objectives: Support for cost-effective integration of back-office systems

2.5) Example of data flow based on 12855 (toolbox)

2.5) European interoperability profile for info exchanges between TSP and TC (16986)

Objectives

Support interoperability and the EETS

Scope

- Definitions of profiles by coherent selection of choices in the underlying 12855 toolbox standard
 - Section discrete profile
 - Section autonomous profile
 - Meshed discrete profile
 - Area distance autonomous profile

Figure 5 — Restrictions to the base standard

2.6) EFC integrated circuit(s) cards-related standards

2.6) Interface for on-board account using ICC (25110)

Objectives

• Support EFC on-board account charging using ICC

Scope

- DSRC ICC interface protocol bridge / "extension of 14906"
 - Transparent and buffering type (bridge 1)
 - Cashing type (bridge 2)
- Reference model for on-board account system
- Command definitions RSE OBE

Referenced toolbox standards

- EN ISO 14906 (EFC API)
- ISO 7816 suite (contact card)
- ISO 14443 suite (contactless card)
- EN 1545 suite (surface transport applications data elements)

2.7) EFC security

2.7) Security framework (19299)

Objectives

- Security framework
- Support for the EETS

Scope

- Threat analysis asset-based and attack-based assessment
- Requirements specification
- Security measures focusing on the interoperable interfaces
- Trust model and basic key management requirements

2.7) Guidelines for security protection profiles (17574)

Objectives

- Preparation & evaluation of security requirements
- Based on IT security standards
 - Evaluation security criteria 15408
 - Protection profiles 15446
- Product-oriented

Scope

- Guide operators to prepare their PP
- "Best practice" through international registrations of PP
- Japanese OBU used as an example

2.8) Test standards and examination frameworks

2.8) Test suites for conformity assessment

Objectives

- Support evaluation of implementation for conformity assessment to the associated requirements standards
- Comparability of results from tests performed at different places and times
- Facilitate communications between parties

Test standards

- 14907-2: OBU testing against 14906 ("AID for DSRC")
- 15876: OBE and RSE testing against 15509 ("IAP for DSRC")
- 13143: OBE and RSE testing against 12813 ("CCC")
- 13140: OBE and RSE testing against 13141 ("LAC")
- 16407, 16401 & 16410 test suites: Testing against 17575 ("AID for GNSS-based EFC systems")

2.8) Test procedures user and fixed equipment (14907-1)

Scope and usage

- Defines test procedures and a test plan
- Useful when defining
 - Type approval tests
 - System acceptance tests
 - Prototype tests
- Outside the scope
 - Equipment in the central system and all equipment used for enforcement (e.g. detection, classification, localization and registration)
 - Benchmark figures

2.8) Charging performance framework (37444)

Objective

• Evaluation of charging performance for discrete and continuous charging schemes to support procurement and service level agreements

Scope

- Charging performance metrics and examination framework
 - Charge reports
 - Toll declarations
 - Billing details
- Invoicing accuracy on the level of user accounts
- Outside the scope
 - Specific numeric performance bounds, average and worst-case error bounds
 - Evaluation of the expected performance of a system based on modelling

2.9) Summary

50+ CEN/ISO EFC standard deliverables

- DSRC-based EFC standards
- GNSS-based EFC
- Information exchanges between Service Provision and Toll Charging

Current focus

- Revision of standards for back-office exchanges (12855 / 16986) extension to support ANPR
- Pre-studies and Technical reports analysis of emerging needs, trends and road maps
 - Integration with related ITS-areas (common payment, traffic management)
- Maintenance of standards. Widespread use of EFC-standards in systems -> plenty of feedback to update standards. Support relevant activities to ensure long-term suitability of DSRC tolling technology

Annex – Published EFC CEN/ISO documents

Annex - Overview of EFC Standards and Technical Specifications

| | DSRC & SRD-based EFC | Technology independent | Autonomous EFC |
|------------|---|---|---|
| Frameworks | CEN ISO/TS 21719-1 OBE personalization | EN ISO 17573-1 Architecture | |
| | | ISO/TS 17573-2 Vocabulary | |
| | | EN ISO 17573-3 Data dictionary | |
| | | CEN ISO/TS 17574 Security Profiles | |
| | | EN ISO 19299 Security framework | |
| Toolboxes | EN ISO 14906 DSRC application interface | EN ISO 12855 Info exchange between Service | ISO 17575 Application interface |
| | ISO 25110 ICC application interface | provision and Toll charging | definition for autonomous systems |
| | ISO/TS 16785 Interface between OBE and external | CEN ISO/TS 37444 Charging performance | CEN/S 16702 Security monitoring |
| | in-vehicle devices | ISO/TS 21192 EFC for traffic management | |
| | CEN ISO/TS 21719-2/3 OBE personalization using DSRC and ICC | ISO/TS 21193 EFC using common media | |
| Profiles | EN 15509 Interoperability application profile for DSRC | prEN 16986 Interoperable application profiles for info exchange between Service provision and Toll charging | EN ISO 12813 Compliance check communication (CCC) |
| | | | EN ISO 13141 Localisation augmentation communication (LAC) |
| Tests | EN ISO 14907-1 Test procedures for user and fixed | CEN/TS 17154-1 Tests against 16986 | ISO 16407 Testing against 17575-1 |
| | equipment | | ISO 16410 Testing against 17575-3 |
| | EN ISO 14907-2 Testing against 14906 | | EN ISO 13140 Testing against 13141 |
| | EN 15876 Testing against 15509 | | EN ISO 13143 Tests against 12813 |

Annex - Overview of EFC Technical Reports

| DSRC & SRD-based EFC | Miscellaneous | Autonomous EFC |
|--|---|--|
| CEN/TR 16040 Urban DSRC CEN/TR 16968 Security assessment TC278 N318 DSRC requirements TC278 N779 ICC requirements | CEN ISO/TR 6026 Pre-study on the use vehicle license plate information and ANPR technologies CEN/TR 17546 EETS gap analysis and roadmap CEN/TR 16092 Pre-payment systems CEN/TR 16152 First mount OBE CEN/TR 16152 First mount OBE CEN/TR 16219 Value added services EFC OBE CEN/TR 16690 EFC on ITS stations ISO/TR 19639 Common payment schemes ISO/TR 21190 Investigation of charging policies and technologies for future standardization TC278 N278 Integration of payment systems for transport services TC278 N780 Threats and security controls | ISO 16401 Testing against 17575-2 TC278 N798 Requirements for autonomous EFC systems |

Annex - Published EFC documents (1) - Technology independent

| EN ISO 17573-1:2019 | EFC - System architecture for vehicle-related tolling - Part 1: Reference model |
|---------------------|---|
|---------------------|---|

- ISO/TS 17573-2:2020 EFC System architecture for vehicle-related tolling Part 2: Vocabulary
- EN ISO 17573-3:2023 EFC System architecture for vehicle-related tolling Part 3: Data dictionary
- EN ISO 12855:2022 EFC Information exchange between service provision and toll charging
- CEN/TS 16986:2016/AC:2017 EFC Interoperable application profiles for information exchange between Service Provision and Toll Charging
- CEN/TS 17154-1:2019 EFC Conformity evaluation of implementation to CEN/TS 16986 Part 1: Test suit structure and test purposes
- CEN ISO/TS 37444:2023 EFC Charging performance framework

EN ISO 19299:2020 EFC - Security framework

Annex - Published EFC documents (2) - Technology independent

CEN ISO/TR 6026:2022 EFC - Pre-study on the use of vehicle licence plate information and automatic number plate recognition (ANPR) technologies

ISO/TS 21192:2019 EFC - Support for traffic management

CEN/TR 16092:2011

CEN/TR 16152:2011

CEN/TR 16219:2011

CEN/TR 17546:2020

ISO/TR 21190:2018

CEN/TR 16690:2014

ISO/TR 19639:2015

ISO/TS 21193:2019 EFC - Requirements for EFC application interfaces on common media

- CEN ISO/TS 21719-1:2018 EFC Personalization of on-board equipment Part 1: Framework
 - EFC Requirements for pre-payment systems
 - EFC Personalisation and mounting of first mount OBE
 - EFC Value added services based on EFC on-board equipment
 - EFC EETS gap analysis and proposed standards roadmap
 - EFC Investigation of charging policies and technologies for future standardization
 - EFC Guidelines for EFC-applications based on in-vehicle ITS Stations

EFC - Investigation of EFC standards for common payment schemes for multi-modal transport services

Annex - Published EFC documents (3) - DSRC-based EFC

| EFC - application interface definition for DSRC |
|---|
| EFC - Test procedures user and fixed equipment - Part 1: Description of test procedures |
| EFC - Test procedures user and fixed equipment - Part 2: Conformance test for the on-board unit application interface |
| EFC - Interoperable application Profile for DSRC |
| EFC - Evaluation of on-board and roadside equipment for conformity to EN 15509 |
| EFC - Interface definition between DSRC-OBE and external in-vehicle devices |
| EFC - Interface definition for on-board account using ICC |
| EFC - Personalization of on-board equipment - Part 2: Using DSRC |
| EFC - Personalization of on-board equipment - Part 3: Using integrated circuit(s) cards |
| EFC - Requirements for urban DSRC systems |
| EFC - Assessment of security measures for applications using DSRC |
| |

Annex - Published EFC documents (4) - Autonomous-based EFC

ISO 17575-1:2016 EFC - Application interface definition for autonomous systems - Part 1: Charging

ISO 17575-2:2016 EFC - Application interface definition for autonomous systems - Part 2: Communication and connection to the lower layers

ISO 17575-3:2016 EFC - Application interface definition for autonomous systems - Part 3: Context data

ISO 16407-1:2017 EFC - Evaluation of equipment for conformity to ISO 17575-1 - Part 1: Test suite structure & test purposes

ISO 16407-2:2018 EFC - Evaluation of equipment for conformity to ISO 17575-1 - Part 2: Abstract test suite

ISO/TR 16401-1:2018 EFC - Evaluation of equipment for conformity to ISO/TS 17575-2 - Part 1: Test suite structure & test purposes

ISO/TR 16401-2:2018 EFC - Evaluation of equipment for conformity to ISO/TS 17575-2 - Part 2: Abstract test suite

ISO 16410-1:2017 EFC - Evaluation of equipment for conformity to ISO 17575-3 - Part 1: Test suite structure & test purposes

ISO 16410-2:2018

EFC - Evaluation of equipment for conformity to ISO 17575-3 - Part 2: Abstract test suite

Annex - Published EFC documents (5) - Autonomous-based EFC

| EN ISO 12813:2019 | EFC - Compliance check communication |
|----------------------------|--|
| EN ISO 13143-1:2020 | EFC - Evaluation of on-board and roadside equipment for conformity to ISO 12813 - Part 1: Test suite structure and test purposes |
| EN ISO 13141:2015/Amd 1:20 | 017 EFC - Localisation augmentation communication |
| EN ISO 13140-1:2016 | EFC - Evaluation of on-board and roadside equipment for conformity to ISO 13141 – Part 1: Test suite structure and test purposes |
| CEN/TS 16702-1:2020 | EFC - Secure monitoring for autonomous toll systems - Part 1: Compliance checking |
| CEN/TS 16702-2:2020 | EFC - Secure monitoring for autonomous toll systems - Part 2: Trusted recorder |
| CEN ITR | Application requirements for EFC systems based on GNSS/CN (CEN/TC278 N798, 1997-11) |

Want to know more or participate?

Co-ordination of EFC standardization in ISO/TC 204/WG 5 and CEN/TC 278/WG 1

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