



Technical Specification

ISO/TS 21193

Electronic fee collection — Requirements for EFC application interfaces on common media

*Perception de télépéage — Exigences relatives aux interfaces
d'application de télépéage sur média commun*

**Second edition
2024-11**

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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 document 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).

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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*.

This second edition cancels and replaces the first edition of ISO/TS 21192:2019, which has been technically revised.

The main changes are as follows:

- [Clause 3](#) has been updated and ISO/TS 17573-2 has been made the primary source for terms and definitions;
- data definitions have been updated, including referring to ISO 17573-3 as the primary source;
- ISO 21177 is now referenced for inclusion of secure data transfer mechanism in [subclause 7.1](#);
- the data elements that originated from EN 1545-2:2015 are formally defined in the ASN.1 module.

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

Transportation network improvement, including road and railway, is essential to drive economic growth. Integrated transport service has been aimed at topics such as user convenience, transport safety, reliability, efficiency and availability. For example, a traffic manager can find which kinds of improvements are needed to relieve traffic bottlenecks by analysing user transport flows in a transport system considered as a whole.

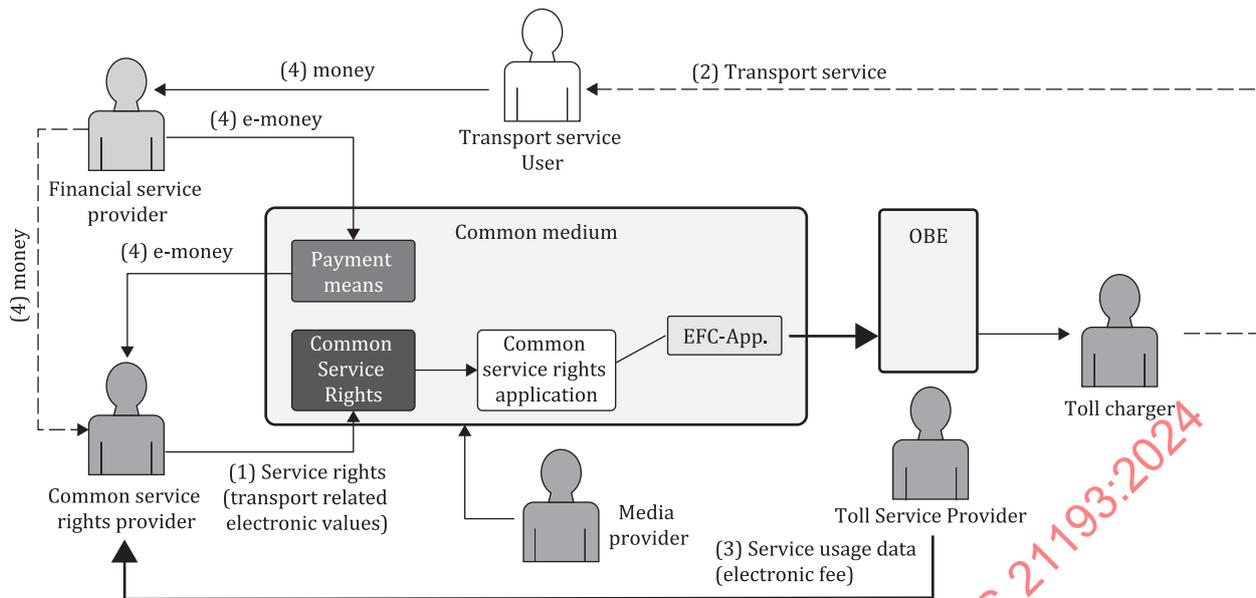
It is usually necessary to use different transport services to transfer people or goods from origin to destination. Sometimes, using different transport services in the same trip becomes cumbersome when transport services are operated by different operators, e.g. bad interconnections between different transport modes due to user needs to search and compare transportation modes, need for separate charging or payment for the transport services used. The connections between different transport modes and the means to achieve seamless travel are improving with the use of information and communication technologies (ICT).

ISO/TR 19639 investigated case studies on the use of a common payment medium when combining public transport services and road services, based on the use of a common payment schema. This common payment schema is further categorised into integrated central accounts and integrated on-board accounts.

ISO/TR 19639 concluded by stating the need for new electronic fee collection (EFC) standards to support on-board integrated accounts, among which is an application interface between the common payment medium and the common service rights provider (CSRP). The background of on-board accounts in EFC are as follows.

- Operational methods of EFC systems might be different due to regional and local circumstances. EFC systems can be classified into central accounts and on-board accounts, using a common payment medium, which are widely adopted in Asian countries.
- On-board account payment media are commonly used for public transport in several countries, e.g. Singapore, Malaysia and China.
- Central payment accounts are considered one of the common service rights methods explained in ISO/TR 20526, whereas the EFC standards are currently predominantly based on central accounts.
- A convergence on the usage of on-board account for both EFC systems and public transport should be considered.

This document describes an EFC application as one type of transport service specific application and the application interface requirements for a common service rights application. A common service rights application is explained in informative [Annex C](#) of this document for understanding a common payment scheme based on this concept as shown in [Figure 1](#).



NOTE 1 Arrowed lines (4) labelled 'money' and 'e-money' are monetary flows that are outside the scope of this document.

NOTE 2 Arrowed line (2) labelled 'Transport service' is not an ICT interface but a physical transport service.

NOTE 3 Other arrowed lines are in the scope of ISO/TC 204 (EFC and public transport standards) and the thick arrow line between common payment medium and OBE is within the scope of this document.

Figure 1 — Common payment medium concept for EFC scheme

This document extends the set of EFC standards to allow provisions for multi-modal transport services by using a common payment medium.

This document defines, among others, the role and responsibilities of a CSRP. The CSRP provides a common payment medium for enabling use of EFC, a public transport service and retail shopping service to service users with one account. CSRP may provide the usage record of user's multi-modal transport trip as a form of customer service.

This document contains several annexes.

- Data type specifications are given in the [Annex A](#), an implementation conformance statement (ICS) proforma is given in [Annex B](#).
- The common payment medium concept for any transport service is presented in the [Annex C](#).
- General types of application structures in a medium are presented in the [Annex D](#).
- General requirements from medium relating standards are presented in [Annex E](#).
- A typical system migration method and technical solution supporting medium upgrading are presented in [Annex F](#). Examples of reloading types and transactions are presented in [Annex G](#).
- The EFC security requirements for a common payment medium are presented in [Annex H](#) based on EFC functional requirements.

The scope of this document includes an EFC application interface for a common payment medium as shown in [Figure 2](#), as well as the role and responsibilities of a CSRP.

[Figure 2](#) explains the relation of CSRP among related sectors including EFC. E-money is exchanged between the Transport Service Provider (TSP) in the EFC sector and the CSRP. E-money is exchanged between retail in the commerce sector and the CSRP.

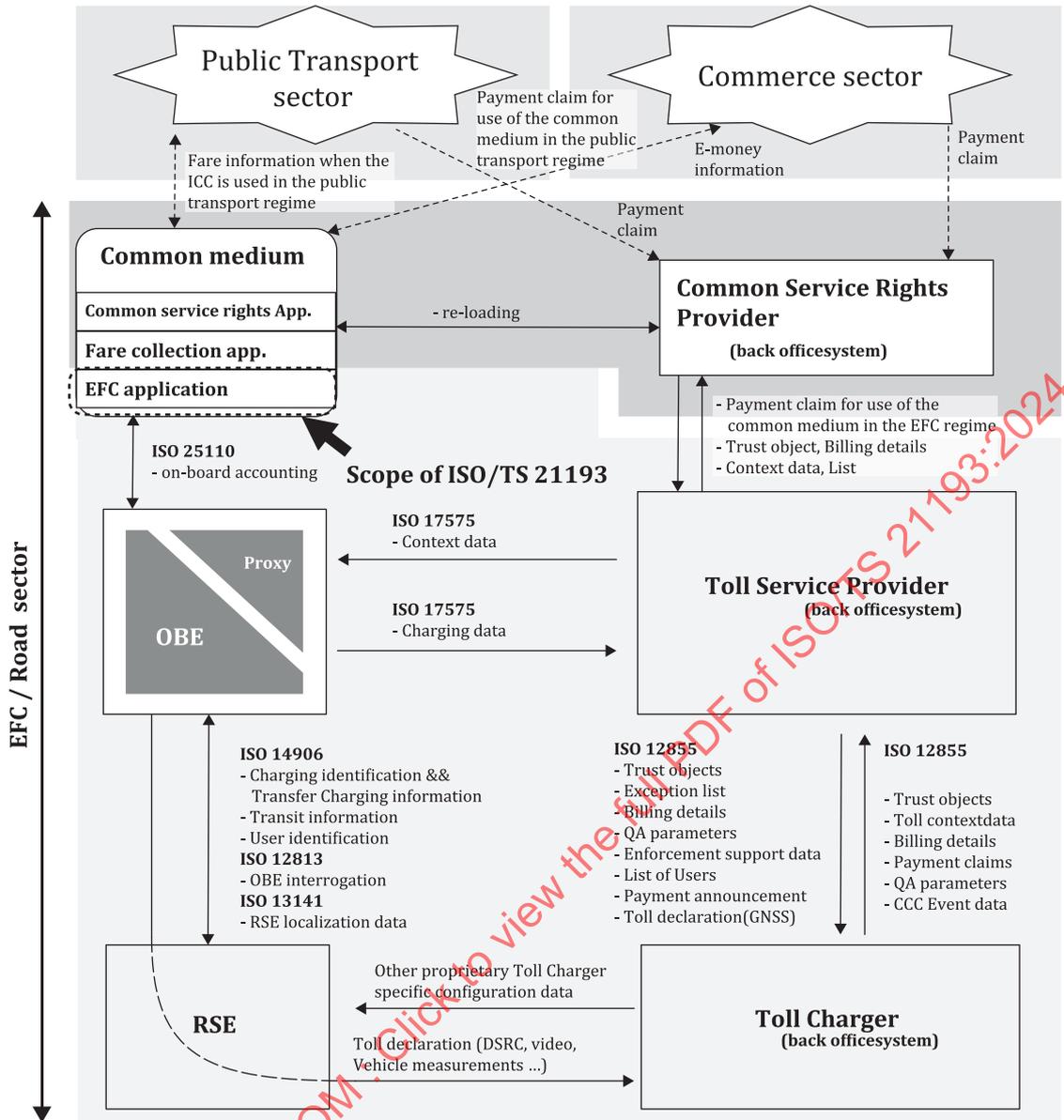


Figure 2— Scope within the EFC computational architecture

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Electronic fee collection — Requirements for EFC application interfaces on common media

1 Scope

This document defines requirements to support information exchanges among related entities of a common payment scheme. It defines:

- a) EFC-related functional requirements for a common payment medium;
- b) an application structure in a common payment medium;
- c) EFC application data in a common payment medium.

The following is outside the scope of this document:

- requirements and data definitions for any other transport services such as public transport;
- a complete risk assessment for an EFC system using a common payment medium;
- security issues arising from an EFC application among all transport services;
- the technical trust relationship between a CSRP and a service user;
- concrete implementation specifications for implementation of security for an EFC system;
- detailed specifications required for privacy-friendly EFC implementations;
- any financial transactions of the CSRP.

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

ISO 17573-1, *Electronic fee collection — System architecture for vehicle-related tolling — Part 1: Reference model*

ISO/TS 17573-2, *Electronic fee collection — System architecture for vehicle related tolling — Part 2: Vocabulary*

ISO 17573-3, *Electronic fee collection — System architecture for vehicle-related tolling — Part 3: Data dictionary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 17573-2 and the following term and definition 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 <https://www.electropedia.org/>

**3.1
common service rights provider
CSRP**

entity providing *common service rights* to the service user

4 Abbreviated terms

CSR	Common Service Rights
CSRP	Common Service Rights Provider
DSRC	Dedicated Short-Range Communications
EFC	Electronic Fee Collection
ETC	Electronic Toll Collection
ICT	Information and Communication Technologies
OBE	On-Board Equipment
PCI DSS	Payment Card Industry Data Security Standard
PT	Public Transport
RSE	Roadside Equipment
SAM	Secure Application Module
SLA	Service Level Agreement
SU	Service User
TC	Toll Charger
TSP	Transport Service Provider

5 Requirements for a common payment medium

5.1 Requirements for EFC architecture

Any EFC architecture using a common payment medium shall conform with the EFC Roles model defined in ISO 17573-1. The relation of role and responsibility of the "Provision of common service rights" and the EFC role model described in ISO 17573-1 is shown in [Figure 3](#) when enabling interoperability with any transport services. The role of CSRP includes a part of EFC function for EFC regime. As an example, the EFC transaction data described in ISO 14906 and ISO 17575-1 includes account information stored in the common payment medium. The EFC role model belongs to the tolling domain and the "Provision of the common service rights" role belongs to another domain, but the two domains are linked together by the use of common service rights in EFC.

NOTE ISO 17573-1 explains how any EFC-specific common payment medium is used when there is no interoperability with other transport services.

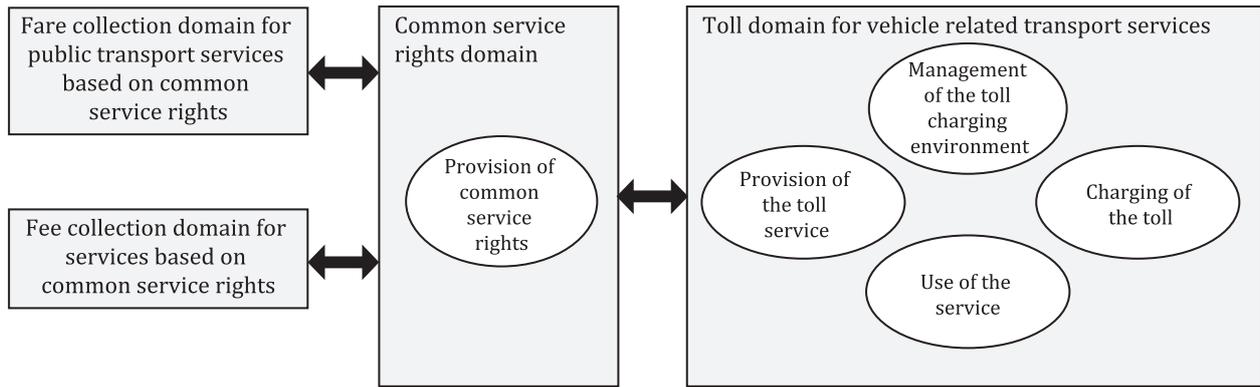


Figure 3 — EFC role model with provision of common service rights

The role related to CSRP is responsible for providing the basic provision, mechanism, organizational structure, and information transfer tools needed to integrate an interoperable EFC system into a multi-modal transport system.

Responsibilities related to this role are only restricted to CSRP and include:

- providing basic provision, including
 - providing a common payment medium,
 - guaranteeing that the entity performing the charging of the transport service rights role will be paid for it,
 - providing the common service rights to the user or accepting an existing one,
 - collecting the money from the signatory of the EFC service contract and performing reloading transaction for common payment medium,
 - collecting all transport service transactions, clearing and distributing the money to the Transport Service Provider (TSP),
 - managing the customer relationships related to the use of the transport service concerning information, claims, questions and answers, error handling and any contractual or financial matters,
 - implementing and adhering to the security and privacy policies for the transport systems, and
 - monitoring the actual operational quality relative to agreed service level agreements (SLAs);
- acting as a contract agent, including
 - offering contractual relations according to defined conditions to interested users and concluding contractual agreements,
 - The user's needs to contract both use of OBE and use of common payment medium for EFC service.
 - providing and managing the transport service contract including the service rights for the toll service user;
- customizing the common payment medium, including customizing the common payment medium in a secure way;
- maintaining the common payment medium, including
 - maintaining the functionality of the common payment medium,
 - maintaining the hot listing of the common payment medium, and

- performing the refund of values stored on the common payment medium.

A CSRП may make requirements to the TSP such as protecting some data, security keys and others.

5.2 EFC functional requirements

While an OBE is generally related to a vehicle, a common payment medium can be carried by the owner or user also for use outside a vehicle. This means that the common payment medium should be considered from the following points of view:

- enabling the use in all transaction models, for payment modes (pre-pay or post pay or both modes) and applying security requirements;
- enabling the use of the EFC service with an OBE;

NOTE Enabling flexible EFC operation both with OBE and without OBE.

- enabling confirmation of account information and usage record of service as basic user services.

Based on these viewpoints, requirements are derived for support of a common payment medium, as shown in [Table 1](#).

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Table 1 — Basic EFC functional requirements

Functional areas	EFC function item	Functional requirement for a common payment medium
Transaction types	Closed Toll - Entry Transaction Closed Toll - Exit Transaction Open Toll Transaction Transit Transaction Checking Transaction Purse Reloading Transaction	<ul style="list-style-type: none"> — Common payment medium shall be usable for all transaction types with OBE — Common payment medium shall store EFC contract information — Common payment medium shall securely store a minimum of 3 usage log entries including transaction type and date and time for use of a service — Common payment medium shall store the entry data for closed tolling system with OBE <p>NOTE 1 This also enables performing flexible EFC operations both with OBE and without OBE.</p>
Payment types	Central Account On-Board Account Pre-Payment Post-Payment Electronic Purse Based Payment Token Based Payment 'Open'(multiple service) Payment System 'Closed'(single service) Payment System No/Zero Payment Refunding	<ul style="list-style-type: none"> — Common payment medium shall be usable for all payment types — Common payment medium shall be usable for common payment among transport services — Common payment medium shall be usable for reloading transaction if user signed a contract
Contract types	Area Dependent Contract Time Dependent Contract Vehicle Dependent Contract Person Dependent Contract Group of Persons Dependent Contract Anonymous Contract	<ul style="list-style-type: none"> — Common payment medium shall be usable for all contract types — Common payment medium shall be usable with OBE for vehicle dependent contract since vehicle information is stored in OBE. Otherwise RSE shall detect vehicle information for this contract when only common payment medium is used.
Contract handling	Contract Selection Implicit Contract Explicit Contract Multiple Simultaneous Contracts	<ul style="list-style-type: none"> — Common payment medium shall be able to store multiple contract information if necessary
Security mechanism	One Way Authentication Two Way Authentication Data Integrity Mechanism No Specific Security Segment Integrity Mechanism Signature Based Mechanism Time/Event Based Mechanism Password-based Access Mechanism Encryption Mechanism	<ul style="list-style-type: none"> — Common payment medium shall implement the required security function(s) — Common service right provider as a common payment medium issuer shall provide secure processing environment to toll service provider

Table 1 (continued)

Functional areas	EFC function item	Functional requirement for a common payment medium
Operational issues	Different gantries configurations Different lane configurations OBE components addressing Alert/Warning information to the customer Dynamic classification Declared classification OBE Transaction Release OBE Remote Switch Off Version Handling Mechanism OBE Capability Handling Mechanism Multi-application Handling	<ul style="list-style-type: none"> — Operational requirements when a common payment medium is used in EFC shall be considered before implementation — Common payment medium shall store Version Handling Mechanism — Common payment medium shall be able to be used for Multi-application Handling <p>NOTE 2 Multiple application access method is defined in ISO/IEC 7816-4.</p> <ul style="list-style-type: none"> — Common payment medium shall store a minimum of 3 usage log entries including transaction type and date and time for the use of a service — Common payment medium shall prevent manipulating the road usage data by user
Tariffing schemes	Distance Dependent Time Dependent Vehicle Dependent Event Dependent Fixed Combined tariffing Scheme	<ul style="list-style-type: none"> — Tariffing schemes shall be considered whenever a common payment medium stores parameters corresponding to the tariff

The requirements on the common payment medium relating to Payment Card Industry Data Security Standard (PCI DSS)^[34] should also be considered as a part of EFC functional requirements. PCI DSS is the security standard of the card industry that was developed for cardholder data protection including technical requirements. Technical requirements related to the EFC system using a common payment medium are derived from a part of the 12 categories of requirements in PCI DSS. These are described in [Table 2](#).

Actor in an EFC system can be certified as PCI DSS compliant.

Table 2 — Requirements of PCI DSS for EFC function requirements

Functional areas	PCI DSS requirement ^[34]	Functional requirement for common payment medium
Data protection	<ul style="list-style-type: none"> — Keep cardholder data storage to a minimum by implementing data retention and disposal policies, procedures and processes — Do not store sensitive authentication data after authorization (even if encrypted) — Mask primary account number (PAN) when displayed (first six and last four digits are the maximum displayed) — Render PAN unreadable anywhere it is stored (including on portable digital medium, backup medium, and in logs) by using any of the approaches 	<ul style="list-style-type: none"> — Primary account number (PAN), shall be secured with strong encryption — EFC system shall store necessary and minimalized personal account data for operation, not store it if not used — EFC system shall not store sensitive authentication data after used
Cryptographic key management	<ul style="list-style-type: none"> — Document and implement procedures to protect keys used to secure stored cardholder data against disclosure and misuse — Fully document and implement all key-management processes and procedures for cryptographic keys used for encryption of cardholder data, including the following: <ul style="list-style-type: none"> — Generation of strong cryptographic keys — Secure cryptographic key distribution — Secure cryptographic key storage — Cryptographic key changes for keys — Retirement or replacement of keys — If manual key management operations are used, keys must be managed using split knowledge and dual control — Prevention of unauthorized substitution of cryptographic keys — Requirement for cryptographic key custodians 	<ul style="list-style-type: none"> — Key lifecycle management, type of key and key generation — Key updating method, on-line and off-line, secure transmission, key switching during operation — Secure key storage in hard and soft — List management, quantity of list, updating method, ensuring real-time
Transmission of sensitive EFC data	<ul style="list-style-type: none"> — Use strong cryptography and security protocols to safeguard sensitive cardholder data during transmission over open, public networks, including the following: <ul style="list-style-type: none"> — Ensure wireless networks transmitting cardholder data or connected to the cardholder data environment, use industry best practices to implement strong encryption for authentication and transmission — Never send unprotected PANs by end-user messaging technologies 	<ul style="list-style-type: none"> — Sensitive EFC data such as cardholder data and PAN shall be encrypted using strong cryptography at air interface such as WAN and contactless card interface

The following security measures derived from functional requirements listed above shall be implemented in EFC system. These explanations are described in [Annex H](#) and a detail of a security specification is provided by medium issuer under contract.

- Key management, type of key and key generation.

- Secure key storage in hardware and software.
- Key updating method, on-line and off-line, secure transmission, key switching during operation.
- List management, quantity of list, updating method, ensuring real-time.
- Sensitive EFC data.
- Secure data protection.

The business process requirements, derived from CEN/TR 16092 shown in [Table E.1](#), should be considered during developing of the specification of and EFC system.

6 Application structure in a common payment medium

This clause explains the application framework including EFC application in a common payment medium.

The common payment medium for usage in several transport services is a portable device such as an IC card or a mobile device. For common use of a medium, this medium shall store either individual applications provided by each TSP or an application that enables usage among all TSPs. In this latter case, the issuer of the medium is required to know all application details to support all service providers.

The common media can support three types of application structures:

- Type 1: Multi application. The common payment medium is configured with individual transport service applications and an application containing the CSR for use by all other transport service applications.
- Type 2: Shared data. The medium is configured with individual transport service applications and application with shared data used for CSR by all other transport service applications.
- Type 3: Single application. The medium is configured with one common application that stores all data for the use of corresponding transport services including CSR.

Further explanations of these types are given in [Annex D](#).

7 EFC application data in a common payment medium

7.1 General

This clause deals with the minimum set of EFC application data in the common payment medium necessary only to serve the interface data according to ISO 14906 for carrying out all EFC schemes described in [5.2](#), the EFC functional requirements.

NOTE 1 According to the additional threats and security measures listed in ISO 19299, some attribute data are added to those defined in ISO 14906 when a common payment medium is used for a closed toll system to prevent swapping a common payment medium in a toll road network for abusing and juggling the toll charge.

NOTE 2 Data elements defined in the EN 1545 series can be used when more transport-related data are necessary to be stored in the medium.

NOTE 3 The mechanism of secure data transfer for use of common media in multi-modal service via ITS station is described in ISO 21177.

The EFC attribute data defined in [7.2](#) is required for the integrated use of a common payment medium within an EFC system. These additional attributes are only stored in the common payment medium. The ASN.1 data types specifications shall be in accordance with [Annex A](#). [Annex B](#) contains an implementation conformance statement proforma that shall be filled in by a supplier that claims a product to be in conformity with this document.

7.2 EFC attribute data for a common payment medium

Table 3 shows the storage location of EFC attribute data in the case of a one-piece OBE (OBE built as a single unit) and two-piece OBE (OBE built as a couple of units, one of which is the common payment medium):

- 1) A one-piece OBE, shown as case 1, stores all attribute data required to operate EFC service defined in ISO 14906 and attribute data defined in this document;
- 2) A two-piece OBE, shown as case 2, stores attribute data for EFC service between an OBE and a medium defined in ISO 14906 and attribute data defined in this document. OBE stores vehicle related-data and a medium stores personal-related data.

According to the additional threats and security measures listed in ISO 19299, an additional attribute data `ReceiptEntryVehicle` shall be added to those EFC attributes defined in ISO 14906 when a common payment medium is used for a closed toll system to prevent swapping of a common payment medium in a toll road network for abusing and juggling the toll charge.

There are selectable implemental options for use of common medium as explained in the following.

- OPTION 1: On a common payment medium for pre-payment service(s), the user can select an option for reloading stored values when EFC charging is performed at a toll station. An additional attribute data group named `ReloadingParameter` is included as a general data group for the reloading function of stored values on a common payment medium for pre-payment service(s) (see Table 5). This data group consists of some parameters for on-site reloading such as validity of reloading, threshold value for low balance and value for reloading.
- OPTION 2: When the common payment medium is present, the stored EFC attribute data from the common payment medium shall be used.
- OPTION 3: When the common payment medium is not present, the stored EFC attribute data in OBE shall be used. This is an option for user convenience service as indicated by a single check in Table 3.
- OPTION 4: There are two parameters for `ContractAuthenticator`, one is stored inside the OBE and another is stored on the common payment medium, and toll charger and toll service provider can check whether these are authorised or not.

This document does not inhibit the OBE from storing data stored on the common payment medium.

Table 3 – Additional attribute data for medium

EFC attributes defined in ISO 14906			Data location			Additional attribute for medium
Data group	Attr.ID	Attribute	Case1	Case 2		
			One-piece OBE	OBE	Medium	
Contract	0	EFC-ContextMark	✓✓	✓✓	✓✓	
	1	ContractSerialNumber	✓✓	✓✓	✓✓	
	2	ContractValidity	✓✓	✓✓	✓✓	
	35	ValidityOfContract	✓✓	✓✓	✓✓	
	3	ContractVehicle	✓✓	✓✓		
	4	ContractAuthenticator	✓✓	✓✓	✓✓	
Key						
✓✓ Requirement for store as mandatory data						
✓ Requirement for store as optional data						
Blank Data can be stored.						

Table 3 (continued)

EFC attributes defined in ISO 14906			Data location			Additional attribute for medium
Data group	Attr.ID	Attribute	Case1	Case 2		
			One-piece OBE	OBE	Medium	
Receipt	5	ReceiptServicePart	✓✓	✓	✓✓	
	6	SessionClass	✓✓	✓	✓✓	
	7	ReceiptServiceSerialNumber	✓✓	✓	✓✓	
	36	ReceiptFinancialPart	✓✓	✓	✓✓	
	9	ReceiptContract	✓✓	✓	✓✓	
	10	ReceiptOBEId	✓✓	✓	✓✓	
	11	ReceiptICC-Id	✓✓	✓	✓✓	
	12	ReceiptText	✓✓	✓	✓✓	
	13	ReceiptAuthenticator	✓✓	✓	✓✓	
	14	ReceiptDistance	✓✓	✓	✓✓	
	33	ReceiptData1	✓✓	✓	✓✓	
	34	ReceiptData2	✓✓	✓	✓✓	
	Vehicle	15	VehicleIdentificationNumber	✓✓	✓✓	
16		VehicleLicencePlateNumber	✓✓	✓✓		
17		VehicleClass	✓✓	✓✓		
18		VehicleDimensions	✓✓	✓✓		
19		VehicleAxles	✓✓	✓✓		
20		VehicleWeightLimits	✓✓	✓✓		
Equipment	24	EquipmentOBEId	✓✓	✓✓		
	25	EquipmentICC-Id			✓✓	
	26	EquipmentStatus	✓✓	✓	✓✓	
Driver	27	DriverCharacteristics	✓✓	✓	✓✓	
Payment	32	PaymentMeans	✓✓		✓✓	
	29	PaymentMeansBalance	✓✓		✓✓	
	30	PaymentMeansUnit	✓✓		✓✓	
	31	PaymentSecurityData	✓✓		✓✓	
Receipt				✓✓	ReceiptEntry-Vehicle	
Payment				✓✓	ReloadingParameter	
Key ✓✓ Requirement for store as mandatory data ✓ Requirement for store as optional data Blank Data can be stored.						

7.3 Additional EFC attribute data

7.3.1 Data group RECEIPT

This data group consists of some optional data elements. Typical data elements for a closed EFC system are shown in [Table 4](#).

Table 4 — Receipt data

EFC attribute	Data element	Definition	Type	Informative remarks
ReceiptEntryVehicle	VehicleLicencePlateNumber	Vehicle licence plate number recognized and stored at entry toll gate.	LPN	EXAMPLE Enabling detection of swapping common payment medium at Service area and/or Parking area for devious toll payment.
	EquipmentOBEId	OBE ID copied and stored at entry toll gate.	OCTET STRING	EXAMPLE Enabling to detect swapping common payment medium at Service area and/or Parking area for devious toll payment.
	VehicleClass	Vehicle class classified and stored at entry toll gate	INT1	
	EntryAuthenticator	Authenticator for this attribute.	OCTET STRING	

NOTE Specification of calculation of authenticator is provided by medium issuer.

7.3.2 Data group PAYMENT

This data group consists of some optional data elements. Typical data elements for pre-payment values stored on a common payment medium is shown in [Table 5](#).

Table 5 — Payment data

EFC attribute	Data element	Definition	Type	Informative remarks
Reloading Parameter	ReloadingValidity	End date and time of the validity of the reloading contract option.	DateAndTime	
	ThresholdBalance	Threshold value of balance in medium for reloading activation at EFC transaction.	SignedValue, INT3	
	ReloadingValue	Value to add balance in medium at reloading transaction.	SignedValue, INT3	
	DepositValue	Amount of a deposit for checking when auto-reloading transaction is performed.	SignedValue, INT3	Described in EN 1545-2, as Amount.
	Dynamic Reloading ValueFlag	Flag for reloading value equal to charging value when insufficient balance.	Flag	
	Reloading Authenticator	Authenticator calculated by the ContractProvider called Common Service Right Provider when issuing the Contract, to prevent tampering with contract data.	OCTET STRING	Authenticator of all data element in ReloadingParameter, except of this ReloadingAuthenticator.
	Autoload StartDate	Start date and time of the period of the reloading option service for checking when EFC transaction is performed.	DateAndTime	Described in EN 1545-2, as DateStamp.
	AutoloadEndDate	End date and time of the period of the reloading option service for checking when EFC transaction is performed.	DateAndTime	Described in EN 1545-2, as DateStamp.
AutoRenewFlag	A flag indicating whether auto-renew is enabled. Valid flag for automatic reloading at EFC transaction.	Flag	Described in EN 1545-2, as Flag.	

NOTE Specification of calculation of authenticator is provided by medium issuer.

Annex A (normative)

Data type specifications

The EFC data types and associated coding related to the EFC attribute data, described in [Clause 7](#), are defined using the Abstract Syntax Notation One (ASN.1) technique according to ISO/IEC 8824-1. The unaligned packed encoding rules according to ISO/IEC 8825-2 are applied.

The actual ASN.1 module is identified by the object identifier {iso(1) standard(0) 21193 version2(2) minor version(1)}. and is contained in the attached file “ISO21193 EfcCsrV 2.1.asn” which can be directly imported in an ASN.1 compiler. The file is available for download at <https://standards.iso.org/iso/12855/ed-3/en/>

The syntax and semantics of the data types in the ASN.1 types in the above-mentioned file that is imported shall conform with ISO 17573-3 and ISO 14906, respectively.

[Table A.1](#) provides the SHA-256 cryptographic hash digests for the referenced files, offering a means to verify the integrity of the referenced files. The SHA-256 algorithm is specified in NIST 180-4.^[35]

Table A.1 — SHA-256 cryptographic hash digests

File name	SHA-256 cryptographic hash digest
ISO21193 EfcCsrV 2.1.asn	84862210e09609da0d4be533be7eb8564ca3a78809ee-f2358a423c3f8826cefa

It is important to be aware that pasting the text of the file into one of the hash digest computation pages available on the web can result in a non-matching hash digest due to changes in the underlying coding.

Annex B (normative)

Implementation conformance statement (ICS) pro forma

B.1 General

To evaluate the conformance of a particular implementation, it is necessary to have a statement of those capabilities and options that have been implemented. This is called an implementation conformance statement (ICS).

This annex presents the pro forma to be used for the attributes defined in [Clause 7](#) and [Annex A](#), with ICS templates that are to be filled in by equipment suppliers.

B.2 Purpose and structure

The purpose of this ICS is to provide a mechanism whereby a supplier of an implementation of the attribute in medium defined in this document can provide information about the implementation in a standardised manner.

The ICS is subdivided as follows corresponding to categories of information:

- identification of the implementation;
- identification of the protocol;
- global statement of conformance;
- ICS tables.

B.3 Instruction for completing ICS

B.3.1 Definition of support

A capability is said to be supported if the implementation under test (IUT) can:

- generate the corresponding operation parameters (either automatically or because the end user requires that capability explicitly), and
- interpret, handle and, when required, make available to the end user the corresponding error or result.

A protocol element is said to be supported for a sending implementation if it can generate it under certain circumstances (either automatically or because the end user requires relevant services explicitly).

A protocol element is said to be supported for a receiving implementation if it is correctly interpreted and handled and also, when appropriate, made available to the end user.

B.3.2 Status column

This column (see [Tables B.1](#) to [B.8](#)) indicates the level of support required for conformance. The values are as follows:

- m mandatory support is required;

- o optional support is permitted for conformance to this document. If implemented, it shall conform to the specifications and restrictions contained in the standard. These restrictions may affect the optionality of other items;
- c the item is conditional (support of the capability is subject to a predicate);
- c: m the item is mandatory if the predicate is true, optional otherwise;
- the item is not applicable;
- the item is outside the scope of this ICS.

In the ICS tables, every leading item marked “m” shall be supported by the IUT. Sub-items marked “m” shall be supported if the corresponding leading item is supported by the IUT.

B.3.3 Support column

This column (see [Tables B.6](#) to [B.8](#)) shall be completed by the supplier or implementer to indicate the level of implementation of each item. The proforma has been designed such that values required are the following:

- Y Yes, the item has been implemented;
- N No, the item has not been implemented;
- the item is not applicable.

All entries within the ICS proforma shall be made in ink. Alterations to such entries shall be made by crossing out, not by erasing or making the original entry illegible, and by writing the new entry alongside. All such alterations to records shall be initialised by the person who made them.

B.3.4 Item reference numbers

Each line within the ICS which requires that implementation details be entered is numbered at the left-hand edge of the line. This numbering is included as a mean of uniquely identifying all possible implementation details within the ICS. This referencing is used both inside the ICS, and for references from other test specification documents.

The means of referencing individual responses is done in the following sequence:

- a) a reference to the smallest individual response enclosing the relevant item;
- b) a solidus character (“/”);
- c) the reference number of the row in which the response appears;
- d) if, and only if, more than one response occurs in the row identified by the reference number, implicit labelling of each possible entry as “a”, “b”, “c”, etc., from left to right, with this letter appended to the sequence.

B.4 ICS for medium

B.4.1 Identification of the implementation

The following pro forma ([Table B.1](#) to [Table B.5](#)) shall be used to identify the implementation on the medium side.

Table B.1 — Identification of ICS

Item no.	Question	Response
1	Date of statement (YYYY/MM/DD)	
2	ICS serial number	
3	System conformance statement cross-reference	

Table B.2 — Identification of the implementation or system or both

Item no.	Question	Response
1	Common service right provider name	
2	Version number	
3	Other information	

Table B.3 — Identification of the medium supplier

Item no.	Question	Response
1	Organization name	
2	Contact name(s)	
3	Address	
4	Telephone number	
5	E-mail address	
6	Other information	

Table B.4 — Identification of the medium

Item no.	Question	Response
1	Brand name	
2	Type, version	
3	Manufacturer ID	
4	Serial numbers of supplied units	
5	Other information	

Table B.5 — Identification of this document

Item no.	Question	Response
1	Title, reference no., publication date of the document	
2	Document edition number	
3	Other information	

B.4.2 ICS tables

This part of the ICS ([Table B.6](#) to [Table B.8](#)) identifies the supported application context, communication services and attributes for the medium side.

Table B.6 — Data requirements regarding Receipt

Item no.	Element	Reference	Status	Support
1	VehicleLicencePlateNumber	7.3.1	0	
2	EquipmentOBEId	7.3.1	0	
3	VehicleClass	7.3.1	0	
4	EntryAuthenticator	7.3.1	0	

Table B.7 — Data requirements regarding reloading

Item no.	Element	Reference	Status	Support
1	ReloadingValidity	7.3.2	0	
2	ThresholdBalance	7.3.2	0	
3	ReloadingValue	7.3.2	0	
4	DepositValue	7.3.2	0	
5	DynamicReloadingValueFlag	7.3.2	0	
6	ReloadingAuthenticator	7.3.2	0	
7	AutoloadStartDate	7.3.2	0	
8	AutoloadEndDate	7.3.2	0	
9	AutoRenewFlag	7.3.2	0	

Table B.8 — Security measures

Item no.	Element	Reference	Status	Support
1	Key management, kind of key and key generation	7.3.2	0	
2	Secure key storage	7.3.2	0	
3	Key updating method	7.3.2	0	
4	List management	7.3.2	0	
5	Sensitive EFC data	7.3.2	0	
6	Secure data protection	7.3.2	0	

Annex C (informative)

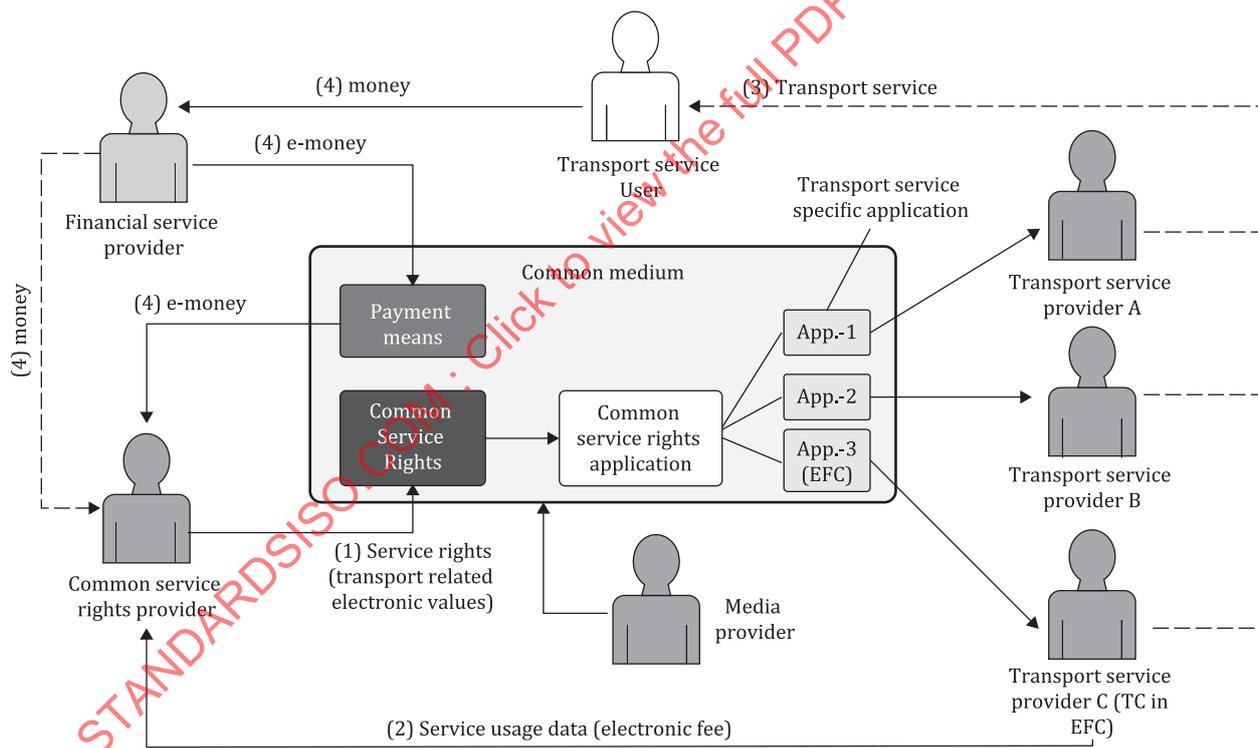
Common payment medium concept

This annex explains EFC application as one of transport service specific application and application interface requirements for Common service rights application.

Service rights are stored in an electronic transport related e-purse (stored value) installed with a Common service right application. The application is owned and operated by a CSRP whose functions could be compared with those of a financial service provider. The CSRP belongs to the transport domain and is within the scope of this document. The financial service provider belongs to the financial domain and is outside the scope of this document.

The payment means are used to purchase the service rights from a CSRP, see [Figure C.1](#). The service rights in the form of a transport specific e-purse (stored value) are again used for purchasing other service rights from TSPs, e.g. passages through toll stations in a tolled road network or single trips in a PT network.

The CSRP needs to collect requirements from the financial service provider and TSPs to issue the common payment medium.



NOTE 1 Interfaces (4) for e-money are monetary flow in financial and out of scope and 'Transport service' lines (3) are not interfaces but just an illustration that the TSP provides a transport service to the user.

NOTE 2 Interfaces between Application in Common medium and TSP are in [Figure C.1](#).

Figure C.1 — Common payment medium concept

In some cases, the TSP is split into two sub-roles. These are the Transport service manager dealing with the user contracts and payments and the Transport operation manager delivering/carrying through the

transport service. It should be noted that the division of the TSP role into two sub-roles is always used in interoperable fee or fare collection systems.

The user has a contract with a transport service manager, e.g. a toll service provider (EFC) or a product owner via a product retailer (public transport).

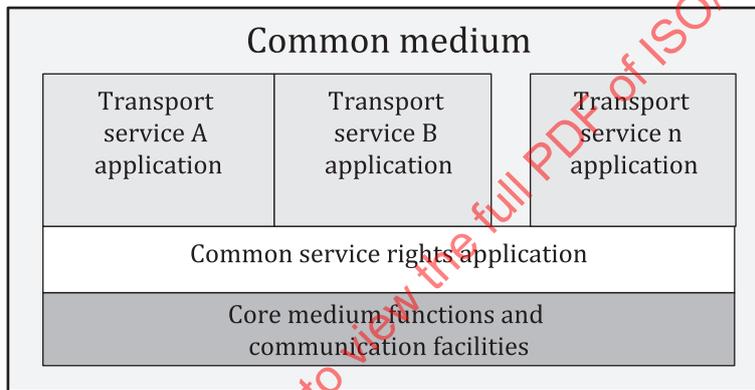
The service rights provided by the transport service manager enable the user to benefit from transport services provided by any transport operation manager having an agreement with the transport service manager.

For EFC this concept is defined in ISO 17573-1. For public transport this concept is defined in ISO 24014-1.

As the medium may exist in many different forms the medium providers could for instance be a credit card company, a smartphone provider or an On-Board Equipment provider.

The CSRP could be a Trusted Third Party, e.g. an external entity or a co-operation between all or a sub-set of the TSPs involved in the common payment medium scheme.

An example of such an application could be an EFC application for common payment medium and on-board equipment. [Figure C.2](#) shows the proposed application hierarchy and some application structures with security functions are shown in [Annex D](#).



NOTE 1 Common medium: Medium used for payment and for multimodal transport services, e.g. IC card and mobile phone.

NOTE 2 Transport service provider: Entity providing the transport services including the basic functionality, data storage and security mechanisms, e.g. public transport, use of tolled roads, road user charging, access control and parking.

NOTE 3 Common service rights provider: Entity providing the Common service rights application including the basic functionality, applications management, data storage and security mechanisms.

NOTE 4 Media provider: Entity providing the media and core functionality used for the Common payment means application.

Figure C.2 — Proposed common payment medium application hierarchy

Annex D (informative)

Application structure examples in common payment medium

D.1 General

This annex explains three types of typical application structures of common payment medium for multi-modal transport usage examples based on integrated-circuit card standards.

Three transport applications such as Public transport, Parking and EFC are briefly described in this annex. This means that this document does not constrain implementing these transport applications but allows implementing any transport service application in medium.

Common use data elements of transport service rights are stored in "common TrSR" memory area. This memory area is located not only in a purpose-built one application but also in a co-existence one application.

D.2 Application structure type 1

The common application structure is shown in [Figure D.1](#). The medium is configured with individual transport service applications and an application containing the CSR for use by all other transport service applications.

The security objects are controlled individually by each transport system and only cryptography keys for "common TrSR" for enabling common use among all transport systems. When a service user uses a transport service, the transport service system accesses both the transport service application and the common TrSR application in sequence. This type needs to perform two or more access control processes such as application authentication at every switching application. This means a relatively significant amount of time is necessary for execution of the transaction.

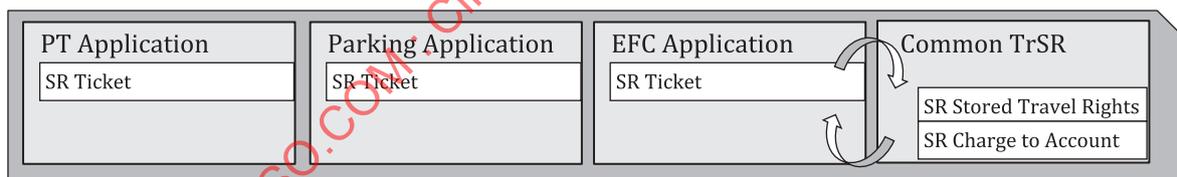


Figure D.1 — Multi-application

D.3 Application structure type 2

Application structure with shared data is shown in [Figure D.2](#). The medium is configured with individual transport service applications and shared data used for CSR by all other transport service applications.

The security objects are controlled individually by each transport system and only cryptography keys for "common TrSR" need to be shared among all transport systems.

When a service user uses a transport service, the transport service system accesses both the transport service application and the shared data file in sequence. This type needs to perform one access control process such as application authentication for accessing both transport service application and common TrSR without switching applications.

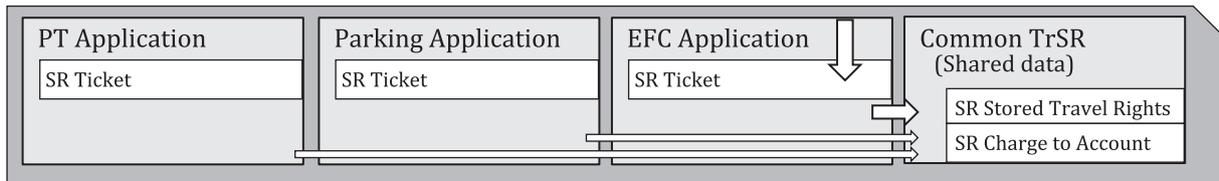


Figure D.2 — Multi-application with shared data file

D.4 Application structure type 3

A single application structure is shown in [Figure D.3](#). The medium is configured with one common application that stores all data for all uses of the corresponding transport services.

This type allows the use of one security object among all transport systems.

When the service user uses a transport service, the transport service system accesses both transport service data and common TrSR data in sequence. This type performs one access control process such as application authentication for accessing both transport service data and common TrSR data.

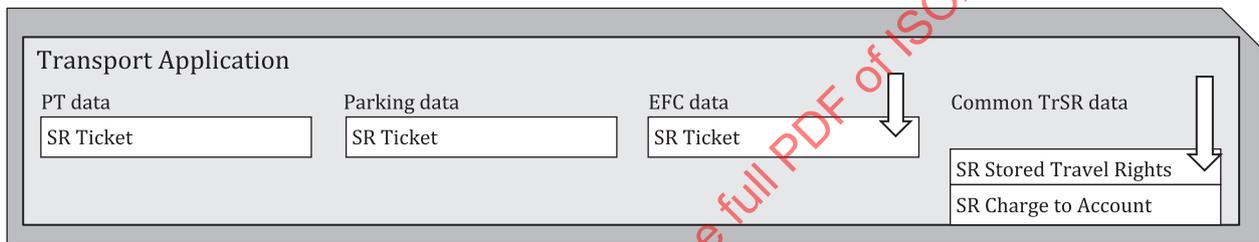


Figure D.3 — Single application

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Annex E (informative)

General information for common payment medium and OBE

EFC related transport service specific application will consist of:

- Application data elements necessary to build an EFC transaction according to ISO 14906. This is explained in [Clause 7](#).

NOTE 1 The EN 1545 series defines application data elements for transport applications.

- Application interface accessing method is explained in ISO 25110.
- Business process requirements is explained in CEN/TR 16092
 - Issuing
 - Personalization
 - Loading; the example of Reloading transaction is shown in [Annex G](#).
 - Charging; the example of Charging transaction is shown in ISO 14906
 - Clearing
 - Hot listing
 - Invoicing
 - Refund
- Technical requirements are explained in CEN/TR 16092 (by referencing to ISO/IEC 7810, ISO/IEC 7816, ISO/IEC 14443, ISO/IEC 18092, ISO/IEC 15693)
 - General requirements
 - Specific requirements for contact/contactless
 - Specific requirements for OBE
- Logical and Physical interface are explained in ISO/IEC 7816, ISO/IEC 14443 and ISO/IEC 18092.
- Command and response are explained in ISO/IEC 7816 and ISO/IEC 14443.

NOTE 2 Any interface such as personal area network and Wi-Fi of Mobile Phone can be applied for use of common payment medium also.

[Table E.1](#) shows the essential to consider the business process in EFC system using medium. Details derived from these requirements are contained in the specification of EFC system using medium.

Table E.1 — The business process

Process name	Description
Issuing	The first process for use of common payment medium is the issuing of common service rights from CSRPs to service user (SU) and the issuing of transport service application. The SU chooses some options, such as stored-value with automatic-reloading or without automatic-reloading or credit.
Personalization	Any common payment medium except anonymous option such as stored-value without auto-reloading is personalized with contract. The link between the ID of the pre-personalized common payment medium and the centrally held account needs to be established before the first use of the common payment medium. Typical personalization method and transaction in EFC scheme is explained in the ISO 21719 series.
Loading	The loading of value into a stored value in common payment medium is done at initial before first use and at periodicity. Reloading related EFC data definitions are described in 7.3.2 and typical loading method and transaction in EFC scheme is explained in Annex G .
Charging	The charging of the toll for the TC allows using medium with OBE and without OBE. Typical DSRC based charging method and transaction in EFC scheme is explained in ISO 14906 and typical autonomous charging is explained in ISO 17575-1.
Auto-reloading	The auto-reloading of value into a stored value in common payment medium is done when low balance is detected under contract. Reloading related EFC data definitions are described in 7.3.2 and typical automatic loading method and transaction in EFC scheme is explained in Annex G .
Clearing	The clearing of transactions takes place between the CSRPs and the TSP and is identical to the claiming.
Hot listing	Hot listing as part of enforcement procedures.
Invoicing	The invoice for the service user is created by CSRPs normally even both CSRPs and TSP do the user service.
Refund	If an SU closes the EFC contract with a CSRPs, the SU must return the associated common payment medium.

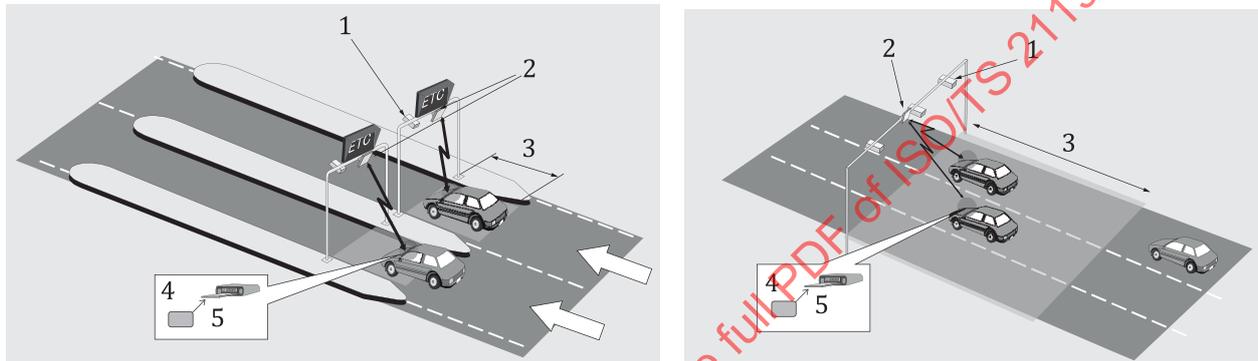
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Annex F (informative)

System migration

This annex describes a general method for seamless upgrade of EFC system and the medium. Upgrading information security in the EFC system, new medium is issued by new medium provider and any medium not only card type can be assumed to use.

At the first implementation of the EFC system on road, the requirements of the medium provider are considered to design the EFC system simply since the EFC system environment using medium is completely first installation as shown in [Figure F.1](#).



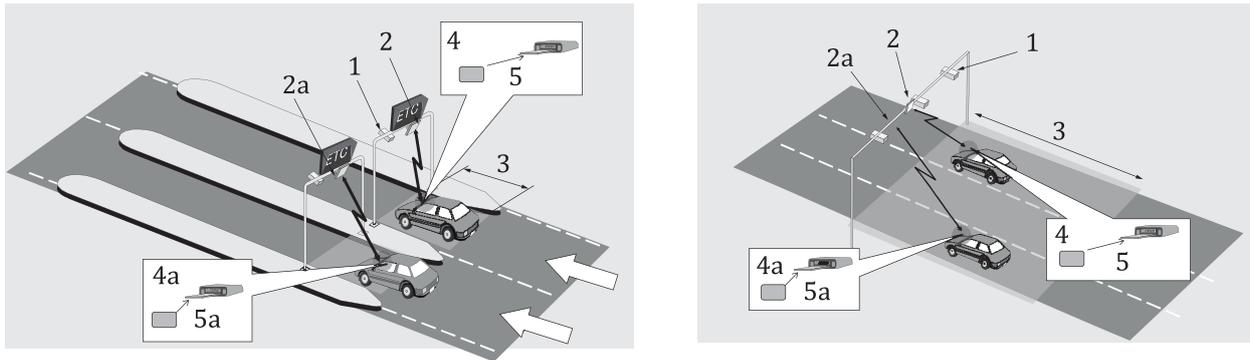
Key

- 1 enforcement camera
- 2 RSE
- 3 DSRC area
- 4 OBE
- 5 contactless IC card

Figure F.1 — First installed EFC system image of single lane and multilane

On EFC system upgrading, when new EFC system is implemented on toll road along with the existing EFC system, the parallel operation method with the new and current EFC systems is required a specific period of time. There are two possible scenarios:

- new roadside infrastructure supporting new and current EFC system; Both current and new EFC systems are installed at the same toll station in both multilane tolling and single lane tolling as shown in [Figure F.2](#). Furthermore, separate current and new EFC single lanes are presentation single lane tolling. After all OBEs are replaced with new OBEs during the time period of parallel operation, current RSE will be replaced with new RSE.

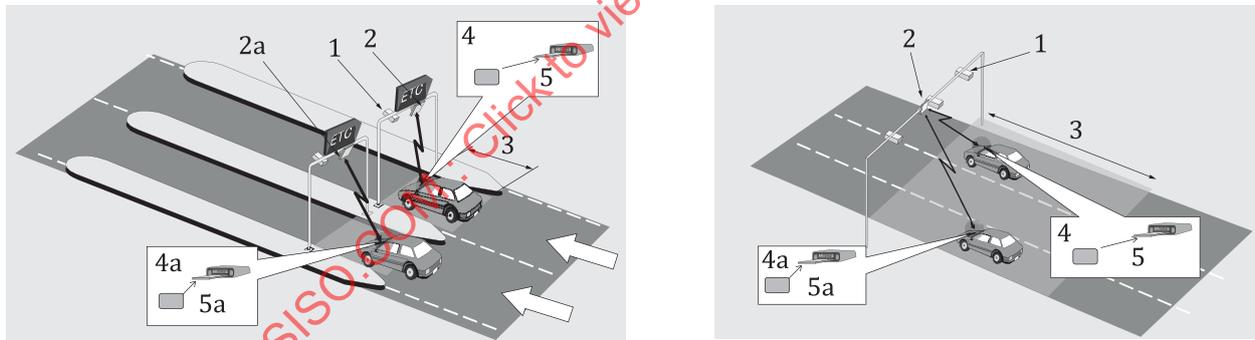


Key

- 1 enforcement camera
- 2 current RSE
- 2a new RSE
- 3 DSRC area
- 4 current OBE
- 4a new OBE
- 5 current contactless IC card
- 5a new contactless IC card

Figure F.2 — Dual EFC RSE tolling station image during parallel operation period

- new OBE supporting new and current EFC system; OBE complies with the current and new EFC system as shown in [Figure F.3](#). After all OBEs are replaced with new OBEs during the time period of parallel operation, current RSE will be replaced with new RSE.



Key

- 1 enforcement camera
- 2 current RSE
- 2a new RSE
- 3 DSRC area
- 4 current OBE and new OBE
- 4a new OBE
- 5 current contactless IC card
- 5a new contactless IC card

Figure F.3 — Dual EFC OBE tolling station image during parallel operation period

In addition to above general migration, following further study is necessary for EFC system with medium. There is different migration approach where the module for corresponding transaction and security processing with medium is equipped on OBE or RSE for OBE with medium.

In case of module equipped OBE; OBE performs transaction and security processing by using module and applies with current and new medium. [Figure F.4](#) shows the medium migration study case with multi-application in OBE.

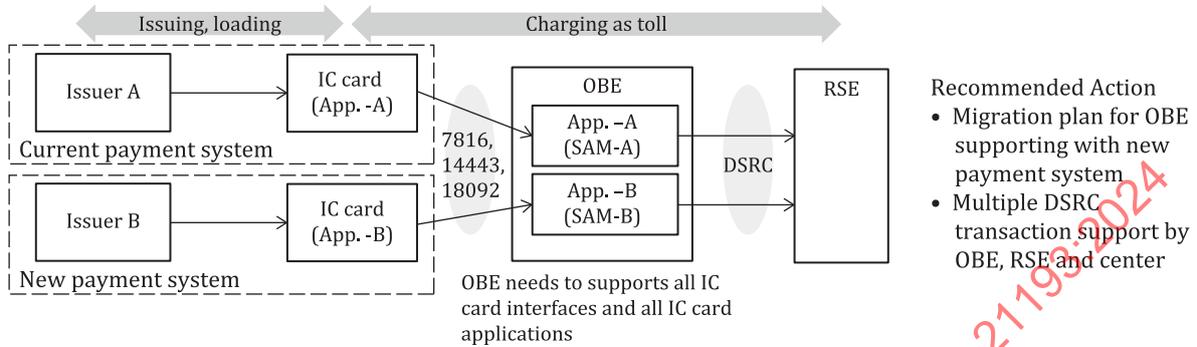


Figure F.4 — Multi-application in OBE

Additionally, if OBE is not equipped with the interface with new medium, OBE has to be upgrade with both new medium and also the interface to it.

In case of module equipped RSE, perform transaction and security processing by using module and apply with current and new medium. OBE use both the interface with current medium and the interface with new medium and OBE work as transparent model described in ISO 25110. [Figure F.5](#) shows the medium migration study case with multi-application in RSE.

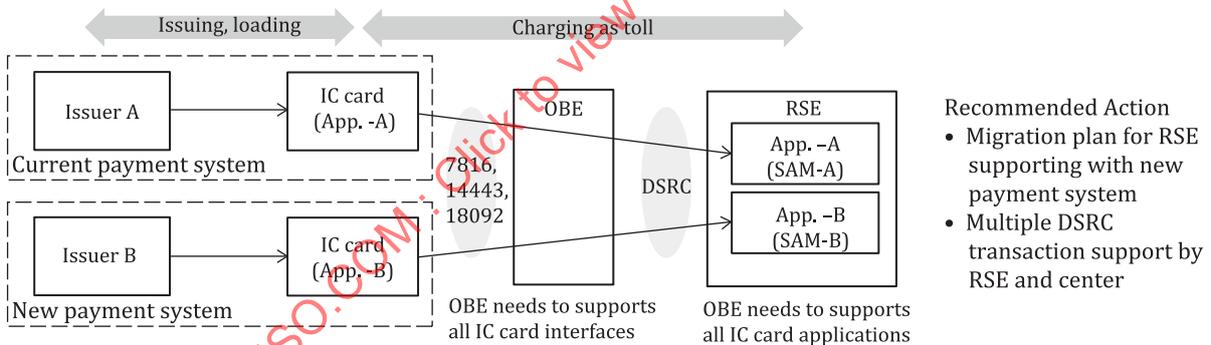


Figure F.5 — Multi-application in RSE

The following items, among others, may also be relevant to consider for EFC system migration.

- Matching processing between a DSRC transaction data from current or new EFC system with an enforcement data.
- Enough migration periods with parallel operation from current EFC system to new EFC system.
- Wide announcement in advance for all service users about the migration plan.

Annex G (informative)

Reloading system for pre-payment medium in Korean ETC

G.1 General

The EFC in the Republic of Korea was started with a prepaid card. After 2009 post-paid card was adopted to the EFC system.

The toll fee is collected from the IC card called a “hi-pass card” which is inserted into the on-board equipment, and the same IC card can also be used in the manual lanes (booth). This is called “Touch & Go”.

Reloading is an especially important function in the same manner as charging. The prepaid card is reloaded with the value at the same time or before the charging transaction.

There are three types of reloading system on the Korean EFC of the prepaid card as follows and shown in [Figure G.1](#).

- (case 1) direct reloading type in the toll booth;
- (case 2) on-line reloading type with POS device;
- (case 3) auto-reloading type in EFC during DSRC wireless communication.

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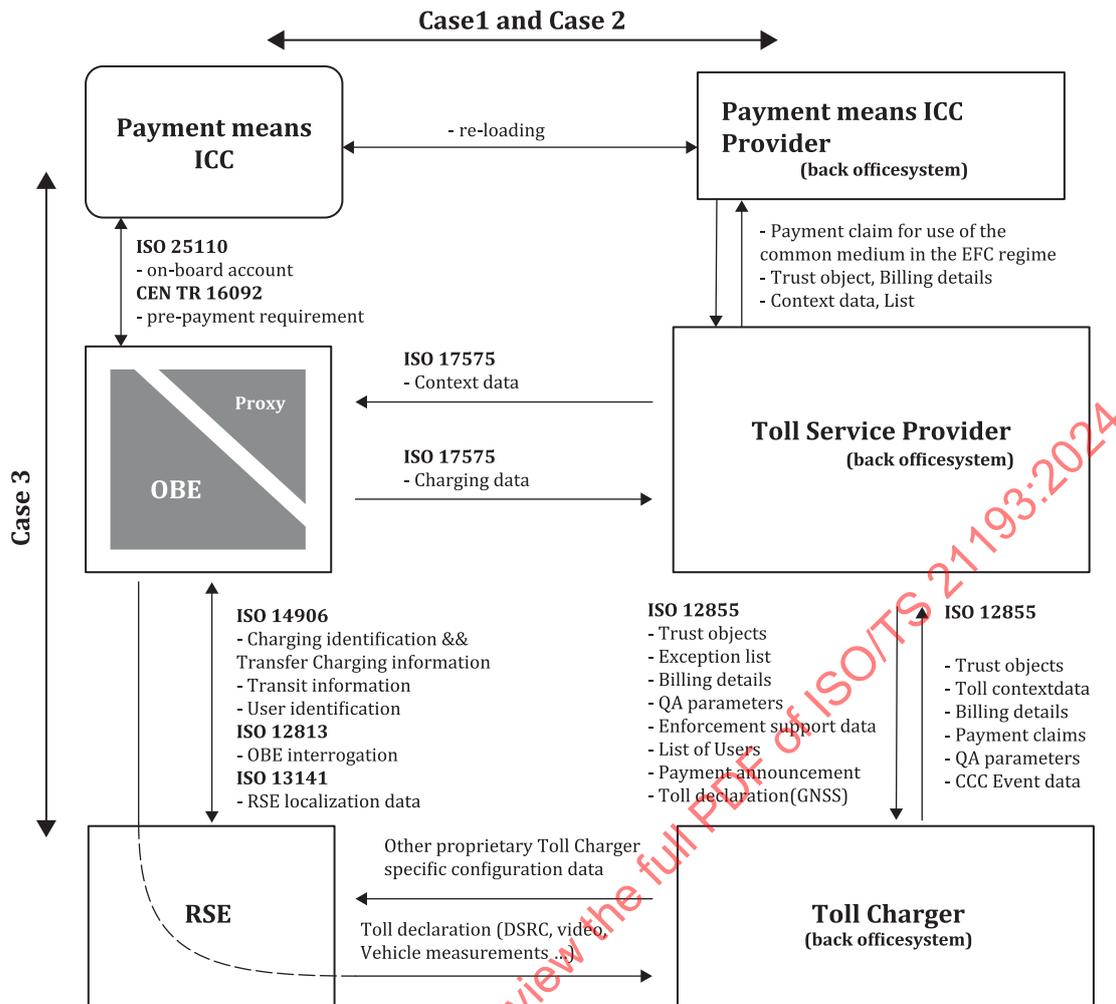


Figure G.1 — Korean EFC reloading model based on ISO/TR 19639

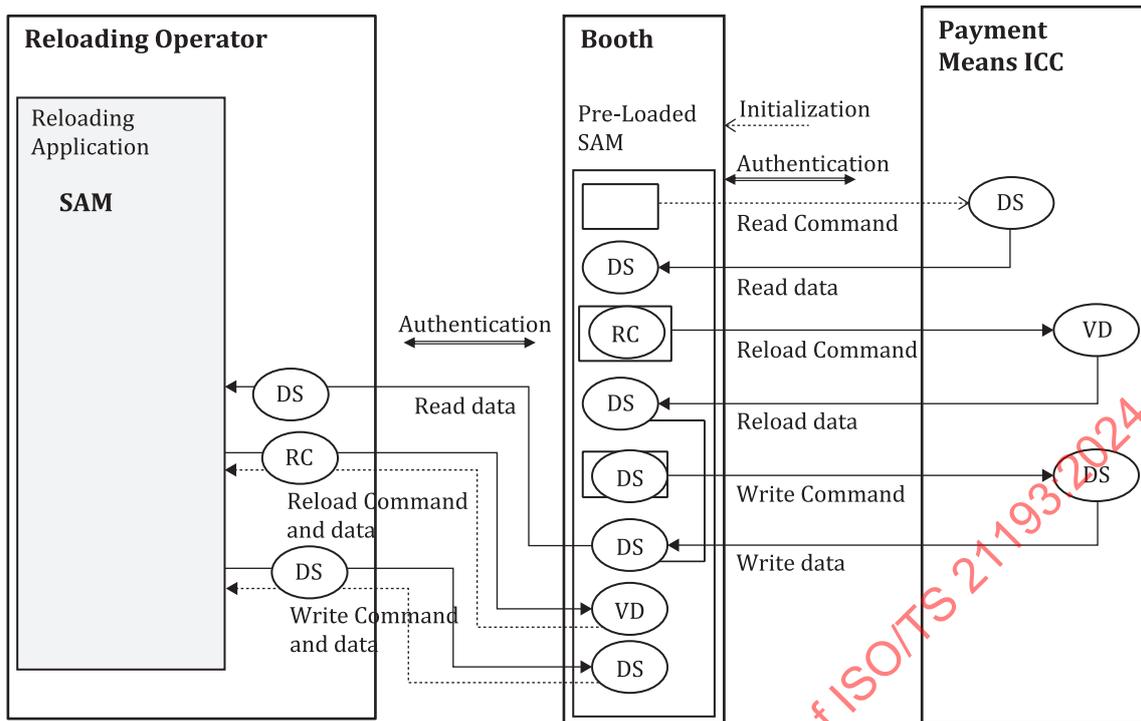
G.2 Direct reloading type

G.2.1 Overview

An amount, when less than threshold, is automatically loaded to the loading secure application module (LSAM), which is installed to the booth controller through a local network. If the user wants to reload to a prepaid card in the manual lane, the value from LSAM could be charged to the prepaid card.

G.2.2 Data transfer process

In this type, there are two reloading procedures, the first is between LSAM and the prepaid card, and the second is between the reloading operator and LSAM as shown in Figure G.2. Mutual authentication between the prepaid card and LSAM is processed directly before the application data is exchanged and the value data is accessed. Both the result data and the balance amount of LSAM are sent to the reloading operator.



Key

-  Value data
-  Data Set
-  Reload Command
-  ICC Command

Figure G.2 — Direct reloading data transfer process according to ISO 25110

G.2.3 Interface definition

G.2.3.1 Functional configuration

In this type, the LSAM in the booth sends reloading command to a prepaid card. Then, the SAM of the reloading operator reads and checks both the result of reloading and the balance of LSAM. If the balance of LSAM is below the set-up amount, the SAM of the reloading operator would send the reload command to LSAM and charge the value to LSAM.

G.2.3.2 Command and response

Using Dsrc-EID('0') and 'action parameter (based on ISO 14906), the LSAM commands access to the prepaid card directly with designating Channel ID=ICC(3)[according to ISO 14906]. The command for ICC is shown in [Table G.1](#), the command for SAM is shown in [Table G.2](#) and the response is shown in [Table G.3](#).

Table G.1 — TRANSFER_CHANNELrequest (between the LSAM and prepaid card)

Parameter	ASN.1 Type	Value	Remarks
Element Identifier EID	Dsrc-EID	0	
Action Type	INTEGER(0..127,..)	8	Transfer Channel
AccessCredentials	OCTET STRING		
ActionParameter	ChannelRq ::=SEQUENCE { channelIdChannelId, apdu OCTET STRING }		Always to be present Channel ID=ICC (3)
Mode	BOOLEAN		TRUE

Table G.2 — TRANSFER_CHANNELrequest(between SAM in the Reloading Operator and LSAM)

Parameter	ASN.1 Type	Value	Remarks
Element Identifier EID	Dsrc-EID	0	
Action Type	INTEGER(0..127,..)	8	Transfer Channel
AccessCredentials	OCTET STRING		
ActionParameter	ChannelRq ::=SEQUENCE { channelIdChannelId, apdu OCTET STRING }		Always to be present Channel ID=SAM (1)
Mode	BOOLEAN		TRUE

Table G.3 — TRANSFER_CHANNELresponse(between SAM in the Reloading Operator and LSAM)

Parameter	ASN.1 Type	Value	Remarks
ResponseParameter	ChannelRs ::=SEQUENCE { channelIDChannelID, apdu OCTET STRING}		Always to be present
Return Code(Ret)	ReturnStatus		Optical use

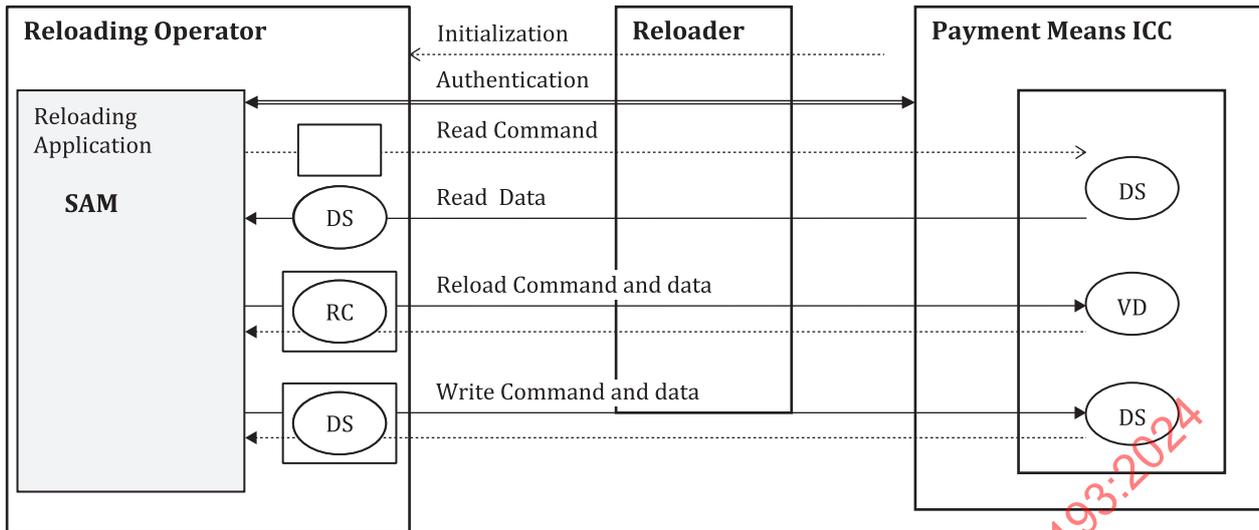
G.3 On-line reloading type

G.3.1 Overview

Users can reload by themselves to access the reloading Operator Server through the Reloader such as an ATM or a card reader device.

G.3.2 Data transfer process

The data exchanged between the reloading operator and the prepaid card are processed directly after authentication between secure application module (SAM) in the Reloading Operator is processed directly before the application data is exchanged and value data is accessed as shown in [Figure G.3](#).



Key

-  Value data
-  Data Set
-  Reload Command
-  ICC Command

Figure G.3 — On-line reloading data transfer process according to ISO 25110

G.3.3 Interface definition

G.3.3.1 Functional configuration

In this type, the SAM of the reloading operator sends the reloading ICC command in its APDU to execute the ICC operation (e.g. read, reload or write) directly.

G.3.3.2 Command and response

Using Dsrc-EID('0') and Action parameter (based on ISO 14906), the SAM of reloading operator commands access to ICC directly with designating Channel ID in the action parameter as channel ID=ICC(3). The command for ICC is shown in [Table G.4](#) and the response is shown in [Table G.5](#).