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Electronic fee collection — Investigation of EFC standards for common payment schemes for multi-modal transport services

Perception du télépéage — Recherche sur les normes de perception du télépéage pour des schémas de paiement communs pour les services multimodaux de transport

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Foreword

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The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

Introduction

On-board account payment means are used, e.g., in public transport systems and in some electronic fee collection (EFC) systems. It is expected that the deployment of on-board account payment scheme will grow, as it has little dependence on the communication network and as it potentially can provide users with a common payment means for a range of multi-modal transport services.

This Technical Report (TR) provides an analysis of the specific requirements of common payment schemes within the framework of EFC systems as outlined in the existing EFC standards. The Technical Report does this by providing more specific information about the Payment means (such as IC cards) and the interfaces between Payment means and the other parts of an EFC system (see e.g. the previous edition of the ISO/TS 17573:2003). Payment means and Payment means Issuer are described in ISO 17573:2010, the latest version of the EFC architecture role model, hence allowing for the usage of the Payment means of the EFC On-board account for payment for other services. This Technical Report provides for an additional information (e.g. requirements, descriptions) relevant to the role of Payment means Issuer and information flows.

The motivation for this Technical Report is as follows:

— On-board account based EFC systems using payment means are widely adopted in many countries in Asia. In several of these countries, payment means are already used or planned to be used for both for the EFC and for the public transport services.

— Central account based EFC systems are widely adopted in many European countries and in the USA. Payment means used in such EFC systems can also be used in the common payment scheme (i.e. for the payment for other services).

Though there is a description of interaction between Toll charging environment and Financial system in the ISO 17573:2010, to provide for the On-board account EFC system used in the common payment schemes, additional information, relevant to the interactions between the Financial system and the Toll charging environment (i.e. interface between the Toll charging environment and objects outside of this environment), is required.

The following are the envisaged benefits of the common usage of payment means in ITS and EFC services:

— greater convenience of transport usage both for EFC and for public transport;

— enhanced multi-modal transport, more cost-effective, efficient and environmentally friendly.

Electronic fee collection — Investigation of EFC standards for common payment schemes for multi-modal transport services

1 Scope

Common payment scheme for multi-modal transport services, such as toll roads and public transport, are implemented all over the world. These systems are often based on a common payment medium, e.g. IC cards, for use in more than one transport service. The aim of this Technical Report is to analyse the existing set of EFC standards for their suitability for using common payment media for multi-modal transport services, where applicable identify standardisation gaps and to make proposals for such EFC standardisation projects. This includes definition of additional information to be exchanged among the related entities and to define the specific requirements for common payment scheme.

The scope of this Technical Report includes:

— investigation of a suitable model for EFC systems and other transport services;

— identification of the required interface definitions between the EFC and the public transport services including e-money services;

— identification of additional needs for additional EFC related information exchange among the related entities;

— provision of guiding information to be considered in revisions of EFC standards.

The scope includes all types of EFC systems, i.e. including both DSRC based EFC and autonomous EFC systems, and both pre-pay type and post-pay type.

Service related information of both public transport and e-money are outside the scope of this Technical Report.

2 Normative references

None.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
central account
payment means, e.g. electronic values or number of passages in an EFC system, stored in a central system operated by the Toll Service Provider

3.2
clearing house
organisation re-allocating value generated in the payment system between the various actors, enabling these actors to execute settlement

3.3
EFC architecture
description of the key elements of an EFC system, their functions, and the interrelationships among the elements

[SOURCE: ISO 22902-1:2006, 3.1.8 modified]

3.4
EFC information exchange
exchange of EFC related information between EFC actors

3.5
electronic-money
value having its equivalence in real money, electronically stored e.g. on a bank account or an IC-card, which thus can be used by the user for payments

3.6
fare collection regime
set of rules, including enforcement rules, governing the fare system in the public transport domain

3.7
integrated circuit card
IC card
card containing electronic components performing processing or memory functions and with the capability to communicate with an interrogator

Note 1 to entry: Contact IC cards are specified in the ISO/IEC 7816 suite of standards, contactless proximity IC cards are specified in the ISO/IEC 14443 suite of standards, contactless near-field communication IC cards are specified in ISO/IEC 18092 and ISO/IEC 21481, whereas contactless vicinity IC cards are specified in ISO/IEC 15693 suite of standards.

Note 2 to entry: All references to an IC card are understood to be references to the IC of the card and not to any other storage on the card (e.g. magnetic stripe).

3.8
issuer
entity responsible for issuing the payment means to the user

3.9
on-board account
payment means, e.g. electronic values, tokens or evidence of passage in an EFC system, stored on-board the payment media held by the user, such as on-board equipment or an IC card

3.10
payment means
value (e.g. cash or stored electronic values), a reference to a central account or a credit card account number or a contract (e.g. a ticket) that gives the user access to available services

3.11
payment medium
the carrier of payment means, such as paper ticket, IC-card, smart phone or on-board unit (OBU)

3.12
prebilling operator
entity for clearing of billing data and for informing on payment claims to issuers

3.13
public transport services
shared passenger transport service which is available for use by the general public, such as buses, trams or trains

3.14
toll regime
set of rules, including enforcement rules, governing the collection of toll in a toll domain

[SOURCE: ISO 17573: 2010, 3.20]

4 Abbreviations

DSRC	Dedicated Short Range Communications
EFC	Electronic Fee Collection
ETC	Electronic Toll Collection
ERP	Electronic Road Pricing
ITS	Intelligent Transport Systems
OBU	On-Board Unit
ODP	Open Distributed Processing
RUC	Road User Charging
HGV	Heavy Good Vehicle
ICC	Integrated Circuit card, IC card
WAN	Wide Area Network

5 Background and context

5.1 Various EFC systems

EFC systems have been introduced all over the world and have become one of the fundamental services of Intelligent Transport Systems (ITS). Regardless of the same type of the service provided, the technical and operational aspects across the existing EFC systems vary (e.g. classification of the charging methods for the DSRC based systems and autonomous systems or account methods for the Central account and On-board account).

A comparison between European EFC and Asian EFC is provided in Table 1.

— In Europe, both DSRC based and Autonomous systems are in operation. In Asia, currently the EFC systems deployed are based on DSRC, the introduction of Autonomous systems is being studied.

— The majority of the EFC systems in Asia use an On-board account method, while most of the European EFC systems use the Central account method.

— An OBU is used as Payment means in EFC systems in Europe, while an IC card in systems in Asia. The issuer of the Payment means is the issuer of the card. In terms of the systems in Asia, this applies to banks, credit card companies and road operators.

— In Europe, service providers, banks or the toll road operators issue the OBU to the user, while in Asia the user usually purchases (and owns) the OBU.

— Interoperability with public transports will be realized by utilizing the common use Payment means in Asia.

Table 1 — Various EFC systems

Item	Region	
	Europe	Asia
1. EFC method	DSRC based EFC Autonomous system	DSRC based EFC (Autonomous system - in Future)
2. Account method	Central account (mainly) and On-board account (Austria and France)	On-Board account (mainly)
3. Payment method	Debit or credit from user's account in central system	Prepaid card and/or Credit card
4. Payment means issuer	Service provision, banks or toll road operators (Payment means=OBU)	Transport related institution (Toll road operator) and/or Financial related institution (Bank, Credit card)
5. OBU issuer	Service provider, banks or Toll road operators	OBU dealers or Toll road operator
6. OBU holder	Service provision (mainly)	User
7. Toll payer	Payment means holder, Vehicle owner	Payment means holder
8. Common payment with public transport	--	YES

5.2 Consideration of EFC architecture and models

5.2.1 General

In order to consider an On-board-account EFC system for common payment scheme for multi-modal transport services, an architecture level (i.e. EFC architecture in ISO 17573:2010) has to be considered.

ISO 17573:2010 contains a role model of the EFC architecture including On-board-account, where the Payment means issuer is an important entity in the On-board-account EFC system. Therefore, the role of this entity in the EFC architecture should be described in more specific and clear way (especially how to use the payment means in EFC system including potential interoperability with any of the relevant transport services).

NOTE The first version of EFC architecture standard was published in 2003. This first version (ISO/TS 17573) described the conceptual model for EFC. The architecture of the on-board account EFC system could be well described in this model, which includes the licensed Collection Agent who recharges prepaid cards and the Clearing operator who will be needed to exchange the transaction data and the claiming data with external Charging systems when common payment with public transport becomes necessary.

5.2.2 Role model (ISO 17573:2010)

At the time when standardization works for Autonomous EFC systems had progressed, the EFC architecture was reviewed and a new version established (in ISO 17573:2010). Figure 1 describes a new model (role model) in the Toll Charging environment of the EFC community. This new role model also explains the interoperability among multiple service providers and toll chargers which is an important aspect for cross-border toll services.

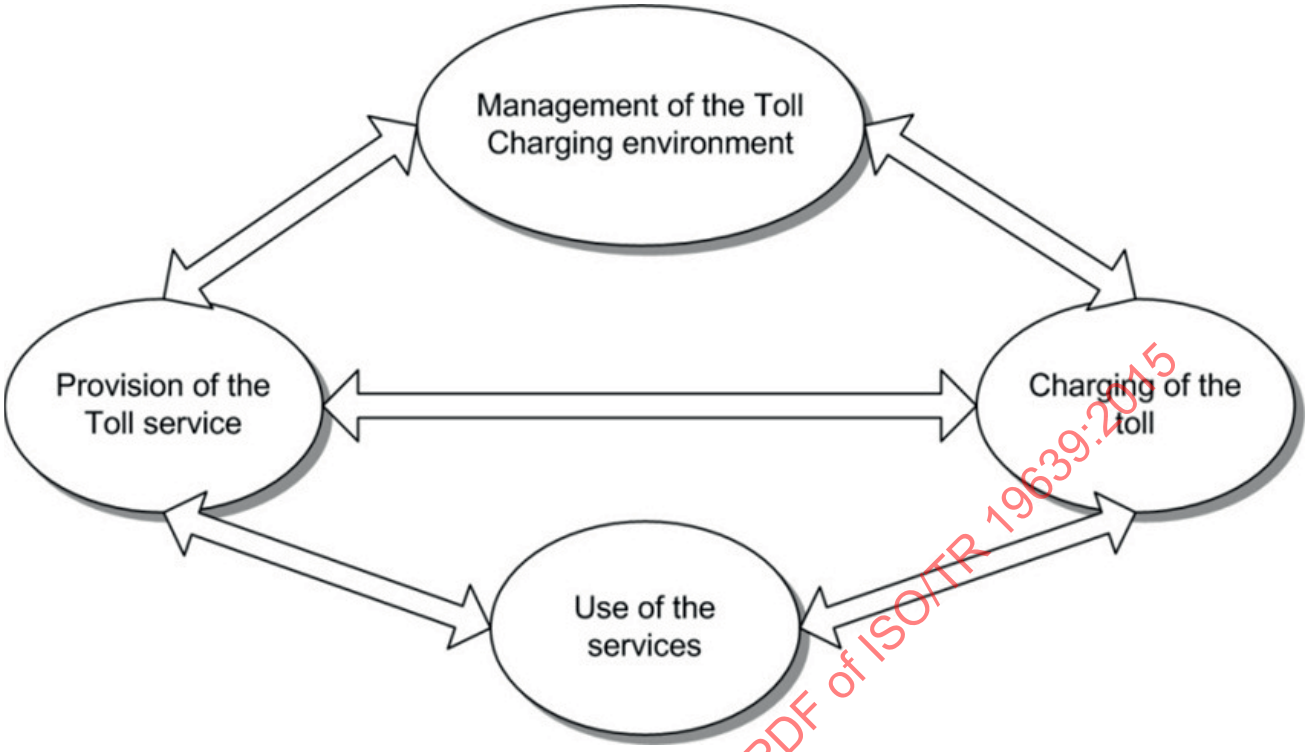

Figure 1 — Roles in the Toll Charging environment

5.2.3 Comparison

The relationships between the new role model and the old conceptual model of the EFC are described in Annex B of ISO 17573:2010. The Issuer role is included in the Provision of the toll service and the Clearing operator role is considered as being outside of the EFC environment and outside of the EFC architecture standard.

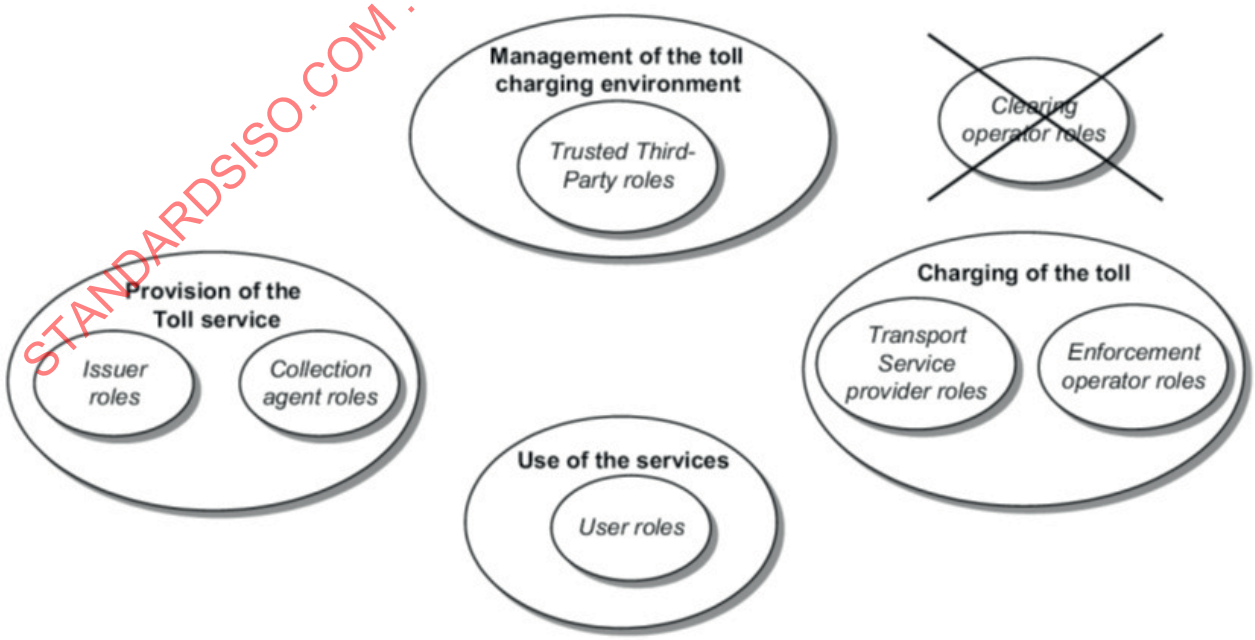

Figure 2 — Comparison of roles between new and old model

On-board account EFC systems using IC cards as payment means are operational in many Asian countries (in some of these countries, IC cards are used also for the public transport services).

A generic role model of On-board account EFC is shown in Figure 2 (as the Issuer role) in which the issuer of payment means has a big role and is an entity with direct interaction with users. Examples of actual EFC systems using payment means in several countries are shown in Annex A.

5.3 Consideration of different account type systems

There are two types of systems, based on the account type implemented: Central account systems and On-board account systems. Existing EFC standards do not fully specify how to realize a common payment scheme in the On-board account system. This is explained in clause 6.

In the case of the central account system, it is feasible to integrate user accounts existing in the central part of the system through the common central account. E.g. existing payment means for transport services are designed for individual service, therefore it seems difficult to migrate these devices into common payment means. The common central account system will have no impact on existing standards because the modification of the existing systems is not necessary. This concept is described in Annex D as well as in ISO/TR 14806:2013.

6 Consideration of On-board account EFC

6.1 Role model

As specified in ISO 17573:2010, the overall EFC architecture is defined by 4 main roles (see Figure 1). Some of these main roles are composed of roles, but adding no more interactions with other roles outside the main role. These definitions constitute the enterprise viewpoint to EFC systems according to the Open Distributed Processing (ODP) definition, see ISO/IEC 10746-1, clause 6.2.2.

As defined in clause 7.3 of ISO 17573:2010 the description of the roles covers also the interaction sequences between roles and therefore the overall functionality. These interaction diagrams represent the ODP information viewpoint of ISO/IEC 10746-1.

However, in case of EFC specific payment means issued by the actor in the EFC environment, in the 2010 version of ISO 17573 there is only the text “providing the payment means”, and no specific interactions defined including the loading/reloading of the on-board account using payment means and how to handle the payment claim by the reload operator getting the physical money or value from the user (however these interactions are included in the phrase “providing the payment meads” in ISO 17573:2010 essentially).

Therefore, descriptions of these interactions are added in this Technical Report (see Figure 4) which completes the information viewpoint for the use of on-board account using payment means.

The following clauses of this document are using the roles of Service Provisioning to recommend how the on-board account using payment means should be used within the overall EFC system configuration.

— payment means issuing

— reload operating

— hot-listing operation

— accepting the payment means

Both on-board account and centralized account payment means are allowed within the EFC regime, and the payment interactions between the Toll Charger and the Toll Service Provider are specified in ISO 12855:—[1)]. So far, the payment means interactions between user and Toll Service Provider, which also covers the role of the Payment Means Issuer, are not specified.

1) To be published. (Revision of ISO 12855:2012)

6.2 Computational architecture

6.2.1 Central account EFC

As discussed in the previous clause, the architecture standard ISO 17573:2010 specifies interoperable EFC clusters in the ODP enterprise and information viewpoint. Deriving from that, the required interfaces between information processing devices the ODP computational viewpoint defined in ISO/IEC 10746-1:1998, clause 6.2.2 is used. However, as shown in Figure 3, which is used in many EFC-related standards, the actual payment information flow is not only between the Toll Service Provider and the Toll Charger, but also between the Payment Service Provider and The Toll Service Provider. However, it is not clear whether the information exchange between the Payment Service Provider and the Toll Service Provider is in or out of the scope of the EFC architecture standard.

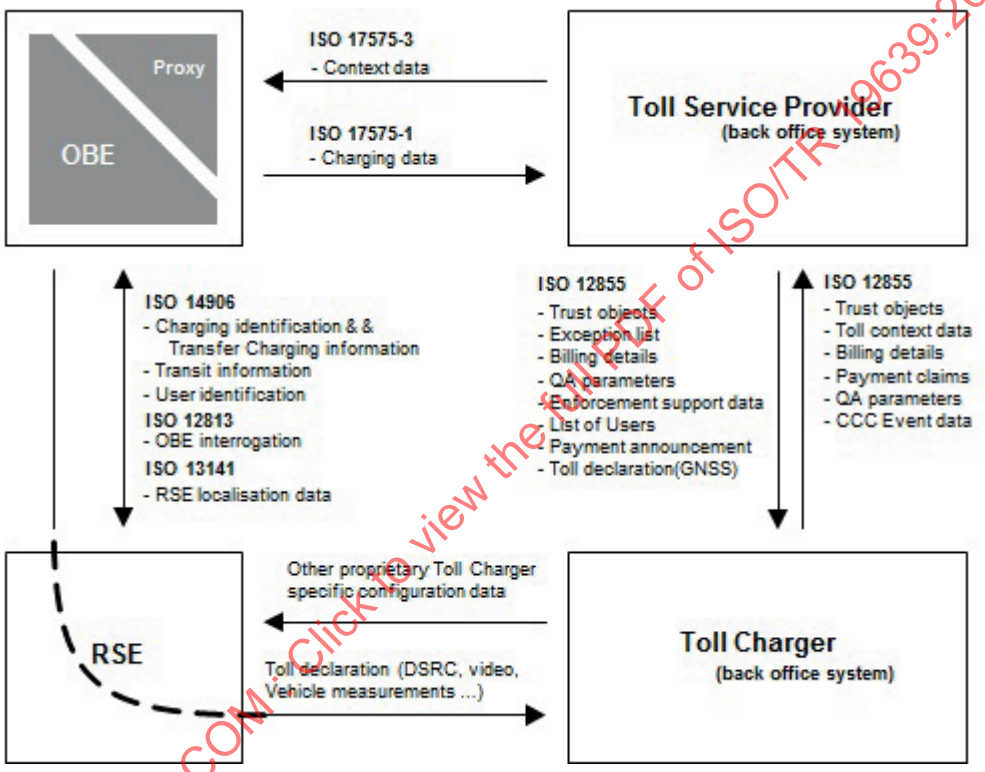

Figure 3 — Computational architecture

Providing on-board account payment means would require including the payment media into the OBE.

6.2.2 On-board account EFC

In Figure 4 the information processing tasks assigned to the actors including the information exchange for on-board accounts is illustrated. A further decomposition of its information processing devices at this level of the computational system architecture would have several options depending on the behaviour and information requirements towards the payment means.

Adding the payment information flows of the on-board account using payment means to the computational viewpoint diagram requires separating explicitly some actors or roles from the Service Provisioning main role. This is specified in clause 7.

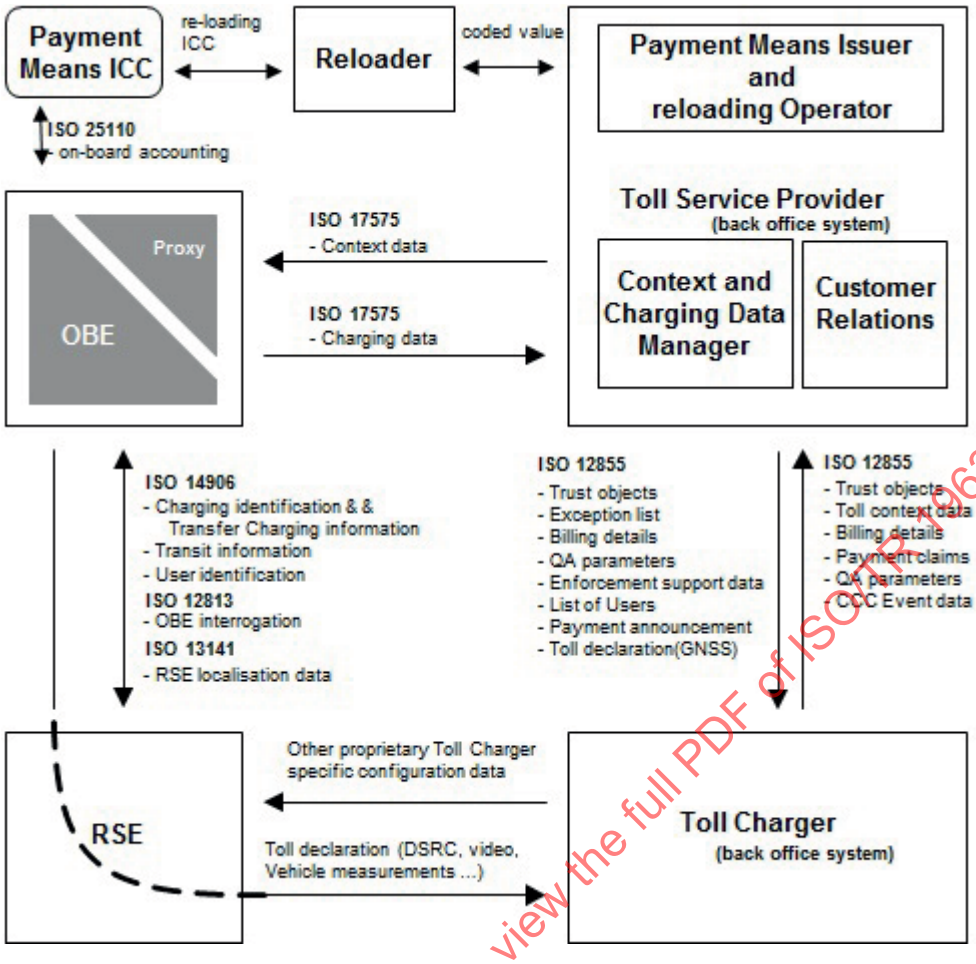

Figure 4 — Computational architecture for On-board account EFC using payment means

It depends also on the general tolling technology – either DSRC or autonomous charging principles – i.e. what processing requirements are specified towards the Toll Service Provider.

Furthermore, for DSRC technology and on-board account payment systems the activity of the Toll Service Provider is reduced to operate the re-loading devices and react on payment claims of the Toll Charger. And if both these activities are operated by non EFC specific entities the "regular" Service Provider role - managing the customer relations and transferring the money from the users to the Toll Chargers – does not exist here.

Clause 8 provides detailed information on how different requirements for different classes of payment means are solved.

6.3 EFC system behaviour for On-board account EFC including payment means

6.3.1 EFC Architecture standard (ISO 17573:2010)

In order to include payment means for both pre-payment and post-payment on-board accounts in an EFC regime which should be interoperable with local public transport systems or even general e-money applications, the overall architecture as specified in ISO 17573:2010 and the additions laid out in this clause should be used.

NOTE Future revisions of the ISO 17573:2010 may incorporate these additions which will make them obsolete in this Technical Report.

6.3.1.1 Action diagrams

(1) Adding (or excluding) a new Payment means issuer

Adding at least one Payment means issuer role to the interoperable EFC scheme is a precondition to start the overall operation. The candidate for the Payment Means Issuer role initiates such operations by applying for the certification process at the appropriate managing authority. If the certification is granted, all of the existing instances of the toll charging role should be informed and the negotiation of bilateral agreements on common operations should be conducted.

The following Figure 5 shows the relevant action diagram. The actor playing the provision role fulfils the basic provision responsibilities.

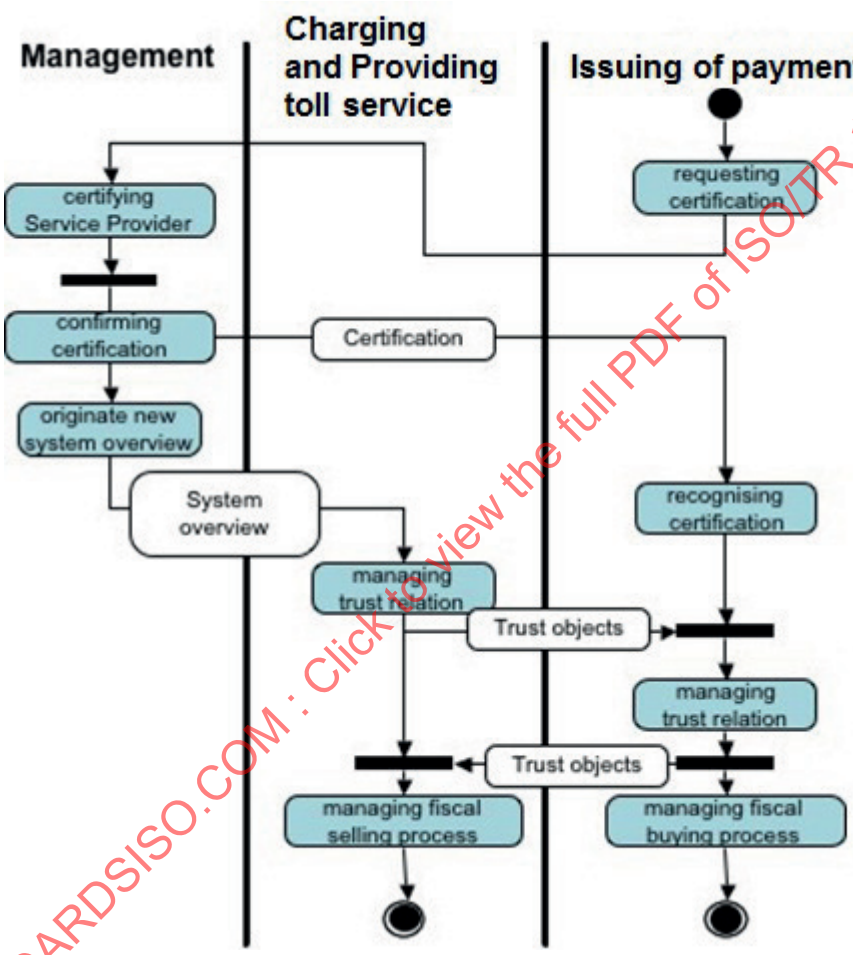

Figure 5 — Adding a new Payment means issuer

(2) Claiming fees from the Payment means issuer

The following Figure 6 depicts the claiming fees process in case of replacing Provision to Payment means issuer. The involved roles are Management and charging and Payment means issuer. In case one of the partners complains that the other partner does not fulfil his obligations defined in the certification, the management will be involved to settle the dispute.

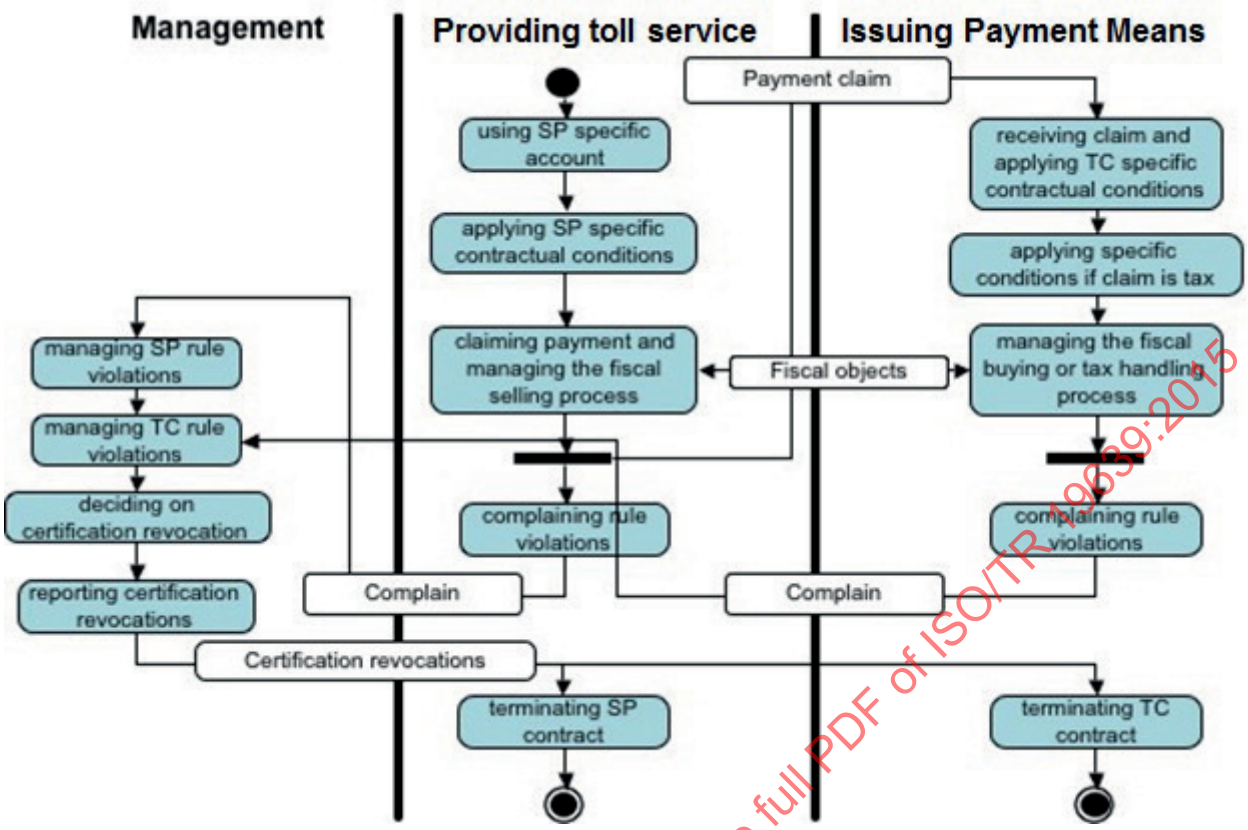

Figure 6 — Claiming fees

7 Consideration for multi-modal transport services

7.1 General

Today, in some parts of the world, the trend for the common use of the Payment means in EFC and public transport is advancing. In some countries, such schemes are already deployed as shown in Annex A. There are different forms of the issuer of the Payment means, as summarized below:

— Case 1 (Payment means issued in EFC regime): The Payment means issuer and all the associated equipment and infrastructure belong to the EFC regime. In this case, the payment means stores EFC specific applications including payment applications.

— Case 2 (Payment means issued in Public transport regime): The Payment means issuer belongs to the Public transport regime. The Payment means issued for the Public transport domain can also be used for EFC. In this case, the payment means stores both EFC specific applications and payment applications functionally owned by non-EFC actors.

— Case 3 (Payment means issued in Electronic money regime): The Payment means issuer and all the associated equipment and infrastructure belong to a third party. The Payment means is of the class e-money and intended to be used for the general-purpose including EFC and Public transport and does not store EFC specific applications.

In all the cases the IC card used as payment means should achieve compatibility with the OBU interface according to ISO/TS 25110.

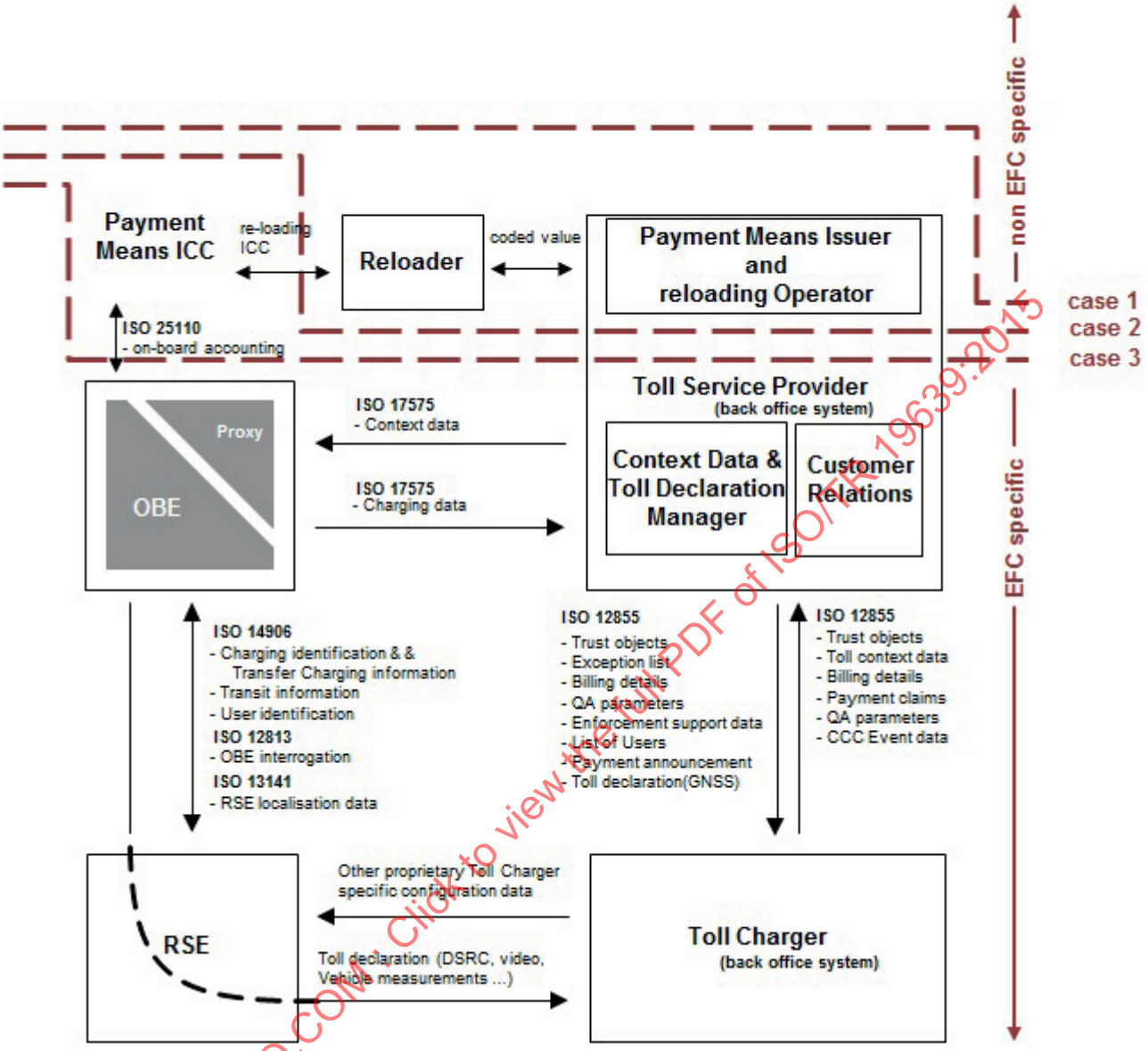

Figure 7 — Computational architecture including common payment scheme

Figure 7 shows the decomposition of the service provider activities and its information exchange with other information processing entities.

7.2 System architecture for Payment means issued in EFC regime (Case 1)

7.2.1 Computational architecture

As illustrated in Figure 7, the case 1 system configuration assigns the responsibility of all the on-board account devices and their management to the Toll Service Provider. It is an EFC specific solution.

The IC card itself and its back-end processing may be compatible with one or more public transport fare management systems. In this case, the IC card must support the toll declaration process of the EFC system as well as the fare declaration assembling process of the public transport regime. The process handling the payment claim of the public transport operator to the EFC service provider is out of the scope of this Technical Report.

The reloading of the IC card should be processed according to one or more of the following options:

— operating a number of teller machines accessible for the road users,

— providing a manual cash reload process at the promises of the EFC service provider,

— providing an on-line reload process for the IC card in the OBE if OBU has a wide area network (WAN) interface such as Cellular Network,

— or others.

The interface between the IC card and a teller machine as well as the interface between the teller machine and the Service provider back-end is an internal EFC service provider interface and not addressed in this Technical Report. This applies also for the other re-load options.

The IC card should support the toll declaration assembling process as specified in ISO 14906 and ISO 12855:—[2)]. This applies for DSRC as well as for autonomous EFC systems.

7.2.2 Architecture of EFC systems for common payment scheme

According to ISO 17573:2010 as well as to the case 1 definition in clause 7.1 of this Technical Report, all actors required for on-board account EFC payment are under the responsibility of the Service Provider.

Figure 8 shows the allocation of tasks to operative entities in EFC regimes for a common payment scheme and explain the relationship between EFC regime and public transport regime.

2) To be published. (Revision of ISO 12855:2012)

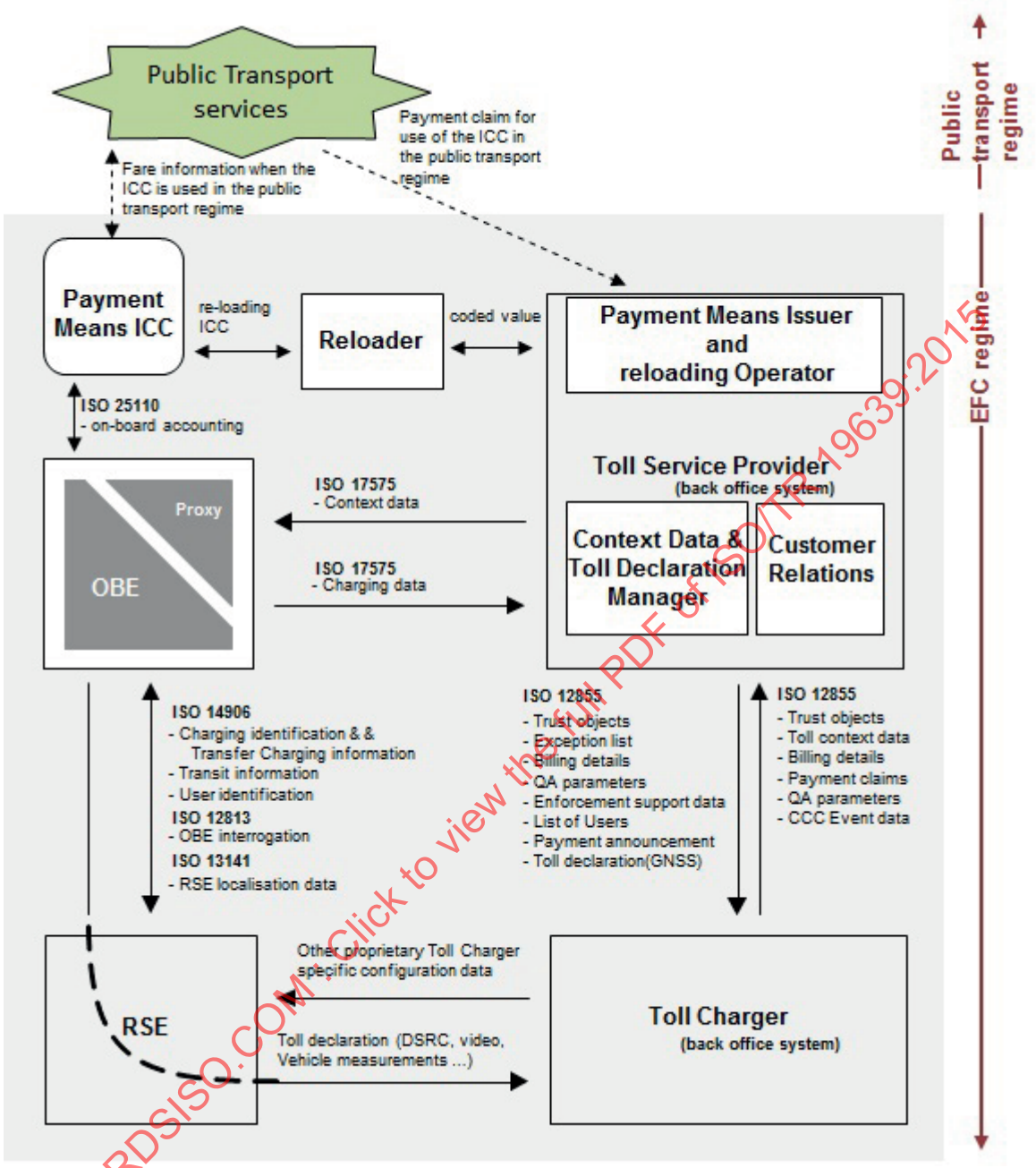

Figure 8 — Task Allocation where Payment means issued in EFC regimes are used for common payment schemes

The Service Provider may be part of an organisation managing more than the associated EFC regime. This may be a public transport system or other services.

The Service Provider may outsource parts of its operational tasks to other organisations or entities. This does not relieve him from bearing the responsibility for these activities.

7.3 System architecture for Payment means issued in Public transport regimes (Case 2)

7.3.1 Computational architecture

As illustrated in Figure 7, the case 2 system configuration should allow assigning EFC specific roles and responsibilities to entities having their main activities outside the EFC environment as specified in ISO 17573:2010, Clause 5.1.

In this case, the IC card must support the fare declaration process of the public transport system as well as the toll declaration assembling process of the EFC regime. The process handling the payment claim of the EFC service provider to the public transport operator is out of the scope of this Technical Report.

This should support the re-use of existing IC card issuers including their infrastructure for reloading the IC card. It may allow adding EFC specific features to IC cards, such as the vehicle configuration parameters or EFC specific security means. This should not jeopardize the functionality the IC card originally was designed for.

These IC cards, when used for tolling and other applications, should be able to be reloaded at locations close to the tolling road infrastructure.

7.3.2 Architecture of EFC systems for common payment scheme

The public transport organization takes an additional role which was originally specified as part of the EFC environment. This does not reduce the functions of the none-EFC roles which are played by the EFC external organization. The Architecture of interoperable fare management system is described in ISO 24014.

In contrast to case 1, the case 2 configuration of the EFC system will include organizations which originally were not focusing on EFC but are now performing an additional role within the EFC environment as specified in ISO 17573:2010, clause 5.1. This reduces the tasks compared to organizations operating according to the full role allocation of the service provisioning. In case the selling process of IC cards is also outsourced, then the remaining rest of service provisioning functions comprises just the payment clearing with the Toll Charger and the customer care.

Figure 9 shows the allocation of tasks to operative entities in EFC and Public transport regimes for EFC systems for common payment scheme and explain the relationship between EFC regime and public transport regimes. Both Public transport application and EFC application and common value data are stored in one IC card and can be used in EFC regime and Public transport regime.

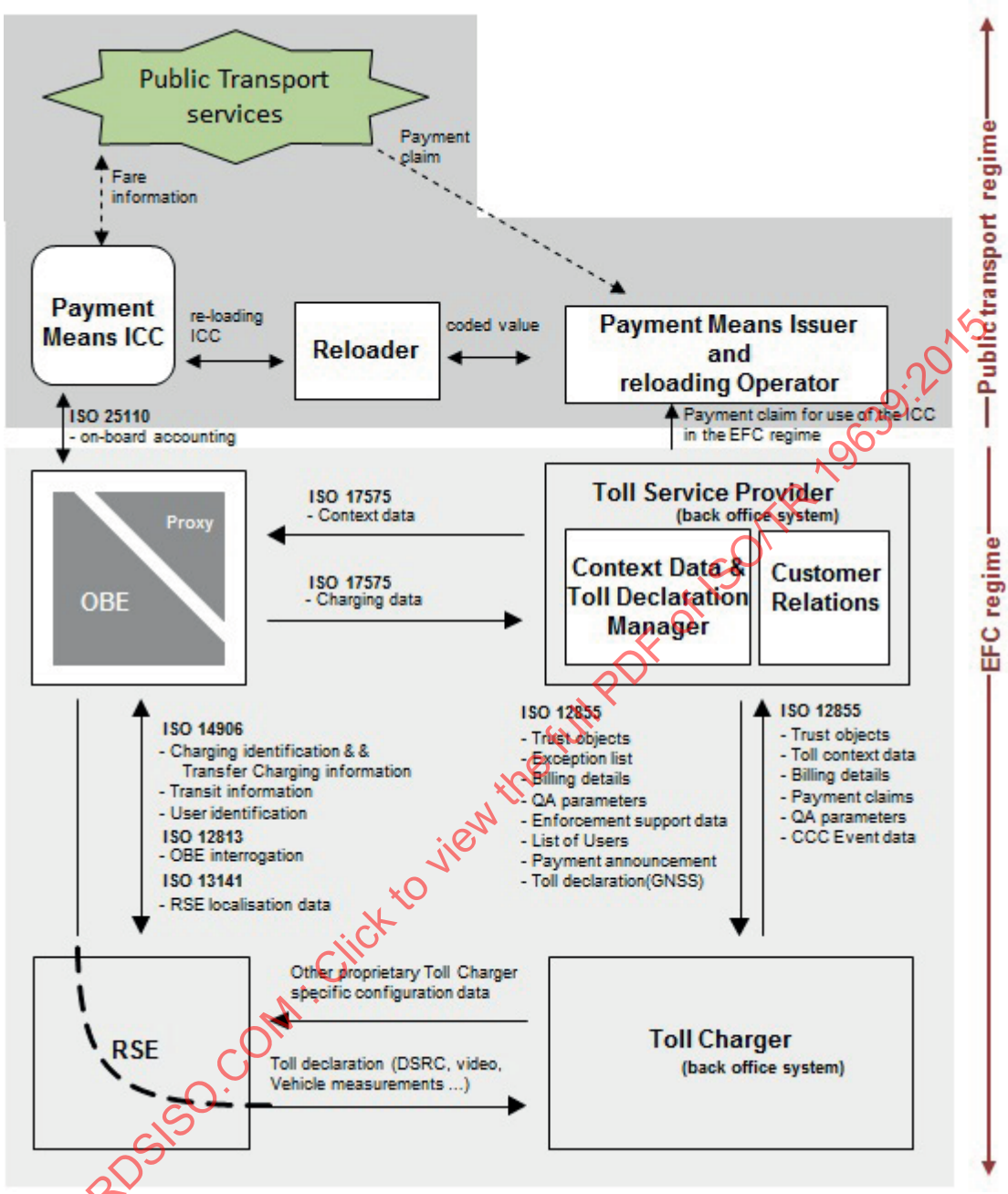

Figure 9 — Task Allocation where Payment means issued in Public transport regimes are used for common payment schemes

The Payment means issuer should handle the customer care for questions regarding the IC card and the reloading process.

Payment clearing process of the on-board account payment with the Toll Charger comprises just forwarding requests and responses from the Toll Charger to the Payment means issuer and back. This may result in assigning the rest of the customer care role to the local toll operator in addition to his tasks relevant to the role of a Toll Charger. Therefore, the Payment means issuer (and operator of the IC card re-load devices – where the money comes from) should directly communicate with the toll operator for clearing the payment claim.

NOTE 1 This is still strictly according to the ISO 17573 architecture. However, the assignment of roles to operational entities cuts the main roles differently as in the system configurations according to case 1.

The information exchange between the IC card issuers back office and the EFC operator should be implemented using one of the following options:

— using the existing interface of the applied public transport system and assigning to the EFC operator as actor of the service provisioning role the task of converting the toll declarations to financial objects,

— using the interface according to ISO 12855:—[3)] and assigning the service provider role task of converting the toll declarations to financial objects to the IC card issuer. In this case, the IC card issuer must implement an EFC specific functionality into his back-office system.

NOTE 2 Further investigations will clarify if the currently available ADUs of ISO 12855:—[3)] are sufficient for it.

7.4 System architecture for Payment means issued in Electronic money regimes (Case 3)

7.4.1 Computational architecture

As illustrated in Figure 7, the case 3 system configuration should allow assigning EFC specific roles and responsibilities to entities having their main activities outside the EFC environment as specified in ISO 17573:2010, Clause 5.1.

In contrast to case 1 and case 2, the case 3 overall system configuration of on-board account tolling payment allocates (according to ISO 17573:2010) roles to EFC environment external entities which will not modify their existing concept to make it usable for EFC. Hence, the use of this e-money functionality will require adapting the EFC system to their existing interfaces. These cover the OBU – IC card interface including its security policy and key management as well as the IC card issuer – EFC operator interface.

NOTE As already discussed in the case 2 version, the strict role allocation of all service provisioning roles to a road owner external organization is not necessarily required. In DSRC systems the "remaining" roles (when allocating the payment means issuer to an external organization) most likely will be allocated to the EFC operator which carries already the role of the toll charger. With this the payment means issuer according to the case 3 definition will directly communicate with the EFC operator for the purpose of payment claim clearing.

According to the EFC architecture standard ISO 17573:2010, clause 7.2 and others, the IC card issuer – EFC operator interaction is actually a service provisioning internal interaction between parts of the basic provision role (allocated to the payment means issuer) and providing toll declaration, the conversion of tolling objects to financial objects and vice versa. Hence, implementing this interaction requires a purely financial interface standard which is out of the scope of the suite of EFC standards.

7.4.2 Architecture of EFC systems for common payment scheme

The allocation of operational tasks to organisations in case 3 is similar to case 2 (see Figure 7). However, the responsibility for the functionality of the IC card is fully in the hands of the Payment means issuer. In most cases this will be an existing e-money organisation. It is also fully under the responsibility of the IC card issuer where and how to implement means for reloading the IC card by users.

Figure 10 shows the allocation of tasks to operative entities in EFC, Public transport and E-money regime for multi-modal payment service and explains the relationship between EFC regimes and public transport regime and e-money regime. E-money applications in IC cards can be used in EFC regime and Public transport regime.

NOTE 1 Payment claim by public transport services and fare information are fully EFC external interfaces which should be out of the scope of this Technical Report. Similarly, Payment claim by E-money services and E-money information are fully EFC external interfaces which should be out of the scope of this Technical Report also.

3) To be published. (Revision of ISO 12855:2012)

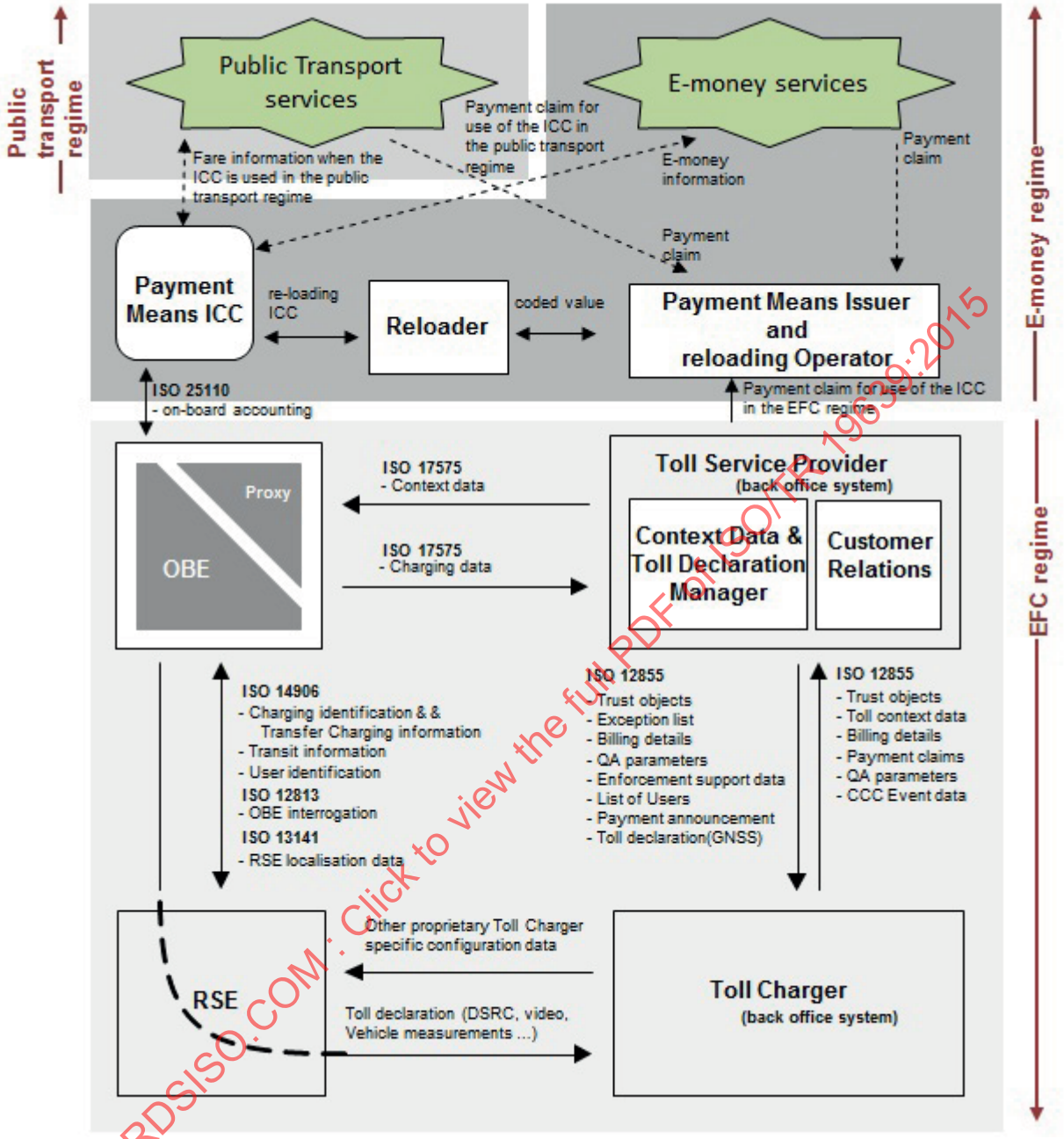

Figure 10 — Task Allocation where Payment means issued in Electronic money regimes are used for common payment schemes

The information exchange between the IC card issuers back office and the EFC operator should be implemented using one of the following options:

— Using the merchant interface of the applied e-money system and assigning to the EFC operator as actor of the service provisioning role the task of converting the toll declarations to financial objects.

— Using an interface according to ISO 12855:—[4)] and assigning the service provider role task converting the toll declarations to financial objects to the IC card issuer. In this case the IC card issuer must implement an EFC specific functionality into his back-office system.

4) To be published. (Revision of ISO 12855:2012)

NOTE 2 The merchant interface is the interface between the e-money terminal at the POS and the clearing operator connected via a WAN aiming on paying the merchant who has delivered the purchased goods to the customer.

NOTE 3 In the case of using e-money cards in EFC regimes, the merchant is either the Toll Charger (in DSRC systems) or the entity taking the part of the responsibility of the service provider claiming to the e-money card issuer the payment for toll declarations received from the OBE.

In case of autonomous systems, the Toll Charger should assign the delivery of context data to the OBE to an external organisation or manage this by its own. Again this is still part of the role of the service provisioning.

8 Conclusions and recommendations

8.1 General

This clause summarises the consideration, results and recommendations for existing EFC standards and other recommendations for common payment scheme for multimodal transport service.

The EFC architecture standard, ISO 17573, defines the role model and the interactions for Toll charging environments. It is, however, restricted to determine the amount to be charged for the use of toll domains and to issue appropriate payment claims. Hence, the payment including the actual money flow is out of its scope. The payment to the Toll Charger is assumed to be state-of-the art based on business to business interactions. The payment from the User to the Toll Service Provider is seen as part of the role service provisioning and is not outlined in detail. In case prepaid payment means is a payment option for users, the toll service provider may define it either according to its own requirement or re-using an existing one which may be compatible with other applications like public transport or even e-money.

Issuing and operating of payment means which has an important role to apply EFC architecture to On-board-account EFC system is explained in clause 5. When implementing On-board-account EFC system, explanation of the Action diagram of Payment means issuer becomes important like other entities in EFC environment. For clearly identifying this, clause 6.3 explains the diagram of Adding and Claiming of Payment means issuer which is a role of Service providing in the EFC environment.

In clauses 6 and 7, Computational architecture and EFC systems for a common payment scheme for three cases, which describe Payment means in On-board-account EFC system, concretely was explained to identify undefined interfaces in EFC architecture or interactions with outside of EFC regime.

For real implementations allowing the use of prepaid payment means, however, some specific detailed requirements must be specified. These EFC specific requirements are currently not standardised.

This leads to the need of some additional standardised EFC specific interface definitions specifying the data elements required to handle the EFC payment process observing the security, the privacy and interoperability with other applications like public transport or even e-money.

8.2 Main findings

To realize the common payment between EFC and the public transport, it is necessary to develop the following interfaces and information exchanges in the three cases of the Payment means issuer described in clause 7.

The reloading can either take place directly with the ICC or via DSRC, and therefore the following two interfaces are distinguished:

— Interface between Payment means (the ICC/hardware directly) and Payment Means Issuer, where new definitions will concentrate on specifying the use of existing and standardised payment means interfaces when used in EFC systems;

— Interface between Payment means and OBU, as described in 6.2.2, is an essential part of pre-payment EFC systems.

NOTE 1 ISO 14906 defines the DSRC application interface including a reloading function in form of the credit command.

NOTE 2 ISO/TS 25110 defines the ICC access method via OBU.

In addition, it is necessary to clarify the following requirements for real systems that are the prerequisites of information exchange before introducing a common payment system, though some relating standard exist but it is out of scope of these standards.

— Requirements for security with the focus on re-using the existing security means of existing payment means when used in an EFC environment. E.g. hot-listing operations are assumed to be a part of the security requirements.

NOTE 3 Requirements for payment media are described in Payment Card Industry Data Security Standard.

NOTE 4 ISO/TS 19299 describes the security framework including payment means.

NOTE 5 ISO/TS 17574 describes the security protection profile of on-board account using payment means.

— Requirements for Payment means with the focus on required additional features of existing payment means allowing their use in EFC systems.

— Requirements for Clearing between other EFC regimes establishing an interoperable EFC cluster when using common payment means, e.g. currency conversion issues. In the case of pre-payment, as the specific currency is stored in the payment media, a problem of conversion occurs at the time of charging varying in the currency. This is an operational issue that requires the agreement for the clearing between operating companies in the area varying in the currency. In the case of post-payment, the payment service provider will be able to do the processing just like a credit card company performs processing of currency conversion at payment after delivery.

— Identification of existing payment means related standards to be taken into account in future specifications or standardisation works.

NOTE 6 EFC interoperability pre-payment requirements (for central and on-board accounts) are described in CEN/TR 16092, but not for post-payment on-board accounts.

NOTE 7 The ISO 12812 series describes mobile payment including e-money services.

NOTE 8 The EMV suite of specifications defines payment cards and associated devices.

— Requirements for OBU specifications. E.g. OBU has to be specified to communicate and communicate with payment means on basis of existing standards. Requirements for EFC application interface definitions which are defined in ISO 14906 and three types of accessing methods are described in ISO/TS 25110.

NOTE 9 ENV 14062-1/2 define the IC card interfaces, physical characteristics, electronic signals and transmission protocols and message sets for EFC.

NOTE 10 The ISO/IEC 7816 series describes contact type of IC card interface, the ISO/IEC 14443 series describes contactless type of IC card interface, and the ISO/IEC 18092 describes near field communication interface.

8.3 Recommendations for the EFC architecture standard (ISO 17573:2010)

In order to define the EFC architecture using the payment means more clearly, in new revisions of ISO 17573, the payment means should be included in the information viewpoint.

ISO 17573:2010, clause 5.1 and Figure 1, defines what is inside and what is outside an EFC environment. These definitions should be extended in a way that e.g. financial systems may take roles defined as being part to the EFC environment even if it is not the main business of these entities.

Because it is most likely that in actual implementations of on-board account EFC systems the actors for the Service Provisioning roles are including:

— payment means issuing,

— operating the re-load machines, and

— operating the on-board account payments with the Toll Charger.

These might be assigned to non-EFC specific organisations and the interfaces between them when these are outside of Toll charging environment and has interaction with Toll charging environment. And the EFC specific actors and interfaces should be specified and/or standardised.

The expanded EFC architecture was described in clause 6.2, and the new additional action diagrams are described in clause 6.3.

8.4 Recommendations for new work items

This clause describes undefined interfaces in EFC architecture using Common payment media and also explains security in EFC architecture using Common payment media and requirements regarding clearing and specification in terms of Payment means in interoperable regime, and the need of the investigation of requirements on the interface.

In order to define the EFC architecture using the Payment media more clearly, it is required defining of the Payment means and following interfaces including message sets.

8.4.1 Application interface for reloading

— Interface between Service user (payment media) and Payment Means Issuer because payment media and this issuer are important actor for on-board account EFC and have important roles in EFC environment.

— Interfaces between payment means and reloading device and between payment means and OBU including application data exchanges. Base standards relating to these interfaces are described in clause 8.2. In addition, the following specifications are necessary:

  — Payment data elements,

  — Reload data elements.

8.4.2 Information exchange between Toll service provider and Payment Means Issuer

— Interface between Payment Means Issuer and Toll Service Provider in service providing. This interface is minor but important for on-board account EFC.

  — Payment claim focussed on the data elements collected during the merchant interaction.

  — Payment re-using existing ADUs and security means.

8.4.3 Requirements of Payment means for EFC use

Following rearrangement of requirements and study of interfaces and information exchanges will be necessary to realize the common payment in Multi-modal transport services.

— Requirements for security. These are described in clause 8.2.

— Requirements for Payment means. These are described in clause 8.2, and additionally the following definitions are necessary for EFC operation in case of on-board account using payment media.

  — Data Definitions for EFC Application in the Payment media.

— Requirements for Clearing between EFC regime, Public transport regime and E-money regime. These requirements should be contract issues among relating actors, these are described in clause 8.2.

— Requirements for OBU specifications. The OBU should support the required interface for accessing payment means, as described in clause 8.2.

NOTE CEN/TR 16092, *Electronic fee collection - Requirements for pre-payment systems* was published in 2010. If a new ISO standard was to cover similar issues, it should seek to take into account this TR and reference to it whenever appropriate.

Annex A
(informative)

Various EFC systems

Detailed comparison of EFC systems in Asian countries is shown on Table A.1.

Table A.1 — Comparison of various EFC systems

Item	Region				
	Europe	Asia			
	(ETC, HGV, RUC)	Japan ETC	Korea ETC	Malaysia ETC	Singapore ERP
1. EFC method	DSRC based EFC Autonomous system	DSRC based EFC (Autonomous system - in Future)			
2. Account method	Central account (Note1)	On-Board account			
3. Payment method	Debit or credit from user's account in centre system	Credit card	Prepaid card Credit card	Prepaid card	Prepaid card Post pay card
4. Payment means issuer	Service provision, banks or toll road operators (Payment means=OBU)	Toll road operators Credit card companies	Toll road operator ,Banks Credit card companies	Transport related company	Financial related company Transport related company
5. OBU issuer	Service provision, banks or toll road operators	OBU dealers (Note 3)	OBU dealers	Toll road operator	Toll road operator
6. OBU holder	Service provision (or User) (Note 4)	User	User	User	User
7. Toll payer	Payment means holder, Vehicle owner	Payment means holder	Payment means holder	Payment means holder	Payment means holder
8. Common payment with public transport	--	YES (Note2)	YES (Note5)	Yes	Yes

NOTE 1 In Austria and France, on-board-account using OBU is operated for several toll roads.

NOTE 2 The IC card for EFC which is the uniform standard in Japan is not available in public transport, however, at some rural toll road the public transport IC card is used.

NOTE 3 OBUs are sold at automobile dealers and auto-supply shops, and at the same time, the OBU sellers conduct registration of the automobile inspection certificate.

NOTE 4 In some road route, OBUs are sold.

NOTE 5 In Korea, the new IC card available in both public transport and EFC is being planned.

NOTE 6 The Chinese ETC market employs an on-board account payment model. The Chinese ETC model is similar to the other Asian countries in Table A.1.

Annex B
(informative)

Examples of EFC systems using payment means

B.1 Korean EFC model

The ETC in Korea began full scale operation in 2005 and is available now on expressways of the whole country. The payment of the fee is done without stopping the car through an IC card called Hi-Pass card inserted into the on board equipment, and the same IC card can also be used for one stop paying method called "Touch & Go."

The payment card has three kinds according to the publisher as follows.

— Case 1: Cards published by the KEC (Korea Expressway Corporation) – Prepayment.

— Case 2: Cards published by the Bank – Prepayment.

— Case 3: Cards published by the credit card company –Post payment.

The "reloader" is the equipment to recharge the prepaid card and is installed in the service area of the express way and the main service point in the city.

The function of the Clearing Centre is different from that of the so-called Clearing House; it makes Payment Claim data for each Card Issuer based on the Toll Declaration data (Debit Trx Data) collected from the Toll Charger. It is a function same as the Japanese Consolidated Center.

Each payment from Card Issuer to respective Toll Charger is processed via Bank which does not have active role in EFC and may be deleted in the Figure B.1.

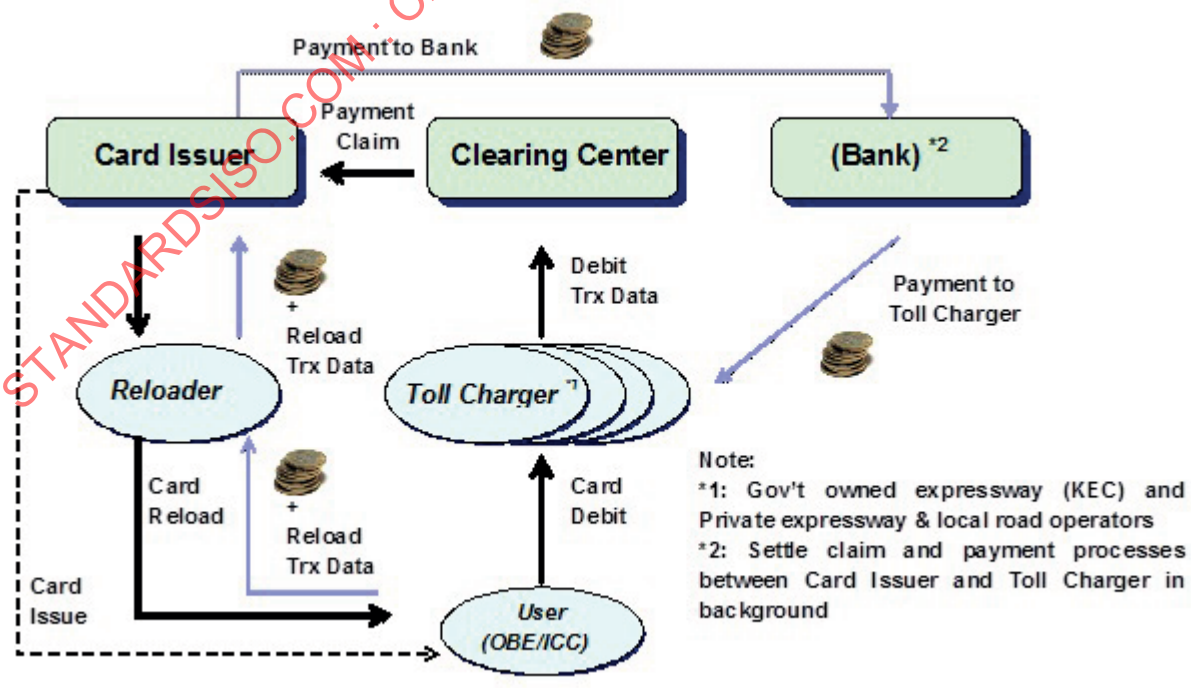

Figure B.1 — Korean EFC model

B.2 Japanese EFC model

B.2.1 Overview

Full-scale operation of the Japanese ETC began in 2000 and the ETC is available now on expressways of the whole country. The payment is performed by inserting the chip card called an ETC card published by credit card companies into the on board equipment of the vehicle.

Figure B.2 is the UML actor's role described in the Annex E of ISO 17573:2010.

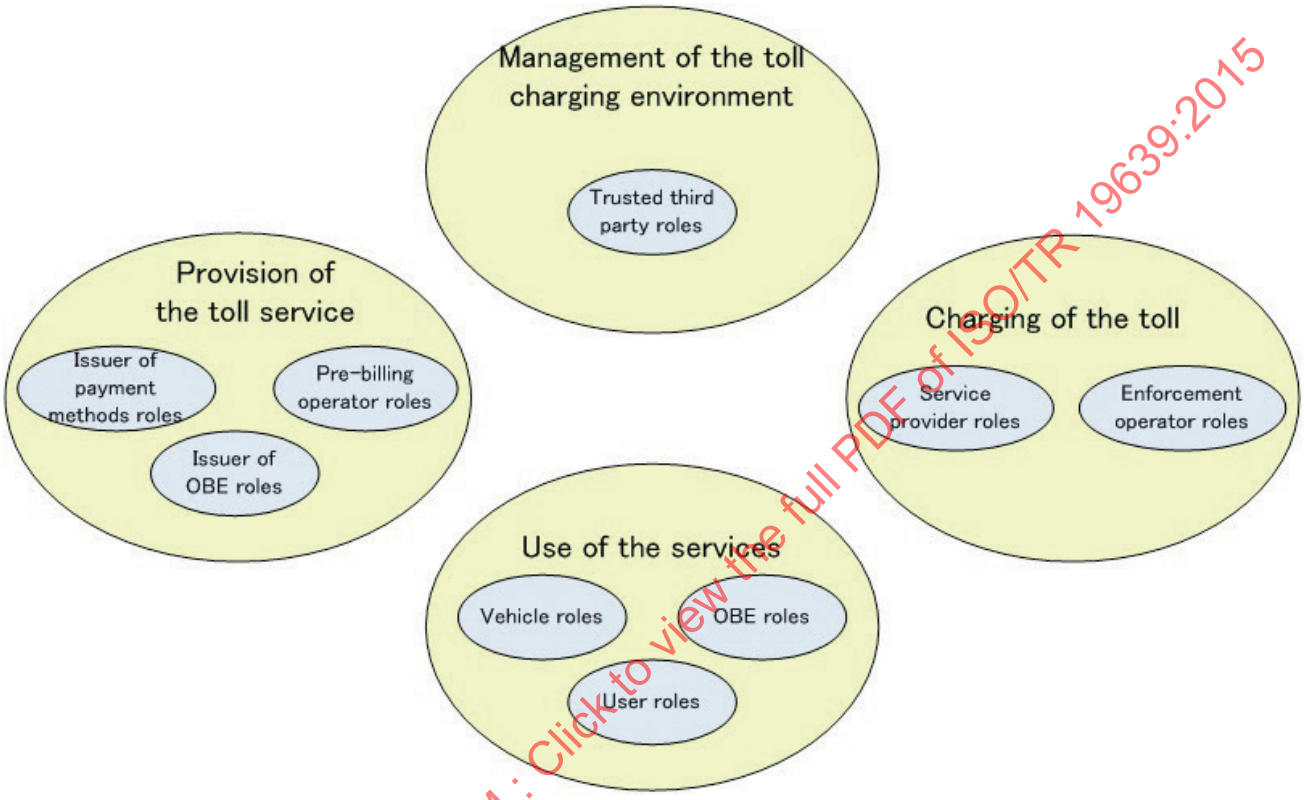

Figure B.2 — UML actor's roles in the new model in ISO 17573:2010

In the case the Payment means issuer (Card issuer) is newly added, the process flow is as shown in Figure B.3.

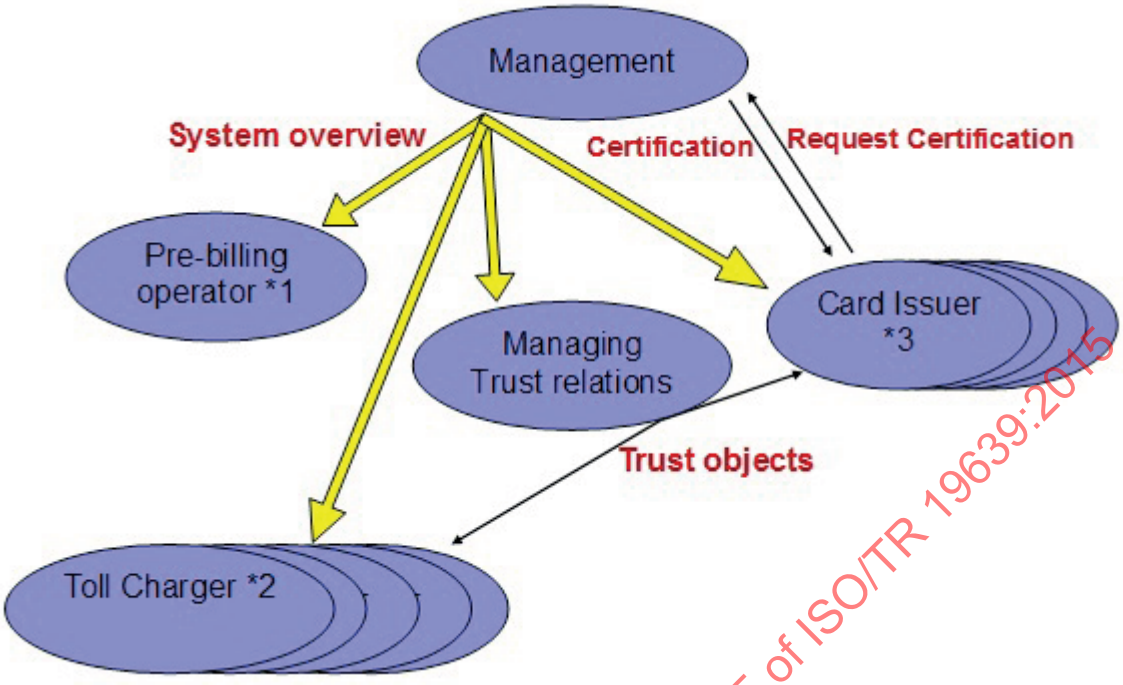

Figure B.3 — Japanese EFC model of Exchange trust objects

The Pre-billing operator is a central system managed jointly by the Toll Chargers, and as in the case of the Korean Clearing Centre, it prepares for every Card Issuer the Payment Claim data based on the Toll Declaration data collected by the Toll Charger.

Each payment from Card Issuer to respective Toll Charger is processed via Bank which is not in the Figure B.4 because it does not have active role in EFC.

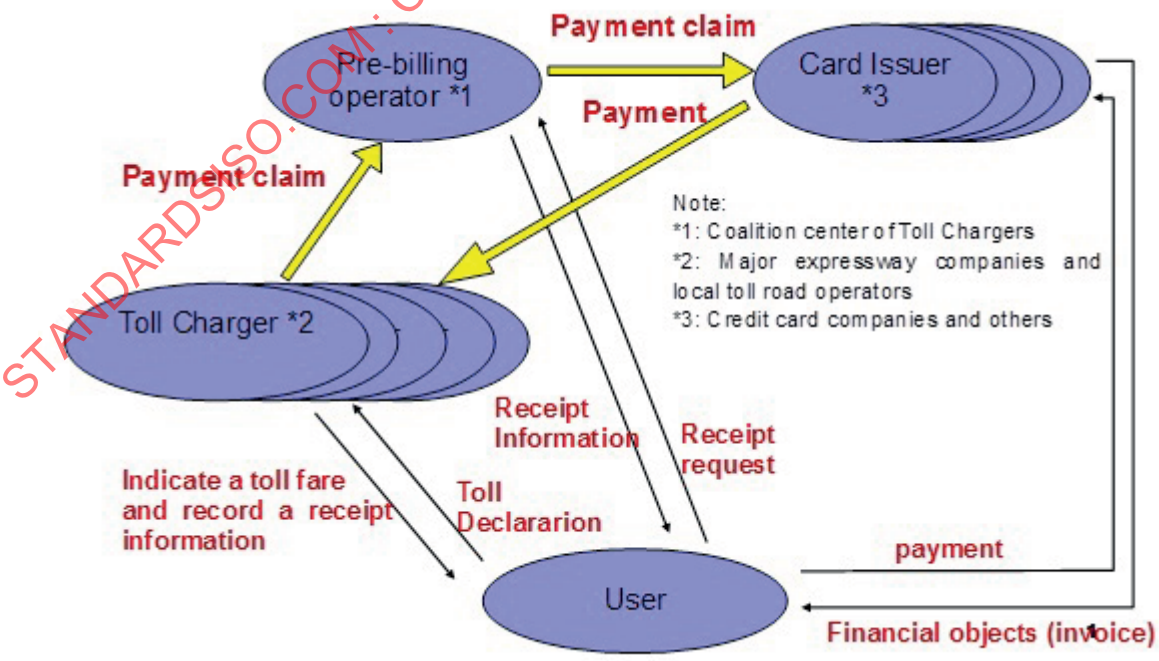

Figure B.4 — Japanese EFC model of Claim payment

B.2.2 Exchange trust objects

Management EFC system overview authorizes a new Payment means issuer when new Payment means issuer requests participating into toll environment, and generates new issuer number for the new payment means issuer.

Management EFC system overview distributes updated issuer number as system overview information to all actors in toll environment. Refer to Figure B.5.

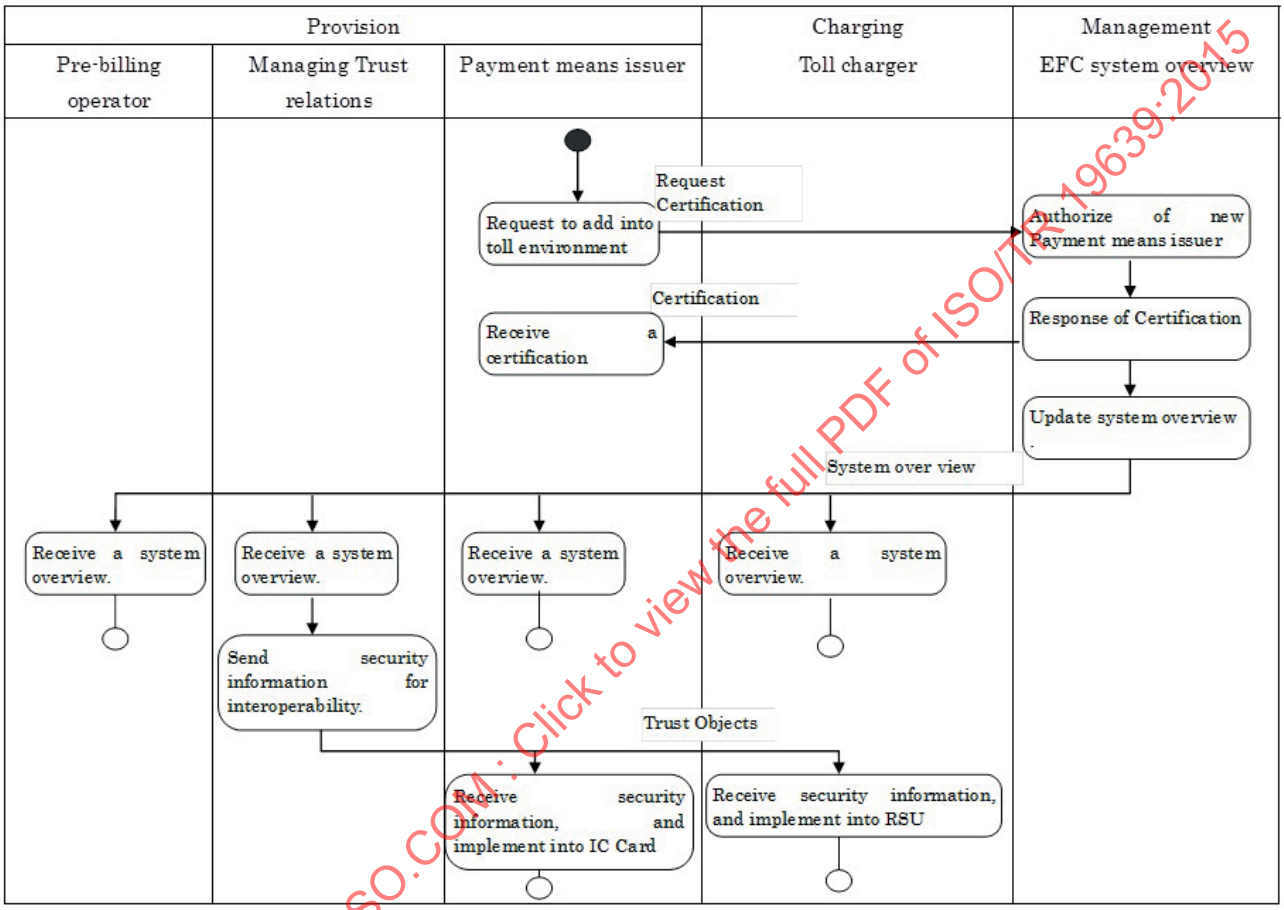

Figure B.5 — Exchange trust objects involving Payment means issuer

B.2.3 Claim payment

Figure B.6 is the sequence flow of the Claim payment.

Toll Charger(s) sends payment claim to Pre-billing operator in an agreed frequency (e.g. tour time per month).

Pre-billing operator calculates individual due amount for each Toll Charger, and reports divided due amount to Toll Charger. And Pre-billing operator sends Invoice to Payment means issuer(s) separately.

Payment means issuer(s) pays due amount according to Invoice to each Toll Charger. After this payment, Payment means issuer(s) has a responsibility to collect all user bills from User.

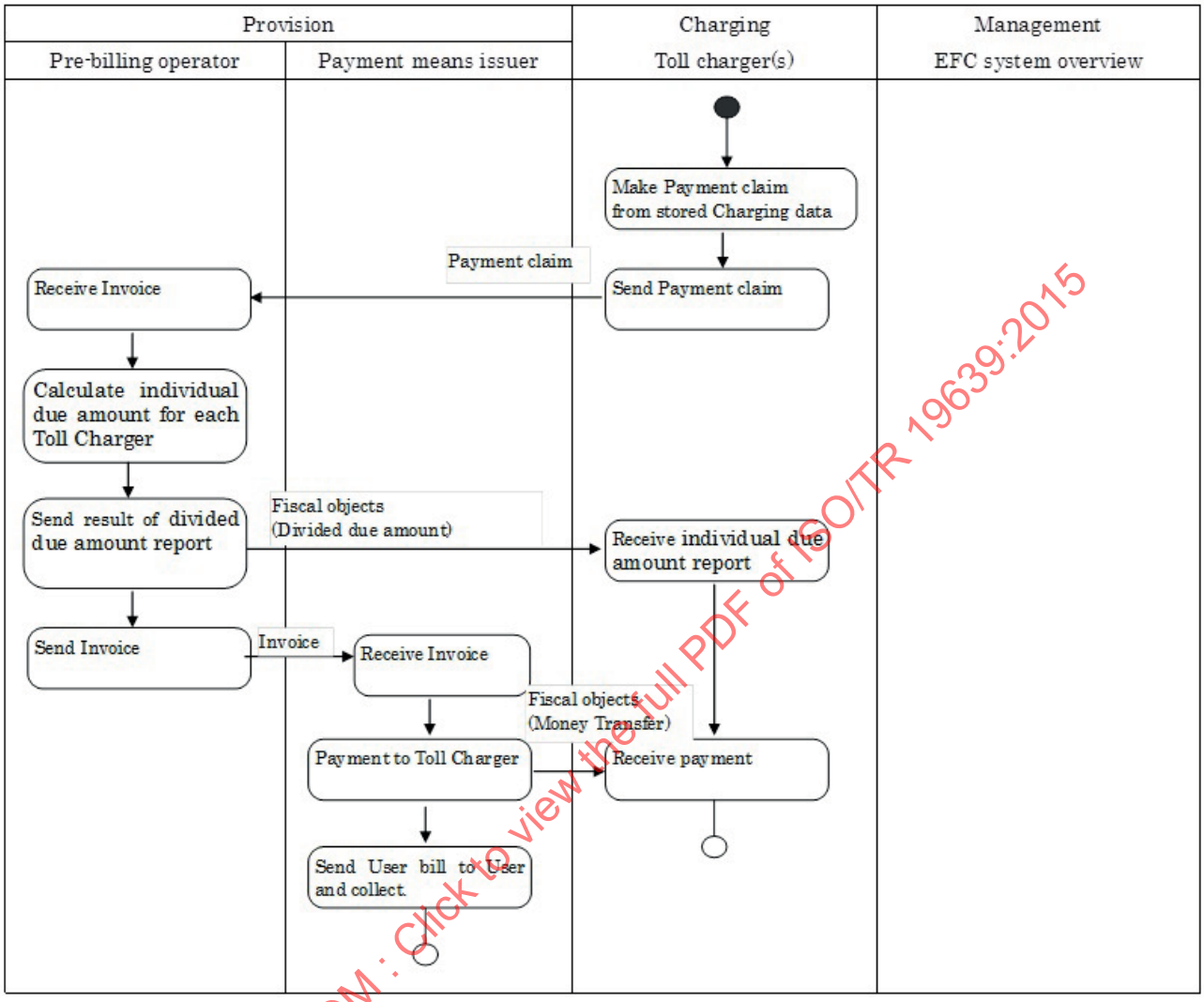

Figure B.6 — Claim payment for service usage involving Payment means issuer