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Electronic fee collection — Information exchange between service provision and toll charging

Perception du télépéage — Échange d'informations entre la prestation de service et la perception du péage

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO 12855 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*, in collaboration with Technical Committee CEN/TC 278, *Road transport and traffic telematics*.

Introduction

The widespread use of tolling also requires provisions for users of vehicles that are circulating through many different toll domains. Users should be offered a single contract for driving a vehicle through various toll domains. Where those vehicles require a form of on-board equipment (OBE) this should be interoperable with the toll systems in the various toll domains. In Europe, for example, this need has been officially recognized and legislation on interoperability has already been adopted (see Directive 2004/52/EC). There is both a commercial and economic justification in respect to the OBE and the toll systems for standards enabling interoperability.

The system architecture defined in ISO 17573 is the basis for all standards that relate to tolling systems in the toll domain. From this system architecture standard, other standards have consistently reused

— common definitions of terms and concepts and basic system functionalities and structure,

— common terminology, and

— identified interfaces that are or need to be defined.

ISO 17573 uses ISO/IEC 10746-3 for the description of the architecture.

The following figure shows the scope of the group of electronic fee collection (EFC) related standards based upon the architecture standard.

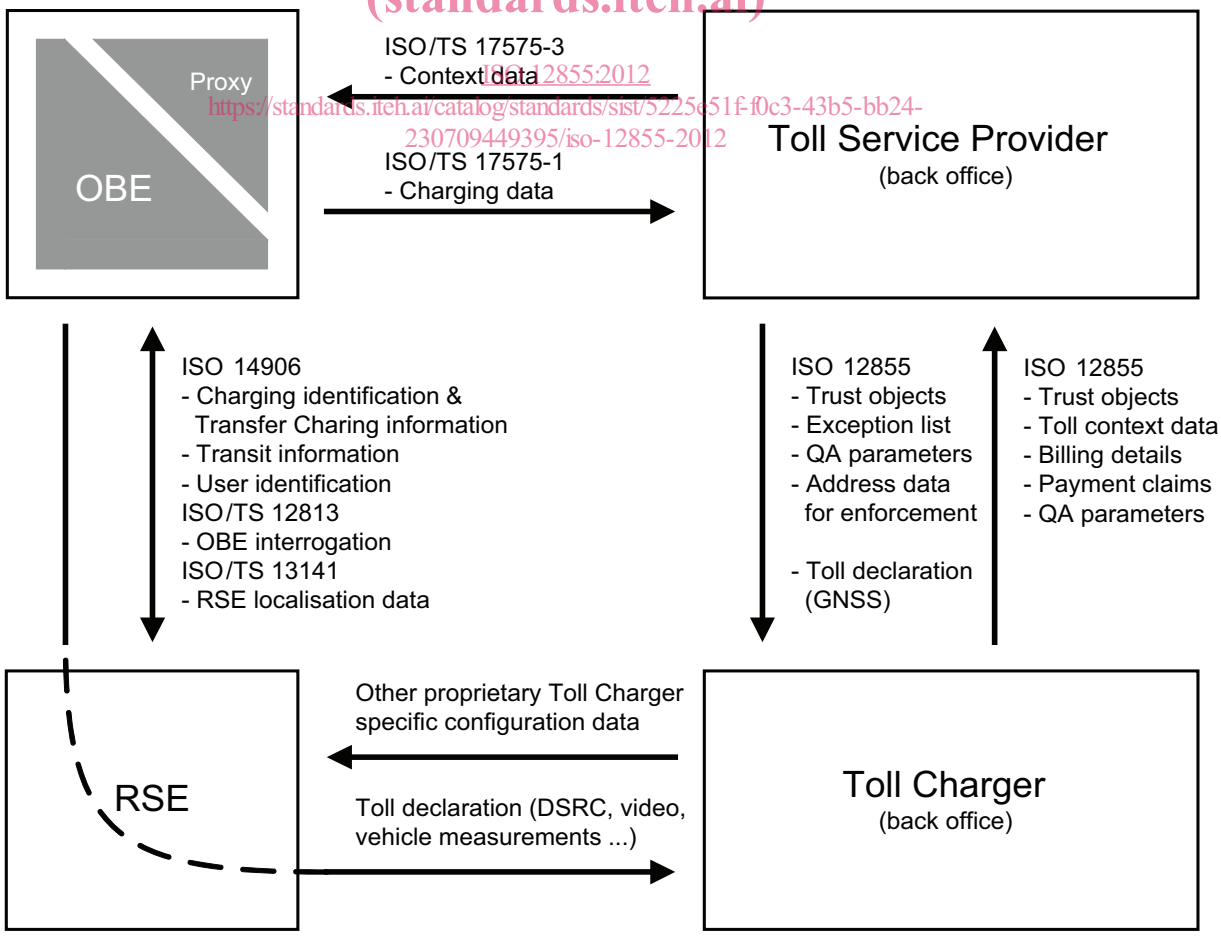

Figure 1 — Scope of EFC related standards

A given transport service for a given vehicle is fully identified by one or several toll declarations, made available to the Toll Charger. Toll declarations have to be made available according to the rules of the toll regime of the toll domain.

The amount due for a given transport service used by a vehicle liable to toll is concluded by the Toll Charger (TC) with the use of toll declarations (as described above) and calculation is made according to the rules of the toll regime (formula, tariff tables, specific situations rules, traffic conditions, etc.).

The information above, associated with a given transport service, is named billing details; for a given transport service, the billing details are referring to one or several toll declarations.

Depending on the toll regime, billing details are elaborated with information collected by the Toll Charger and/or the relevant Toll Service Provider (TSP); they are concluded by the toll charger.

The Toll Charger elaborates and makes the payment claims (or toll payment claims) available to each Toll Service Provider, according to the bilateral agreements it has with each Toll Service Provider, referring to billing details. These payment claims include an amount due taking into account any specific commercial conditions applicable to a vehicle, a fleet of vehicles or a given Toll Service Provider.

This International Standard identifies and specifies the set of messages exchanged between two actors in the roles of Toll Service Provider and Toll Charger as defined in ISO 17573. To specify these interfaces, this International Standard uses the enterprise description of the toll environment, and the interactions defined between the named classes of roles, as defined in ISO 17573. This allows for a complete specification of the data that is transferred between those identified entities. In addition to that, a number of computational interfaces are identified, where interactions in terms of sequences of messages are defined.

Electronic fee collection — Information exchange between service provision and toll charging

1 Scope

This International Standard specifies

— the interfaces between electronic fee collection (EFC) systems for vehicle related transport services, e.g. road user charging, parking and access control; it does not cover interfaces for EFC systems for public transport; an EFC system can include any EFC system, e.g. also systems automatically reading licence plate numbers of vehicles passing a toll point;

— an exchange of information between the central equipment of the two roles of service provision and toll charging, e.g.

  — charging related data (toll declarations, billing details),
  — administrative data, and
  — confirmation data;

— transfer mechanisms and supporting functions;

— information objects, data syntax and semantics;

— examples of data interchanges.

This International Standard supports any toll service and any technology used for charging.

It is defined as a toolbox standard of transactions and messages which can be used for the assigned purpose. The detailed definitions of mandatory and optional elements in a real implementation are defined elsewhere. It does not define all communication sequences, communication stacks and timings.

The scope of this International Standard is illustrated in Figure 2. The data types and associated coding related to the data elements described in Clause 6 are defined in Annex A, using the abstract syntax notation one (ASN.1) according to ISO/IEC 8824-1.

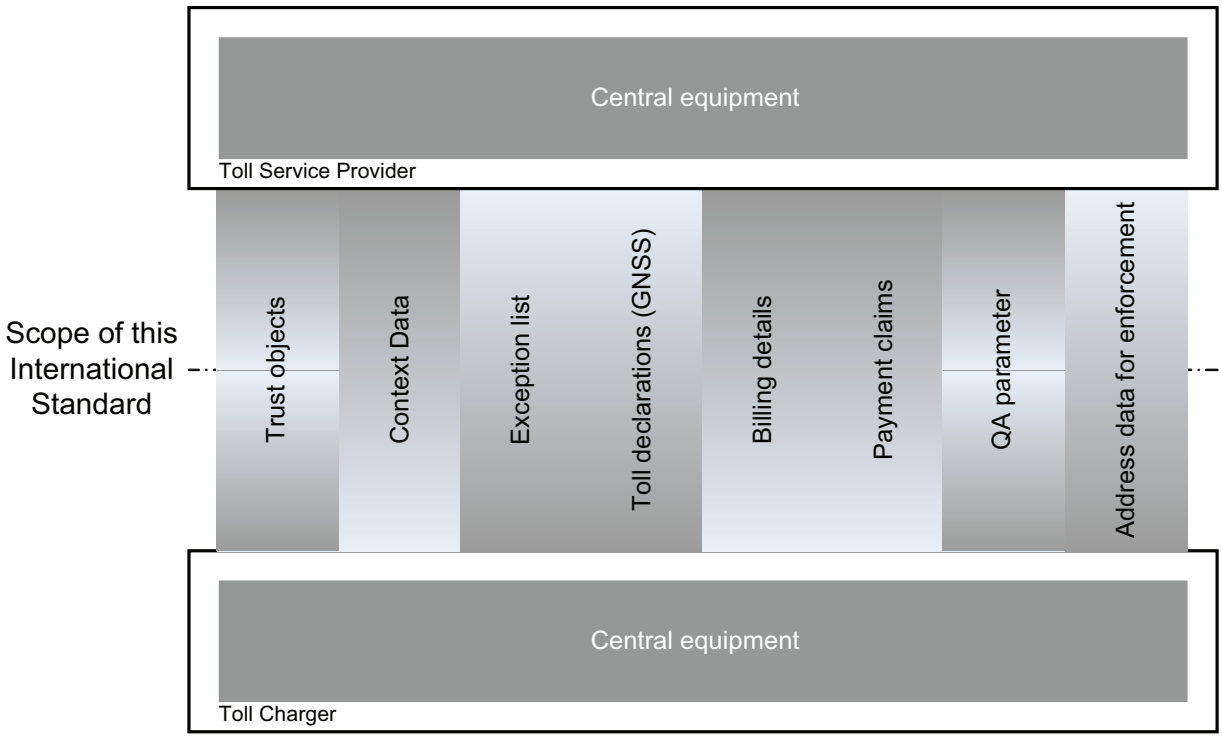

Figure 2 — Scope of this International Standard

Any communication between Toll Charger and/or Toll Service Provider with any other involved party is outside the scope of this International Standard. Any communication between elements of the Toll Charger and the Toll Service Provider which is not part of the back office communication is outside the scope of this International Standard.

The processes regarding the payments and exchanges of fiscal, commercial or legal accounting documents are outside the scope of this International Standard.

The definitions of service communication channels, protocols and service primitive to actually transfer the messages are outside the scope of this International Standard.

2 Normative references

The following referenced documents are indispensable for the application 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 17573, *Electronic fee collection — System architecture for vehicle-related tolling*

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

ISO/TS 17575-1, *Electronic fee collection — Application interface definition for autonomous systems — Part 1: Charging*

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

ISO/TS 17575-4, *Electronic fee collection — Application interface definition for autonomous systems — Part 4: Roaming*

ISO/IEC 9646-7, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 7: Implementation Conformance Statements*

ISO/IEC 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 8825-4, *Information technology — ASN.1 encoding rules: XML Encoding Rules (XER)*

ISO 639-1, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

3 Terms and definitions

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

3.1
billing detail
for a given transport service, all necessary data required to determine and/or verify the amount due for the service user

NOTE 1 If the data is accepted by both the Toll Charger and the Toll Service Provider then it is called a concluded billing detail which can be used to issue a payment claim.

NOTE 2 For a given transport service, the billing detail is referring to one or several valid toll declaration(s). A valid billing detail has to fulfil formal requirements, including security requirements, agreed between the Toll Service Provider and the Toll Charger.

3.2
charge report
data structure transmitted from the front end to the Back End to report road usage data and supplementary related information

NOTE In 2009/750/EC charge report is referred to as "toll declaration".

3.3
charging data
toll relevant data produced by the on-board equipment and sent to the Toll Service Provider's back-office systems

3.4
computational specification
decomposition of a system into objects performing individual functions and interacting at well defined interfaces

3.5
context data
information defined by the responsible Toll Charger necessary to establish the toll due for circulating a vehicle on a particular toll domain and to conclude the toll transaction

[ISO 17573, definition 3.1]

3.6
customer
person or legal entity that uses the service of a Toll Service Provider

[ISO 17573, definition 3.2]

NOTE Depending on the local situation, the customer can be the owner, lessor, lessee, keeper, (fleet) operator, holder of the vehicle's registration certificate, driver of the vehicle, or any other third person.

3.7
driver
person who drives a vehicle

[ISO 17573, definition 3.3]

NOTE The driver is assumed to operate (use/serve) the on-board equipment (e.g. the setting of the number of axles).

3.8
electronic fee collection
EFC
toll charging by electronic means via a wireless interface

NOTE 1 Adapted from ISO 17573, definition 3.4.

NOTE 2 The actual payment (collection of the fee) may take place outside the toll system.

3.9
enforcement
process of compelling observance of a law, regulation, etc.

[ISO 17573, definition 3.5]

NOTE In this context: the process of compelling observance of a toll regime.

3.10
interface
abstraction of the behaviour of an object that consists of a subset of the interactions of that object together with a set of constraints on when they may occur

[ISO/IEC 10746-2]

3.11
interoperability
ability of systems to provide services to, and accept services from, other systems and to use the services so exchanged to enable them to operate effectively together

[ISO 17573, definition 3.7]

NOTE For tolling, interoperability aims at enabling a vehicle to drive through various toll domains while having only one on-board equipment operating under one contract with a Toll Service Provider.

3.12
on-board equipment
OBE
equipment fitted within or on the outside of a vehicle and used for toll purposes

[ISO 17573, definition 3.9]

NOTE The OBE does not need to include payment means.

3.13
one(s) liable for toll
person(s) or legal entities liable to pay toll under the operation of a toll regime

[ISO 17573, definition 3.10]

NOTE A toll regime can designate more than one person to be (jointly and severally) liable for paying the toll.

3.14
payment claim
recurring statement referring to concluded billing details made available to the Toll Service Provider by the Toll Charger who indicated and justified the amount due

NOTE The payment claim is used by the Toll Service Provider to issue financial objects to its customers (e.g. invoices on behalf of the Toll Charger). A given toll payment claim is referring to billing details and takes into account any specific commercial conditions applicable to a vehicle, a fleet of vehicles, a customer of a Toll Service Provider and/or a Toll Service Provider. A valid "payment claim" has to fulfil formal requirements, including security requirements, agreed between the Toll Service Provider and the Toll Charger.

3.15
roadside equipment
RSE
equipment located along the road transport network, for the purpose of communication and data exchanges with on-board equipment

[ISO 14906, definition 3.1]

3.16
service user
see **user** (3.29)

3.17
tariff scheme
set of rules to determine the fee due for a vehicle in a toll domain for a tolled object at a certain day and time

[ISO 17573, definition 3.14]

EXAMPLE A table that shows the fee for various classes of vehicles.

3.18
toll
charge, tax, fee, or duty in connection with using a vehicle within a toll domain

[ISO 17573, definition 3.15]

NOTE The definition is a generalization of the classic definition of a toll as "a charge, a tax, or a duty for permission to pass a barrier or to proceed along a road, over a bridge, etc.". The definition above also includes fees regarded as an (administrative) obligation, e.g. a tax or a duty.

3.19
Toll Charger
TC
legal entity charging toll for using a vehicle within a toll domain

[ISO 17573, definition 3.16]

NOTE In other documents the terms "operator" or "toll operator" can be used.

3.20
toll declaration
statement to a Toll Charger that confirms the presence of a vehicle in a toll domain in a format agreed between the Toll Service Provider and the Toll Charger

[ISO 17573, definition 3.17]

NOTE A valid toll declaration has to fulfil formal requirements, including security requirements, agreed between the Toll Service Provider and the Toll Charger.

3.21
toll domain
area or part of a road network where a toll regime is applied

[ISO 17573, definition 3.18]

3.22
toll point
location within a toll domain where the on-board equipment has to issue a toll declaration

[ISO 17573, definition 3.19]

EXAMPLE A part of a toll plaza for electronic fee collector.

3.23
toll regime
set of rules, including enforcement rules, governing the collection of a toll in a toll domain

[ISO 17573, definition 3.20]

3.24
toll service
service enabling users having only one contract and one set of on-board equipment to use a vehicle in one or more toll domains

[ISO 17573, definition 3.22]

3.25
Toll Service Provider
TSP
legal entity providing to its customers toll services on one or more toll domains for one or more classes of vehicles

[ISO 17573, definition 3.23]

NOTE 1 In other documents the terms “issuer” or “contract issuer” can be used.

NOTE 2 The Toll Service Provider can provide the on-board equipment or can provide only a magnetic card or a smart card to be used with on-board equipment provided by a third party.

NOTE 3 The Toll Service Provider is responsible for the operation (functioning) of the on-board equipment.

3.26
toll system
off-board equipment and possible other provisions used by a Toll Charger for the collection of toll for vehicles

NOTE 1 The on-board equipment is excluded from the definition. On-board equipment should be part of any toll system for which it may be used.

NOTE 2 The actual payment (collection of the fee) may take place outside the toll system.

3.27
tolled object
distinguished part of a toll domain for which one or more tariff schemata apply

EXAMPLE An area, all public roads within an area, a bridge, a zone, or a stretch of a road (network).

3.28
trust object
information object that is exchanged between entities to ensure mutual trust

EXAMPLE An electronic signature or an electronic certificate.

3.29
user
customer of a Toll Service Provider, one liable for toll, the owner of the vehicle, a fleet operator, a driver etc. depending on the context

[ISO 17573, definition 3.26]

4 Symbols and abbreviated terms

ADU	Application Data Unit
ANPR	Automatic Number Plate Reading
APCI	Application Protocol Control Information
APDU	Application Protocol Data Unit (ISO 14906)
CCC	Compliance Check Communication (ISO/TS 12813)
CRL	Certificate Revocation List
DSRC	Dedicated Short Range Communication (ISO 14906)
EFC	Electronic Fee Collection (ISO 17573)
GNSS	Global Navigation Satellite System
ICS	Implementation Conformance Statement
IEC	International Electrotechnical Commission
IUT	Implementation Under Test
ITU	International Telecommunication Union
LPN	Licence Plate Number
OBE	On-Board Equipment (ISO 14906)
OBU	On-Board Unit
OCSP	Online Certificate Status Protocol
OSI	Open Systems Interconnection
PAN	Personal Account Number (ISO 14906)
PICS	Protocol Implementation Conformance Statement
QA	Quality Assurance
RSE	Roadside Equipment (ISO 14906)
SLA	Service Level Agreement
SU	Service User
SUT	System Under Test (ISO 14907-1)
TC	Toll Charger
TSP	Toll Service Provider

5 Architectural concept

5.1 Main roles in the Toll Charging environment

This International Standard is built upon ISO 17573. ISO 17573 defines the four main roles shown in Figure 3.

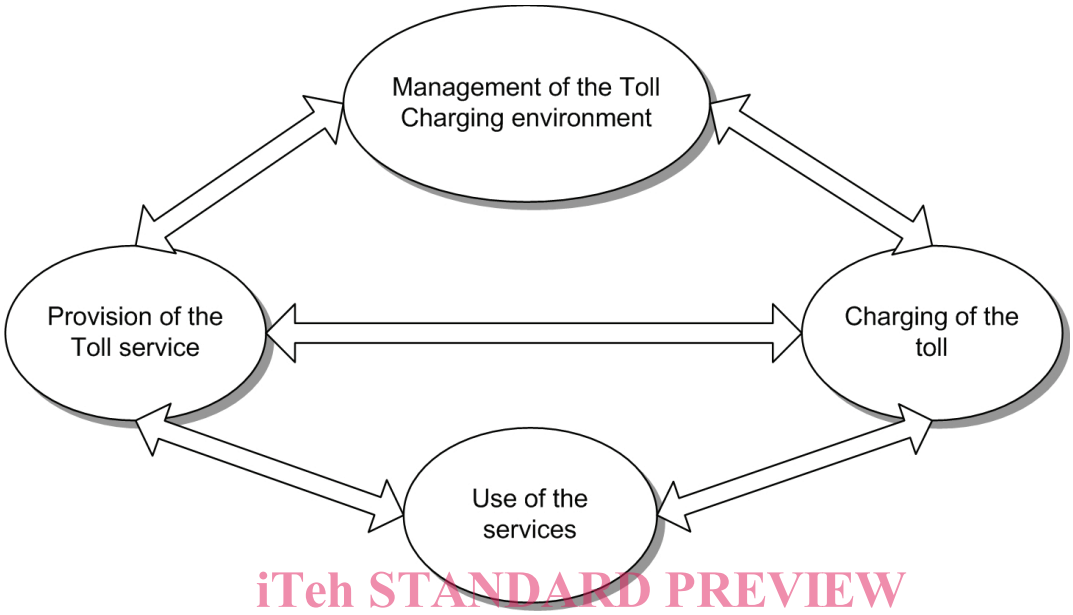

Figure 3 — Roles in the Toll Charging environment

Information exchanges are agreed upon between Toll Charger and Service Provider also taking into account privacy regulations. The information exchanges needed by the Toll Charger and the Toll Service Provider to perform their roles are described in this clause.

5.2 Information exchange between Toll Charging and Provision

5.2.1 General

The information exchange between the Service Provision and the Toll Charging roles supports the provision of the following functionalities, which are all based on the EFC system behaviour definitions in ISO 17573:

— Exchange Trust Objects

— Originating and providing EFC context data

— Manage Exception list

— Report Toll declarations

— Report Billing details

— Claim payment for service usage

— Exchange Enforcement data

— Exchange Quality assurance parameters

This International Standard leaves implementers the freedom of defining suitable protocol procedures, i.e. for complex transactions, hence it only defines:

— A basic interaction protocol (request – response) for information exchange

— Basic protocol mechanisms, to be used to build more complex protocol procedures

— The semantics and the format of the messages that are exchanged

The following subclauses describe the functionalities listed above.

5.2.2 Basic interaction protocol

Information exchanges happen by means of Application Protocol Data Unit (APDU) transfers.

Some APDU transfers need to be acknowledged. When this happens, related protocol procedures are specified. This International Standard defines no provisions for complex transfers (transactions), i.e. APDU transfers that cover several APDUs. Instead, this International Standard defines basic protocol mechanisms, to be used by implementations that need to identify transactions.

5.2.3 Basic protocol mechanisms

5.2.3.1 General approach

This International Standard provides the following basic protocol mechanisms, which shall be implemented to exchange information between the Toll Service Provider's and the Toll Charger's central equipment. These basic protocol mechanisms consist of:

— An identification schema for the messages that are exchanged.

— A generic interaction (i.e. not related to any specific functionality) that allows requesting a specific information exchange from the counterpart. This interaction is provided by the "Request" message.

— A generic acknowledge mechanism (i.e. not related to any specific functionality) that allows acknowledging a specific interaction. This mechanism is provided by the "Acknowledge" message.

— A generic status mechanism (i.e. not related to any specific functionality) that allows providing status information for a specific interchange. This mechanism is provided by the "Status" message.

By means of the above mechanisms, an implementation can build more complex protocol procedures, including rollback, recovery, checkpointing or restart.

This International Standard does not specify timings and retry procedures for acknowledgements. Timeouts can be defined as agreements between Toll Charger and Toll Service Provider to cover the case of missing acknowledgments. To handle any lost messages a timeout system can be implemented.

5.2.3.2 Identification schema

Each interaction is performed by means of one or more message exchanges. Each message shall contain a unique identifier in the namespace of the originator of the message. The combination of originator identifier and message identifier ensures that all messages are uniquely identified.

5.2.3.3 Request message

The Request message may be used to:

— Alert the counterpart that one is ready to accept any kind of information exchange.

— Inform the counterpart that one is ready to accept a specific type of message, by indicating the type of message one is ready to accept.