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# Navigation data delivery structures and protocols



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# Navigation data delivery structures and protocols

*Structures et protocoles pour la diffusion de données dans les systèmes de navigation*

Reference number
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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.

ISO 24099 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

# Introduction

This International Standard was developed in relation to growing market demand for dynamic update services for map-related data in navigation systems. Map-related data includes not only feature geometry and attributes but also point of interest (POI) data such as hotels, restaurants, and dynamic content such as traffic, weather, movie schedules, parking availability, etc. Currently, most map data updates are provided on physical media whose map data content begins aging rapidly once it is delivered to the user. In the future, it is anticipated that the transmission of these data will most often, but not exclusively, be via wireless means. The advantage of wireless data delivery is that it simplifies the distribution logistics thereby accelerating the ability of a consumer to receive fresher data. This International Standard facilitates the potential for on-demand updates of on-board map databases. Further, the updates do not necessarily require the replacement of an entire map database. Rather, the updates can be limited to a portion of a dataset or a specific list of attributes or POI changes can also be provided.

The services described above have begun to be deployed in a non-interoperable manner by various car manufacturers and information system providers. This International Standard is intended to promote the successful widespread adoption of such services through user access to an interoperable network of servers offering more content choices than is available through a single provider.

This International Standard defines the data structures and protocol needed to enable interoperability between multiple content providers and consumers of map-related data content in a wireless environment. As far as possible the data structures are compatible with the ISO geographic data file (GDF) data model. Different software profiles can be developed to support various system configurations: systems which store all data in the vehicle (on-board), systems which store all data in a central server (off-board), and systems which use both on-board and off-board data storage (hybrid).

Furthermore, this International Standard is designed to utilize the communications protocols such as those under development in TC 204/WG 16. This International Standard recognizes the possible need for security mechanisms in the provision of this data.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning procedures, methods and/or formats given in this document.

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# Navigation data delivery structures and protocols

## 1 Scope

This International Standard defines the data structures and protocol(s) used in intelligent transport system (ITS) applications for the delivery and update of map-related data from Service Centre (SC) to users [(In-vehicle Systems (IVS)].

This International Standard also specifies the message generation protocols in the Service Centre and the message receiving protocols in the In-vehicle Systems.

The map centre specified in this International Standard represents the supplier of map data and the Service Centre provides data and services to user devices.

The term protocol as used in this International Standard is a temporal sequence of map-related data interactions between system components that implement map-related data delivery and update. The delivery and update of map-related data rely on existing communication technology. The protocols associated with communication technology, and the other application control protocols and non-map-related data, for example images to display independent of the map database such as HTML images, are outside the scope of this International Standard.

Definitions of security mechanisms and business transaction mechanisms are also outside the scope of this International Standard.

Figure 1 below illustrates the scope of this International Standard.

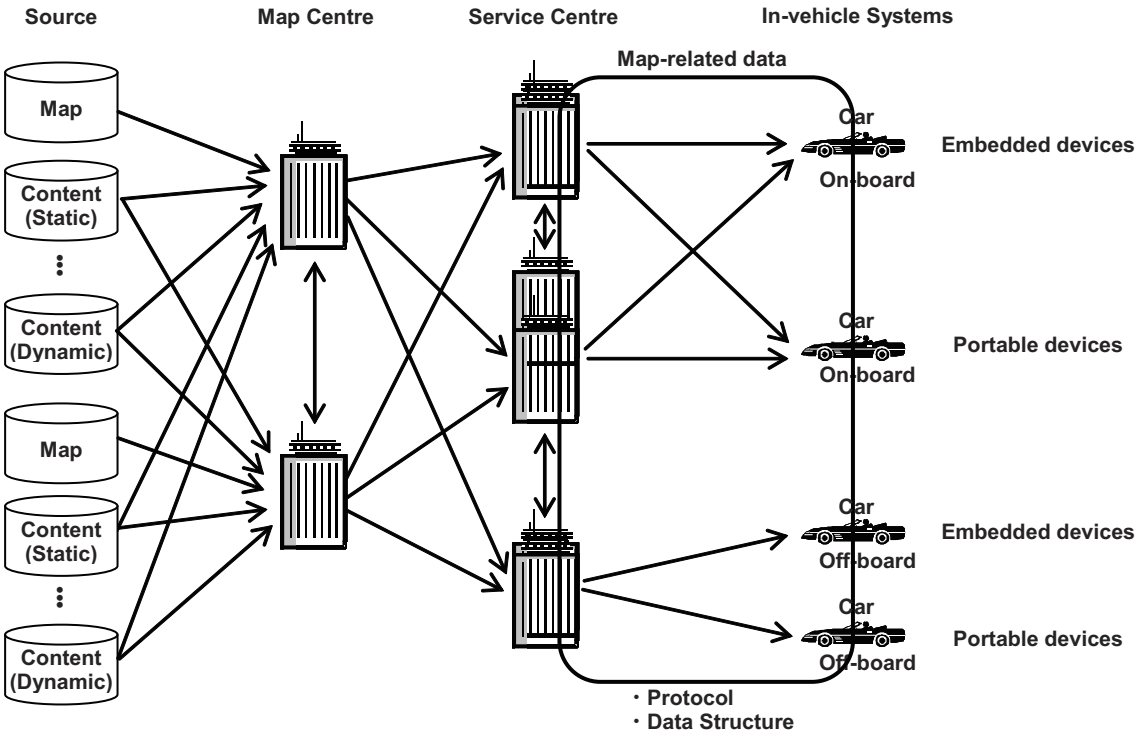



**Figure 1 — Scope of this International Standard**

## 2 Conformance

Protocols and data structures shall be provided as specified in Clauses 8 and 9.

Any protocols and data structures claiming conformance with this International Standard shall pass the requirements presented in the abstract test suite in Annex A.

## 3 Terms and definitions

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

**3.1**
**address location**
application category that deals with the task of expressing a real world position in terms of the physical storage format (PSF) data representation

NOTE One of the six application categories supported by the physical storage format (PSF) and the application programming interface (API) and defined in ISO/TS 20452.

**3.2**
**application category**
basic sub-function within the set of functionality for vehicle navigation and traveller information system applications

NOTE ISO/TS 20452 identifies six application categories: positioning, route planning, route guidance, map display, address location, services and point of interest (POI) information access.

**3.3**
**data broadcasting**
one-way communication by a Service Centre

**3.4**
**data providing**
two-way communication of data initiated by the In-vehicle System in which the version is controlled by the Service Centre

**3.5**
**data pushing**
two-way communication of data initiated by the Service Centre

**3.6**
**data retrieving**
two-way communication of data initiated by the In-vehicle System in which the version is controlled by the In-vehicle System

**3.7**
**emergency data**
data that is safety and/or security related

NOTE This data can be unilaterally sent by a sender to a user (such as data of accidents or disasters).

**3.8**
**incremental update**
action allowing for the replacement, insertion or deletion of features and/or attributes only when they change from a previous version of the data set

**3.9**
**in-vehicle system**
function that receives update data and provides navigation and traveller information system applications

**3.10**
**map centre**
supplier of map data

**3.11**
**map data**
shape data composed from road, background and topology data (such as features, geometry, and attributions)

**3.12**
**map display**
application category that deals with graphical information presentation

NOTE One of the six application categories supported by the physical storage format (PSF) and the application programming interface (API) and defined in ISO/TS 20452.

**3.13**
**point of interest (POI) data**
destination and/or site of interest to travellers (such as restaurants)

**3.14**
**positioning**
application category that deals with the determination of vehicle location and map matching

NOTE One of the six application categories supported by the physical storage format (PSF) and the application programming interface (API) and defined in ISO/TS 20452.

**3.15**
**protocol**
computer language enabling computers that are connected to each other to communicate

NOTE Protocol here is as sequence.

**3.16**
**route guidance**
application category that deals with the generation of graphical, textual, and/or audio instructions for following a planned route

NOTE One of the six application categories supported by the physical storage format (PSF) and the application programming interface (API) and defined in ISO/TS 20452.

**3.17**
**route planning**
application category that deals with the determination of routes between specified points

NOTE One of the six application categories supported by the physical storage format (PSF) and the application programming interface (API) and defined in ISO/TS 20452.

**3.18**
**update target**
the object of update, which is sometimes specified by area, and the other times by features and attributes

NOTE One of the six application categories supported by the physical storage format (PSF) and the application programming interface (API) and defined in ISO/TS 20452.

**3.19**
**services and point of interest (POI) information access**
application category that deals with the provision of point of interest (POI) information to the navigation application

**3.20**
**Service Centre**
function that provides update data to In-vehicle Systems

**3.21**
**status data**
data that represent a status of a road or traffic (such as real time geographic traffic data)

**3.22**
**update**
sequence of flow of data between a Service Centre and an In-vehicle System to change the data inside a map database in an In-vehicle System

**3.23**
**update by geographic area**
action allowing for the complete replacement of data for a specific geographic area or for an entire data set

## 4 UML Expressions for diagrams

This International Standard uses UML to express specific circumstances; the graphical elements are used to express specific constraints and structural relationships. A full definition can be found in ISO 19501. However, a short introduction of elements is given in Annex B.

## 5 Abbreviated terms

| | |
|---|---|
| ADAS | Advanced Driver Assistance System |
| API | Application Programming Interface |
| CU | Close Update |
| CPU | Central Processing Unit |
| DB | Database |
| FTP | File Transfer Protocol |
| GDF | Geographic Data File |
| HTTP | Hyper Text Transfer Protocol |
| IP | Internet Protocol |
| ITS | Intelligent Transport System |
| IVS | In-vehicle System |
| LDO | Logical Data Organization |
| LR | Location Referencing |
| NetBEUI | NetBIOS Extended User Interface |
| NetBIOS | Network Basic Input/Output System |
| OSI | Open Systems Interconnection |

| | |
|---|---|
| POI | Point of Interest |
| PPP | Point-to-Point Protocol |
| PSF | Physical Storage Format |
| ROD | Request of Data |
| RUC | Request of Update Category |
| SC | Service Centre |
| SMTP | Simple Mail Transfer Protocol |
| TCP | Transmission Control Protocol |
| TOD | Transmission of Data |
| TUC | Transmission of Update Category |
| UML | Unified Modelling Language |

# 6 Requirements

## 6.1 User-related requirements

User-related requirements are defined as follows.

— R-1. The data delivery structures and protocols shall support the six application categories: map display, positioning, route planning, route guidance, address location, service and POI information access.

— R-2. The protocols and data structures shall be designed in such a way that they do not force degradation of system performance before, during or after their use.

— R-3. The data exchanges between the Service Centre and In-vehicle Systems shall use an open (non-proprietary) data format (see example). The specification of the sender's address of data is described under the open data form, but the description of the content may be done by binary representation.

EXAMPLE XML.

## 6.2 Data requirements

Data requirements are defined as follows.

— R-4. The data shall include, at a minimum, map data (see Example 1), and it may also include some status data, and POI data. Advanced driver assistance system (ADAS) related map data may be included as an extension. Some of the data shall be distinguished as emergency data (see Example 2).

EXAMPLE 1 Features, geometry, and attributes.

EXAMPLE 2 Real time geographic traffic data.

— R-5. Data structures shall be easy to handle by In-vehicle Systems.

— R-6. The data structures shall minimize dataset size as much as possible for both transmission and processing in In-vehicle Systems coming on the market.

### 6.3 Protocol requirements

Protocol requirements are defined as follows.

— R-7. The update protocol(s) shall be compatible with both wireless and wired methods.

— R-8. The protocol shall not require more storage or computing power than is expected to be available in In-vehicle Systems coming on the market.

— R-9. The protocol in this International Standard shall be written with sufficient flexibility both to support existing communication technology and to improve the capability to address future communication technologies.

— R-10. The protocol defines how to deliver map-related data between Service Centre and In-vehicle Systems.

— R-11. The protocol is expected to be used in a mobile environment in which communications may be interrupted (see Example). The protocol shall support complete and efficient recovery from interruptions of communication. For example, it shall avoid retransmission of an entire update when only a small part is not received.

EXAMPLE By driving through tunnels or driving in areas of poor or no reception.

— R-12. The protocol shall minimize dataset size as much as possible for both transmission and processing in In-vehicle Systems coming on the market.

### 6.4 Communication requirements

Communication requirements are defined as follows.

— R-13. The general update process shall be independent from the (technical) communication link between the Service Centre and the In-vehicle Systems.

— R-14. Within reason, the update process shall support communication links with a limited bandwidth.

### 6.5 Update strategies

Update strategies are defined as follows.

— R-15. The design of the update process shall be independent from the data supplier (see Example 1). The design of the update process shall be independent from the in-vehicle application.

EXAMPLE 1 Map Centre.

— R-16. This International Standard shall support updates of different categories of data (see Example 2) at different frequencies.

EXAMPLE 2 Map features and attributes, status data and POI data.

— R-17. In-vehicle System functionality is affected by real world changes to spatial features and their attributes (see Example 3). Therefore, the data available in the In-vehicle System shall be kept up-to-date.

EXAMPLE 3 New roads are built, road names can change, and previously existing errors can be corrected.

— R-18. This International Standard supports two methods for supplying updates:

  — Update by geographic area: this method allows the complete replacement of data for a specific geographic area or for an entire data set.

  — Incremental update of Spatial Features and Attributes: this method allows the replacement, insertion or deletion of features and/or attributes only when they change from a previous version of the data set.

— R-19. This International Standard supports four strategies for supplying updates:

  — Data Providing: two-way communication of data initiated by the In-vehicle System in which the version is controlled by the Service Centre.

  — Data Retrieving: two-way communication of data initiated by the In-vehicle System in which the version is controlled by the In-vehicle System.

  — Data Pushing: two-way communication of data initiated by the Service Centre.

  — Data Broadcasting: one-way communication by the Service Centre.

### 6.6 Others

Other requirements are defined as follows.

— R-20. The process of defining requirements in this International Standard shall not favour any particular logical data organization (LDO) and/or physical storage format (PSF). Existing LDOs and/or PSFs may be taken into account in defining requirements.

— R-21. This International Standard shall be scalable and generic to support future communication technologies and data structures.

— R-22. The interfaces shall be designed in such a way that a newer interface shall still support older PSFs on the market, and older interfaces shall support newer PSFs, potentially restricted to the content of the older version.

## 7 Reference architecture and framework concept

### 7.1 Reference architecture

Figure 2 represents the general architecture that supports the navigation data delivery by a Service Centre to an In-vehicle System according to this International Standard.

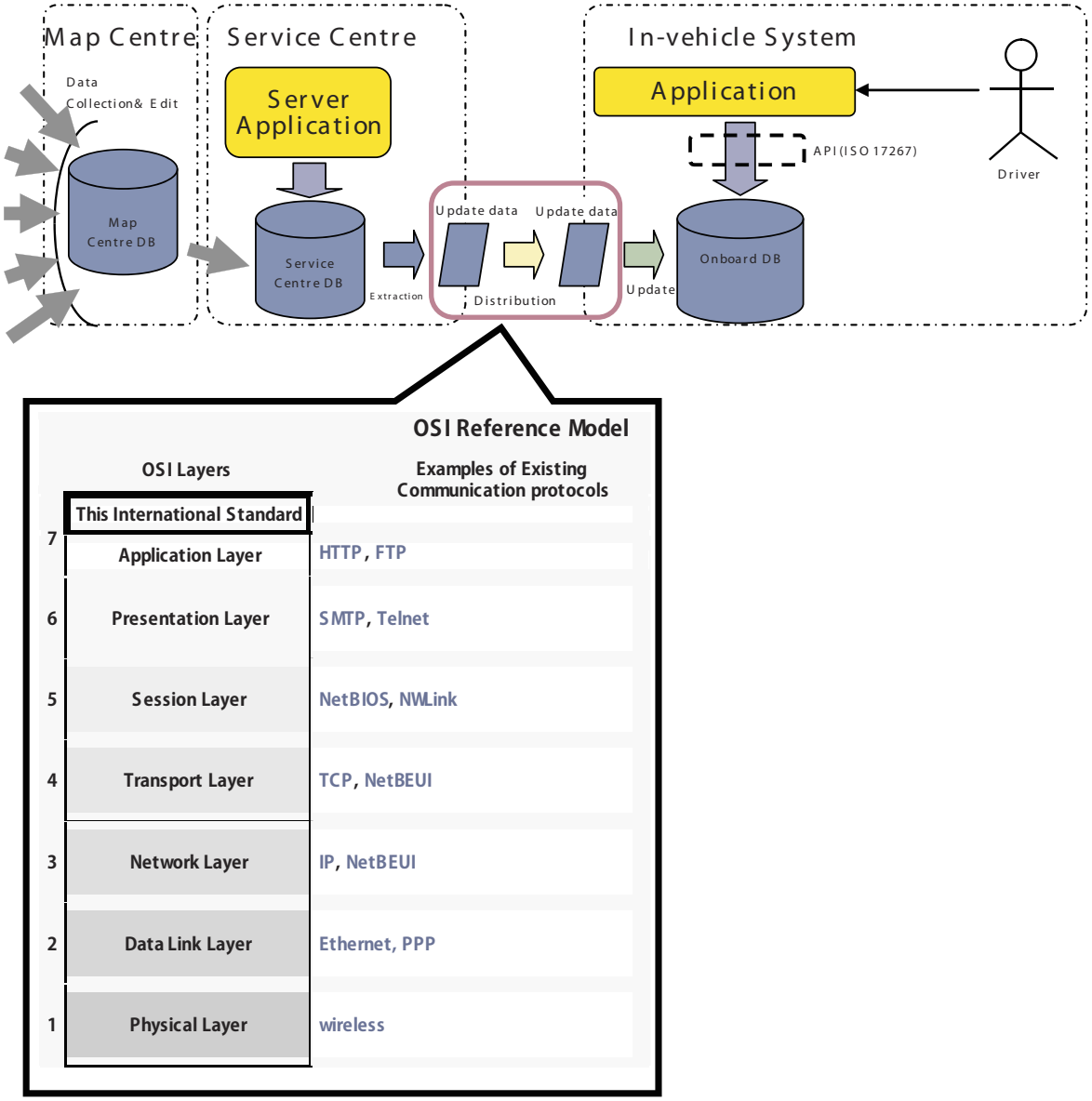



**Figure 2 — Reference architecture**

This International Standard can be used with widely used standardized protocols such as transmission control protocol/internet protocol (TCP/IP) and hyper text transfer protocol (HTTP). The delivery data is composed of a header and bodies.

This International Standard mainly defines the header information used in the In-vehicle System to judge whether the delivered data can be used or not. An In-vehicle System can skip the unnecessary data by reading the header information.

The data sent as body are map data, status data, POI data or emergency data.

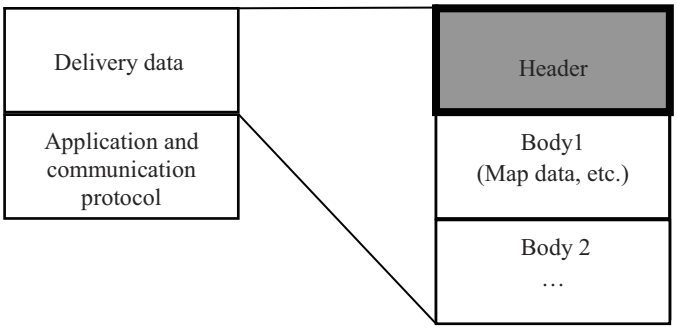



**Figure 3 — Basic structure of delivery data**

## 7.2 Framework concept

### 7.2.1 Varieties of updates

Varieties of updates are defined as triple of initiatives, types and data categories.

Classifications of data categories initiatives and types can be found in Clause 6 and Annex C.

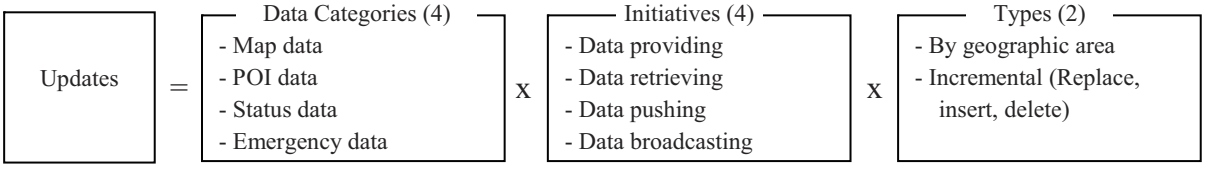



**Figure 4 — Varieties of updates**

### 7.2.2 Case of update by geographic area

#### 7.2.2.1 Introduction

When an update is done by geographic area, all the data of the geographic area is sent, which means the data set also includes unchanged information.

There are two methods of updates: Mode1, execute post-compilation at the In-vehicle System, Mode2, execute some kind of pre-compilation at the Service Centre (i.e. generating necessary layers, etc.) in order to reduce the process at the In-vehicle System.

Most of the actual systems are hybrids of Mode1 and Mode2.

A full update is a specific case of an update by geographic area. A full update is done to replace the whole In-vehicle System dataset.

#### 7.2.2.2 Case of Post-compilation (Mode1)

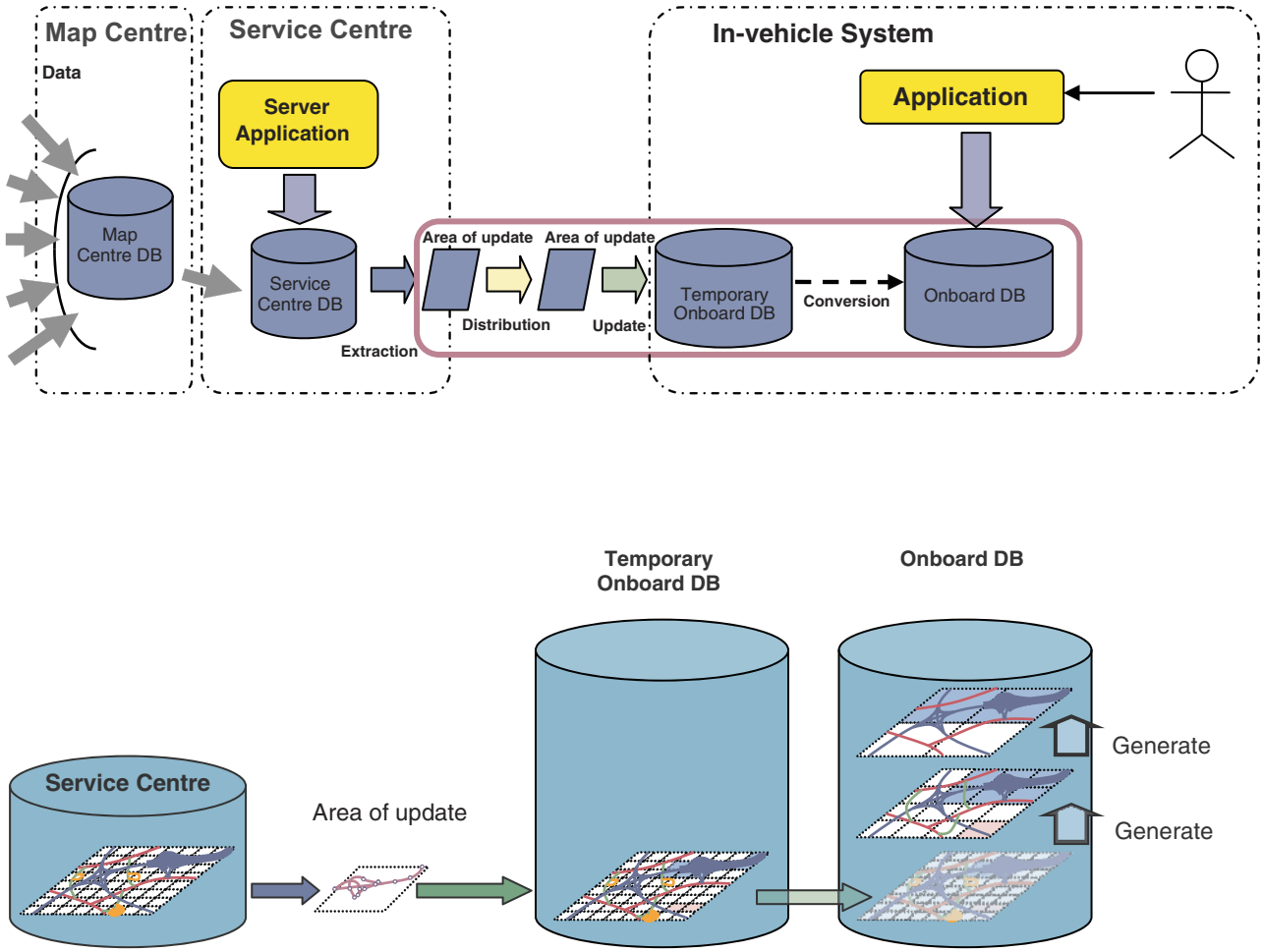



**Figure 5 — Case of Post-compilation (Mode1)**

An In-vehicle System receives an area of update data from a Service Centre through the communication. Compilation and layer generations are done in the In-vehicle System.

NOTE Generally, a Post-compilation Mode tends to have a lower volume of transmitted data.

#### 7.2.2.3 Case of Pre-compilation (Mode2)

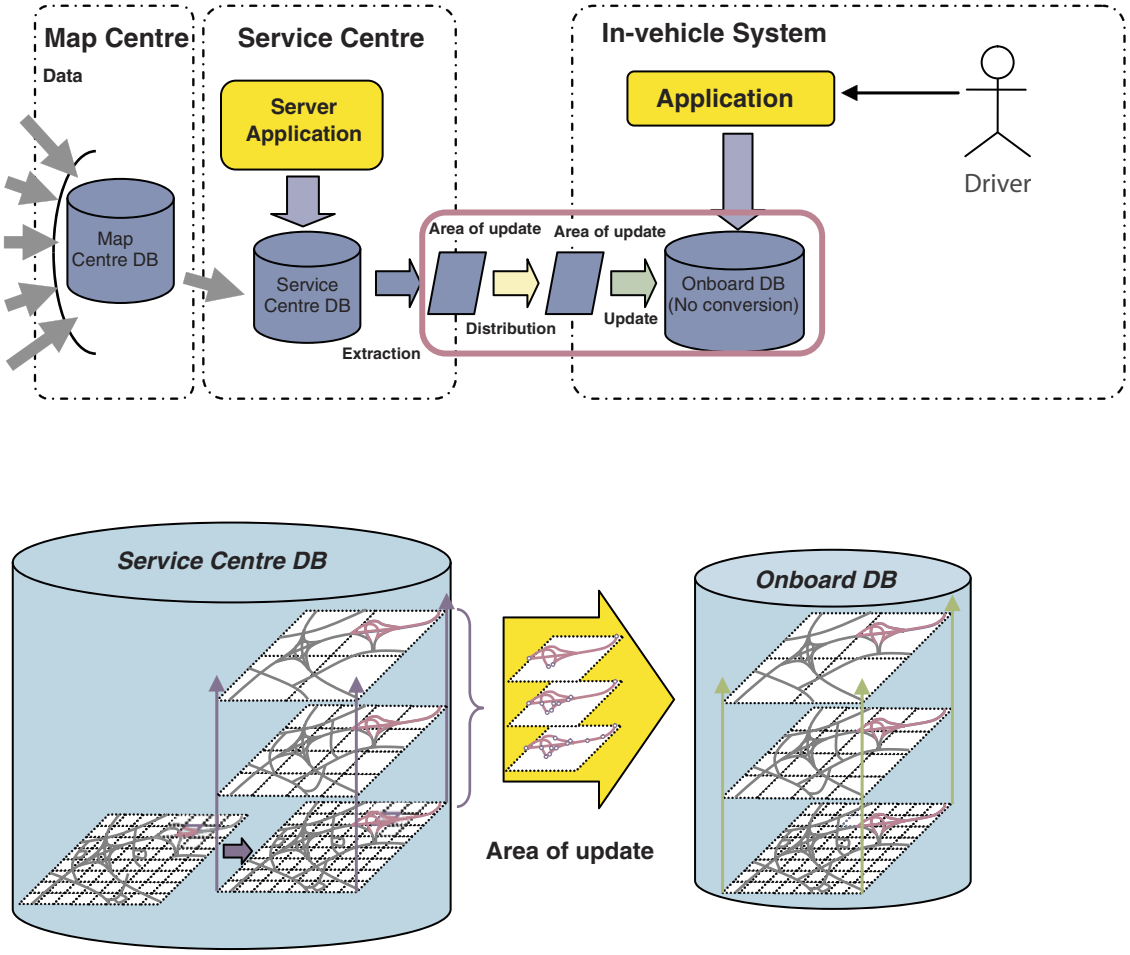



**Figure 6 — Case of Pre-compilation (Mode2)**

An In-vehicle System receives an area of update data from a Service Centre through the communication. Updating data of all layers is made at a Service Centre, including the relationships of each layer.

NOTE Generally, the compilation in the In-vehicle System is minimized. Integrating the data to the onboard database (DB) is basically the only process needed in an In-vehicle System. The central processing unit (CPU) load is likely to be lighter than in a Post-compilation system (Mode1), though the volume of update data is likely to increase.

### 7.2.3 Case of incremental update

When update is done incrementally, only the different parts are sent.

As seen in the update by geographic area, there are also two modes of incremental updates: Mode1, to compile the data at an In-vehicle System (Post-compilation), and Mode2, to compile the data at a Service Centre and provide required layers (Pre-compilation).

Most of the actual systems are hybrids of Mode1 and Mode2.

Mode1 Post-compilation

An In-vehicle System receives the minimum amount of update data (i.e. only changes) from a Service Centre through the communication mean. Each In-vehicle System compiles and generates the subset of data.

NOTE 1 Generally, a Post-compilation method (Mode1) tends to have a lower volume of data transmitted.

Mode2 Pre-compilation

An In-vehicle System receives update data from a Service Centre through the communication. The compilation of data is executed in a service centre. Update data is sent out to an In-vehicle System and incorporated without on-board compilation.

NOTE 2 Generally, the compilation in the In-vehicle System is minimized. Integrating the data to the onboard DB is basically the only process needed in an In-vehicle System. The CPU load is likely to be lighter than in a Post-compilation system (Mode1), though the volume of update data is likely to increase.

### 7.2.4 Descriptions of the exchange process of updating data

When updating a map, a Service Centre and an In-vehicle System shall check the status before and after the update. For more details, see Annex E.

The process is divided into three steps:

1) Preprocessing: prepare the data to be updated and confirm the user's intention.

2) Delivering of update data: data sending and receiving.

3) Post-processing: verification of the termination and other related tasks.

An entire update process is shown in Figure 7. The data flows in the shaded area in Figure 8 are defined in this International Standard.

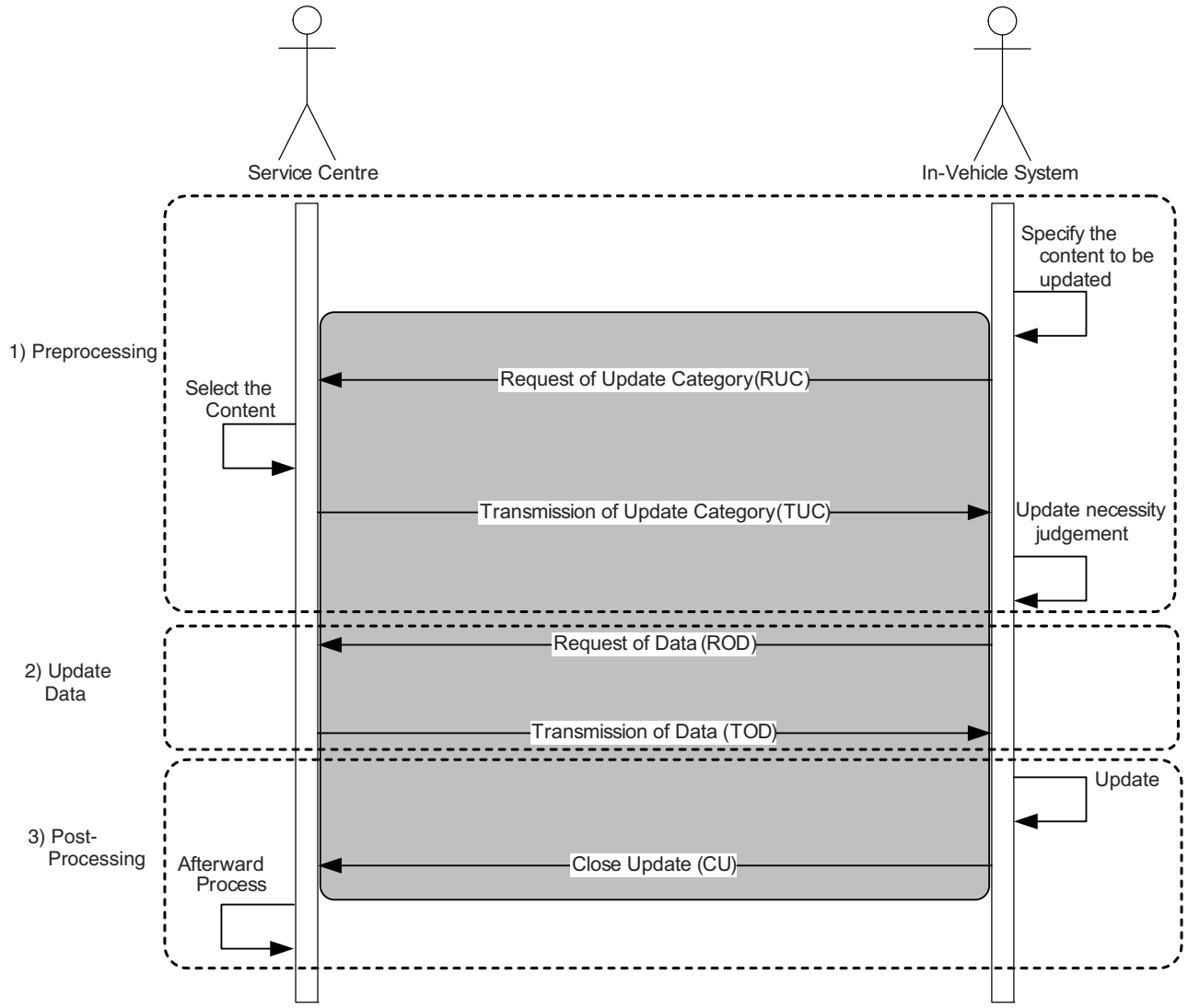



**Figure 7 — Entire process of update**

The process is conducted by the requests and answers between a Service Centre and an In-vehicle System. The basic structure of data is described below.

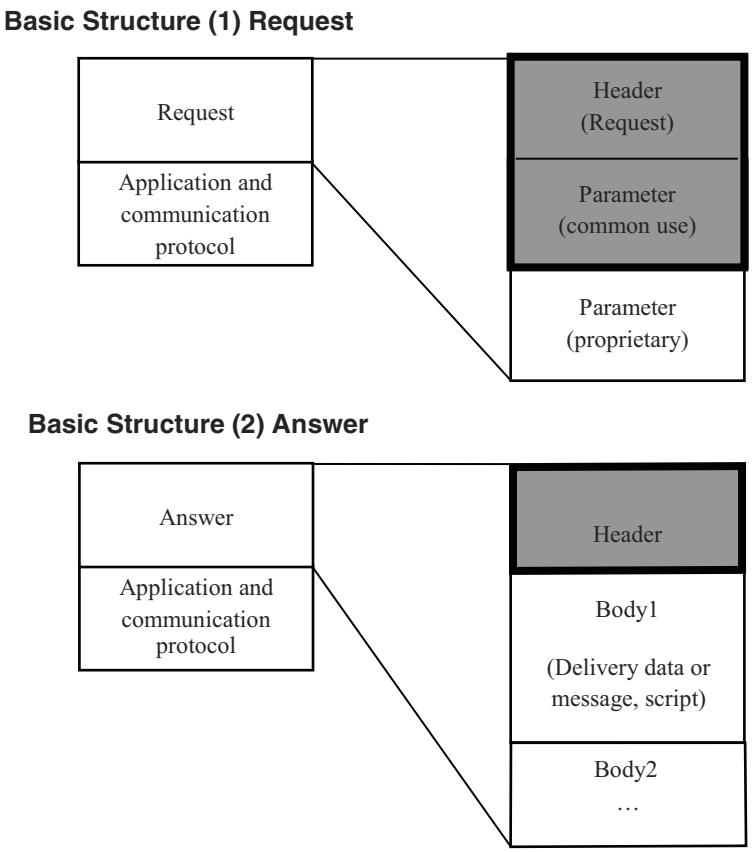



**Figure 8 — The basic structure of data**

### 7.2.5 Methods for specifying update data by users or centre

The user can specify the update content using the following information:

— data provider;

— type of data;

— area;

— time (version);

— priorities (emergency data, etc.).

The centre defines the possible update content available according to the information above.

### 7.2.6 Rules for specifying the objects to be replaced or deleted (Rules for identifiers)

It is necessary to identify exactly objects (such as features, attributes, areas) to be replaced or deleted.

However, the rules for specifying the objects are outside the scope of this International Standard.

### 7.2.7 Version control

The versions of the content in each In-vehicle System, as well as between the In-vehicle Systems, can be different.

EXAMPLE Various area-data composes one map, and the version differs from each area-data. Also, each system has different content.

The entire DB of a Service Centre does not necessarily match the entire onboard DB. However, the versions of the target object/area in both DB shall match after the update.

To make appropriate updates under these circumstances, it is necessary to be able to exchange the version identifiers between Service Centres and In-vehicle Systems to realize what data needs to be updated.

# 8 Protocols

## 8.1 Introduction

This clause defines the protocols for updating data in an In-vehicle System according to the concepts defined in Clause 7. There are four protocols. Two of them are used when an In-vehicle System is the trigger. The other two are used when a Service Centre is the trigger. These protocols can handle several data categories. The relationship between these protocols and the update varieties defined in 7.2.1 is described in Table 1.

The protocols are defined as sequences between a Service Centre and an In-vehicle System. An actual system may skip the optional sequences of those protocols. In the figures of this clause the optional sequences are shown as dot-line arrows.

Processes in an In-vehicle System and in a Service Centre are outside the scope of this International Standard. These processes are shown as chain-line arrows in the figures.

NOTE These protocols result from a study of different cases corresponding to the different varieties of update as defined in 7.2.1. The studied cases are in Annex D.

**Table 1 — Protocols and relationship with the update varieties**

| Protocols | Update varieties | | |
|---|---|---|---|
| | Data Categories | Initiatives | Types |
| Protocol for an In-vehicle-System-trigger system delivering map data or POI Data | Map data, POI data | Data providing | By geographic area |
| | | | Incremental |
| | | Data retrieving | By geographic area |
| | | | Incremental |
| Protocol for an In-vehicle-System-trigger system delivering status data | Status data | Data providing | By geographic area |
| | | | Incremental |
| | | Data retrieving | By geographic area |
| | | | Incremental |
| Protocol for a Service-Centre-trigger system delivering map data, POI data or status data | Map data, POI data, status data | Data pushing | By geographic area |
| | | | Incremental |
| | | Data broadcasting | By geographic area |
| | | | Incremental |
| Protocol for a Service-Centre-trigger system delivering emergency data | Emergency data | Data pushing | By geographic area |
| | | | Incremental |
| | | Data broadcasting | By geographic area |
| | | | Incremental |

## 8.2 Protocol for an In-vehicle-System-Triggered system delivering map data or POI data

First, an In-vehicle System specifies the content to be updated. Then the In-vehicle System sends the information that specifies content to be updated to a Service Centre. The Service Centre selects the content. It sends the requested content information. The In-vehicle System judges the update necessity. It requests the content to be updated. The Service Centre sends the content. The In-vehicle System executes the update. It sends the completion information. Finally, the Service Centre executes the Afterward Process.

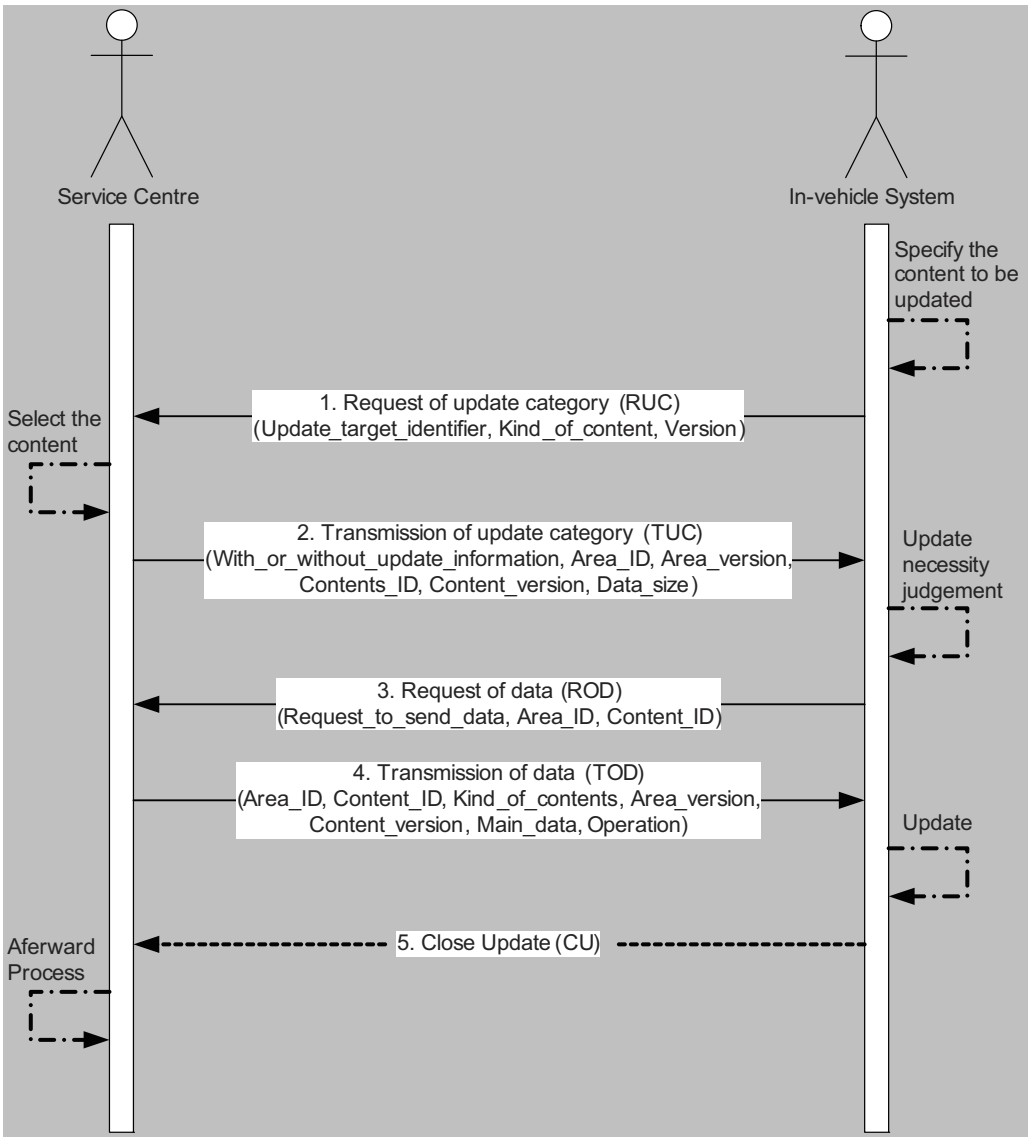



**Figure 9 — Protocol for an In-vehicle-System-Triggered system delivering map data or POI data**

### 8.3 Protocol for an In-vehicle-System-Triggered system delivering status data

First, an In-vehicle System specifies the content to be updated. Then the In-vehicle System sends the information that specifies content to be updated to a service centre. The Service Centre sends the content. The In-vehicle System executes the update.

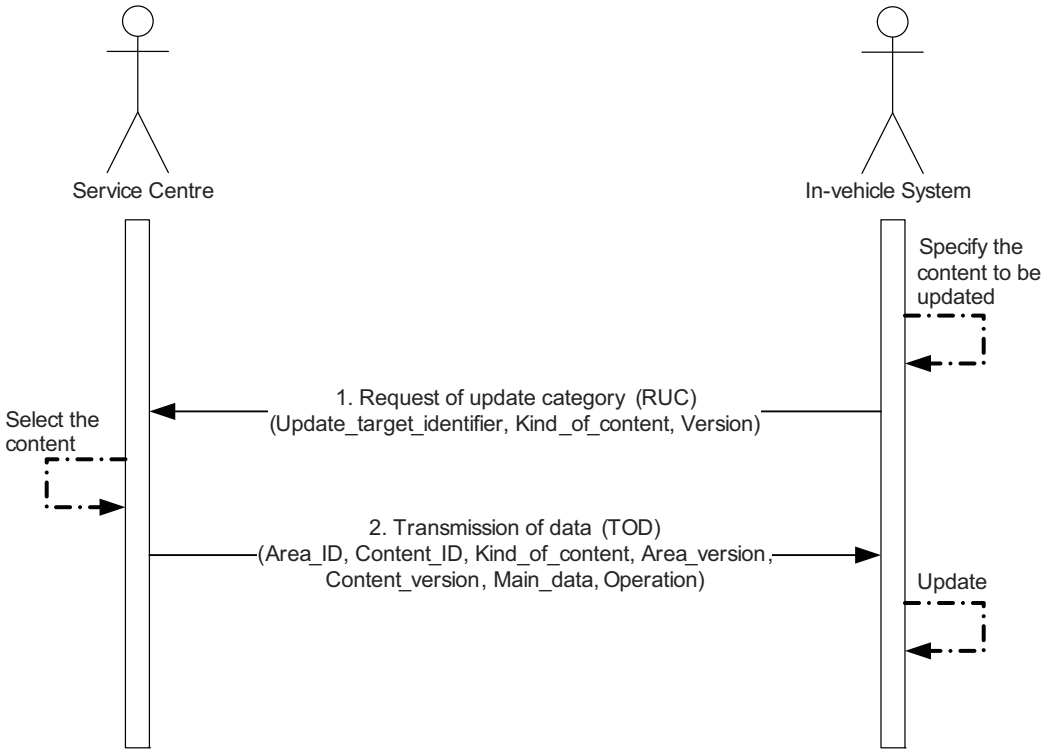



**Figure 10 — Protocol for an In-vehicle-System-Triggered system delivering status data**

## 8.4 Protocol for a Service-Centre-Triggered system delivering map data, POI data or status data

First, a Service Centre selects the content to be updated. The Service Centre sends the content information of update content to an In-vehicle System. The In-vehicle System selects the content to be updated. It requests the content. The Service Centre sends the content. The In-vehicle System executes the update. It sends the update completion information. Finally, the Service Centre executes the Afterward Process.

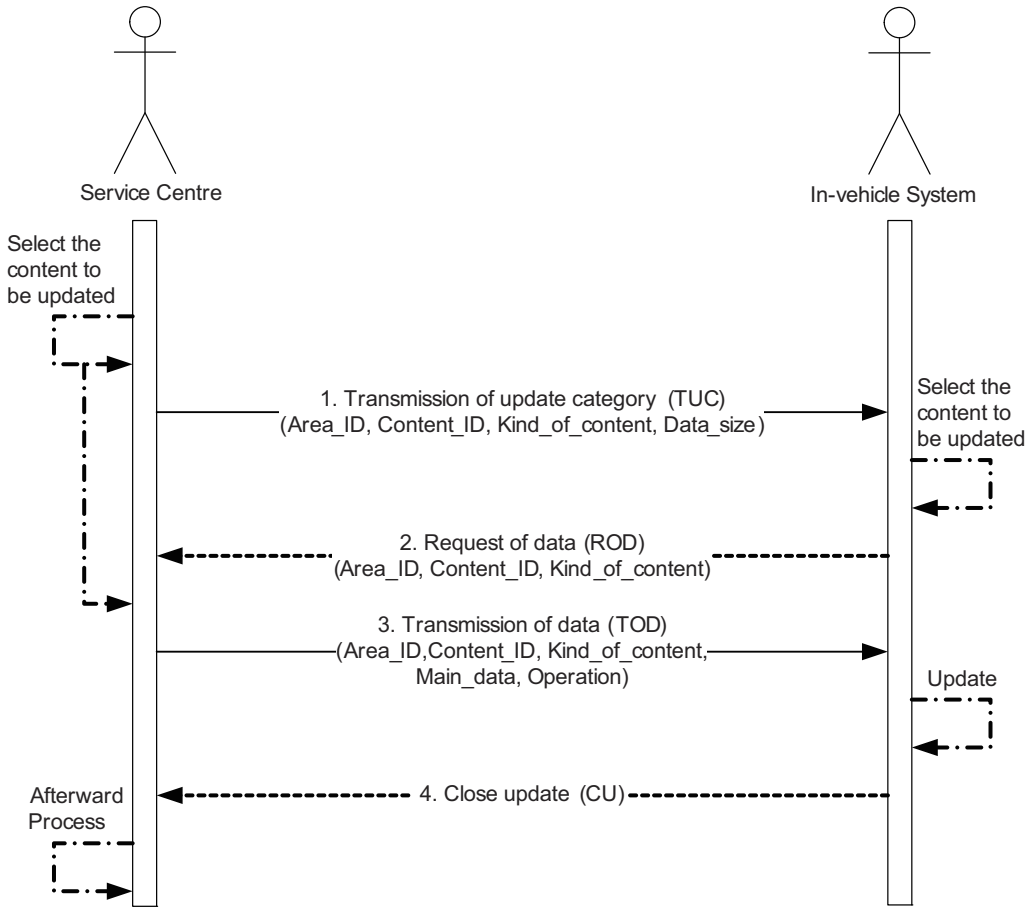



**Figure 11 — Protocol for a Service-Centre-Triggered system delivering map data, POI data or status data**

## 8.5 Protocol for a Service-Centre-Triggered system delivering emergency data

First, a Service Centre selects the content to be updated. The Service Centre sends the content to an In-vehicle system. The In-vehicle System executes the update.

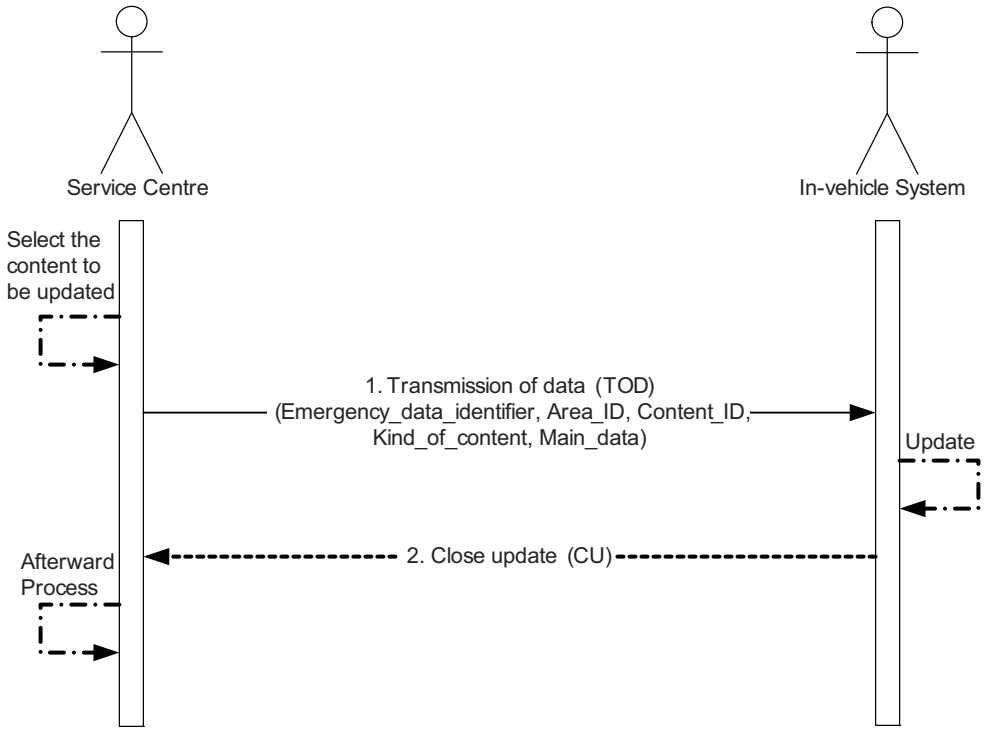



**Figure 12 — Protocol for a Service-Centre-Triggered system delivering emergency data**

## 8.6 Definitions of messages used in the protocols

This subclause specifies the messages used by the different protocols to exchange information between a Service Centre and an In-vehicle System (see Table 2).

**Table 2 — Definitions of messages used in the protocols**

| Name | Description | Origin | Destination | Parameters |
|---|---|---|---|---|
| RUC<br>(Request of update category) | RUC is a message sent by an In-vehicle System that triggers the update procedure in a Service Centre with a range of update. | In-vehicle System | Service Centre | Update target_identifier, Kind_of_content, Version |
| TUC<br>(Transmission of update category) | TUC is a message sent by Service Centre which describes the available update categories. | Service Centre | In-vehicle System | With_or_without_update_information, Area_ID, Area_version, Content_ID, Content_version, Data_size<br>Kind_of_content |
| ROD<br>(Request of data) | ROD is a message sent by an In-vehicle System to request the update data. | In-vehicle System | Service Centre | Request_to_send_data,<br>Area_ID, Content_ID<br>Kind_of_content |
| TOD<br>(Transmission of data) | TOD is a message sent by a Service Centre, which contains the update data. | Service Centre | In-vehicle System | Area_ID, Content_ID,<br>Area_version, Content_version, Kind_of_content, Main_data, Operation, Emergency_data_identifier |
| CU<br>(Close update) | CU is a message sent by an In-vehicle System to inform of the update completion. This message is optional in the protocols and has no parameter. | In-vehicle System | Service Centre | |

# 9 Data structures

## 9.1 Introduction

The data exchange between a Service Centre and an In-vehicle System is structured by the five messages defined in Table 2. The relationship between the messages and the parameters exchanged is shown in Figure 13. The multiplicity appearing at each end of a relationship explains whether a parameter is optional or not, and whether it may appear several times.

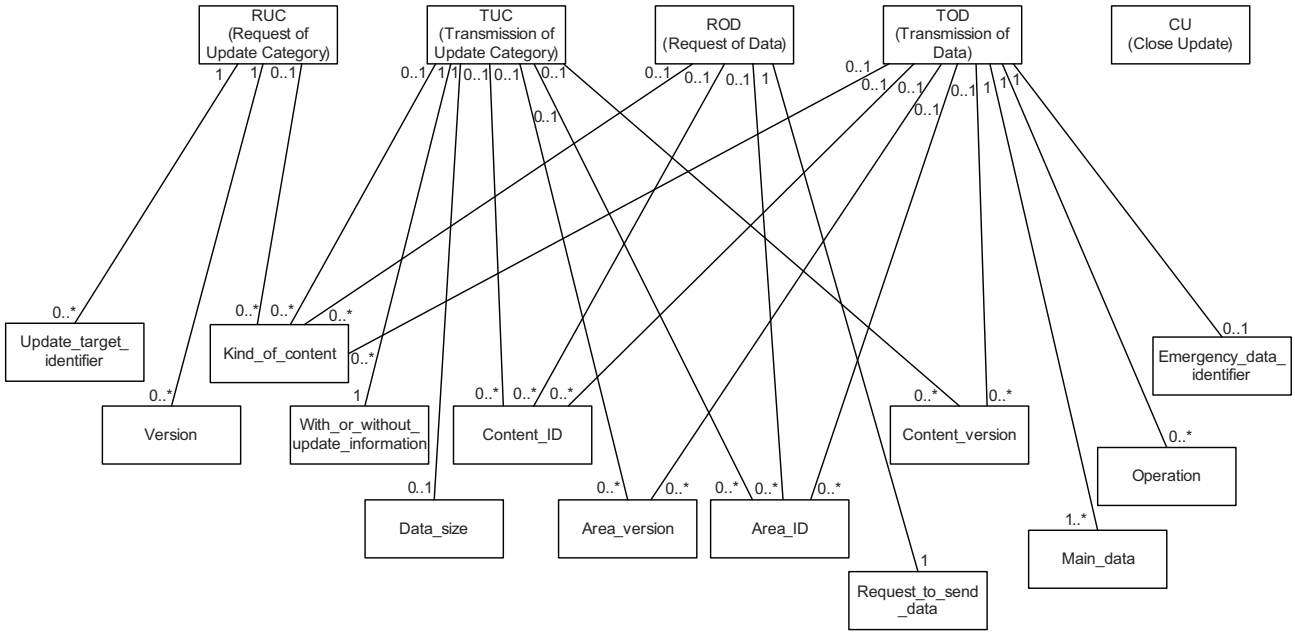



**Figure 13 — Data structure**

## 9.2 Class: Update target_identifier

Class Update target_Identifier is a class used in a message originated with an In-vehicle System to a Service Centre to specify the update target where the update is required. This is used when the In-vehicle System cannot identify the IDs of the content coming from the Service Centre when requested.

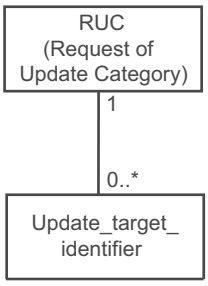



**Figure 14 — Class: Update target_identifier**

## 9.3 Class: Area_ID

Class Area_ID is a class used by a data provider to inform a data receiver about the identifier of the update target to be updated. It is then used to specify the update target identifier of the update data. This is used when the type of the update is “By Geographic area”.

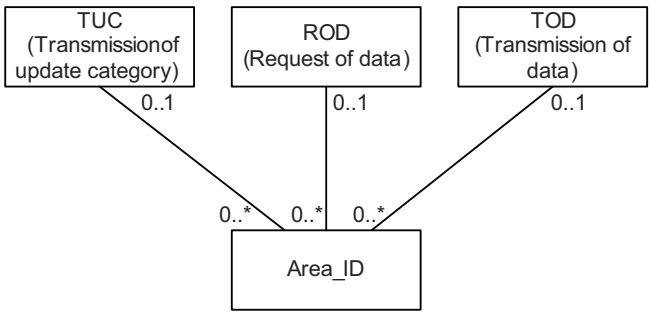



**Figure 15 — Class: Area_ID**

## 9.4 Class: Content_ID

Class Content_ID is a class used by a data provider to inform a data receiver about the identifier of the content to be updated. It is then used to specify the content identifier of the update data. This is used when the update type is “Incremental”.

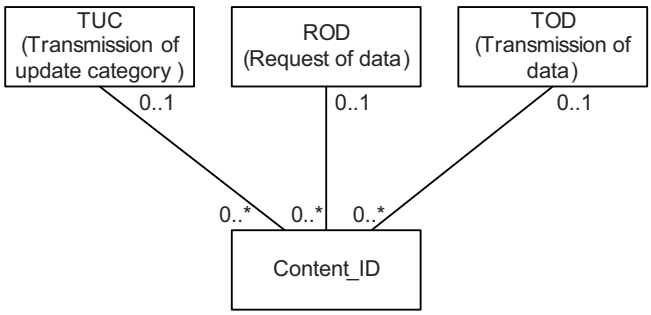



**Figure 16 — Class: Content_ID**

## 9.5 Class: Version

Class Version is a class used by an In-vehicle System to specify the version of the data required for a Service Centre. This is used when an In-vehicle System cannot specify the version of the data.

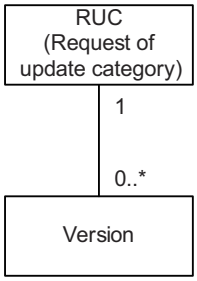



**Figure 17 — Class: Version**

## 9.6 Class: Area_version

Class Area_version is a class used by a data provider to inform a data receiver about the version of the area to be updated. This is used when the update type is “By Geographic area”.

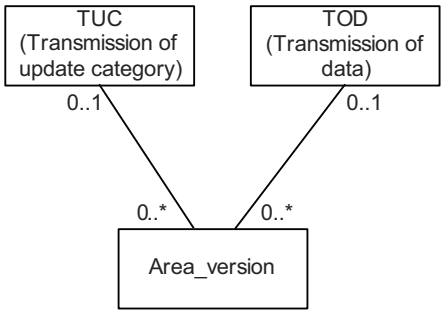



**Figure 18 — Class: Area_version**

## 9.7 Class: Content_version

Class Content_version is a class used by a data provider to inform the data receiver about the version of the content to be updated. This is used when the update type is “Incremental”.

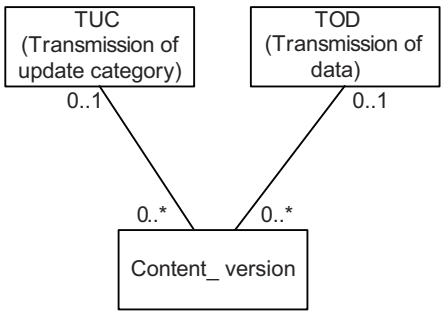



**Figure 19 — Class: Content_version**

## 9.8 Class: Operation

Class Operation is a class used by a Service Centre to specify whether the In-vehicle System has to add, update or delete the In-vehicle data according to the data sent by the Service Centre. This is used when the update type is “Incremental”.

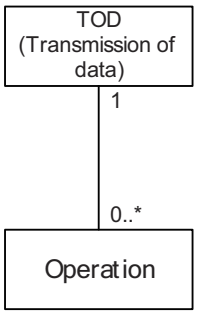



**Figure 20 — Class: Operation**

## 9.9 Class: Request_to_send_data

Class Request_to_send_data is a class used by an In-vehicle System to request a Service Centre to send the body of the data.

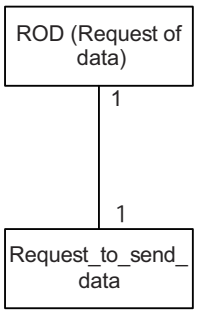



**Figure 21 — Class: Request_to_send_data**

## 9.10 Class: With_or_without_data

Class With_or_without_data is a class used by a Service Centre to inform an In-vehicle System whether the data corresponding to the update request exists or not.

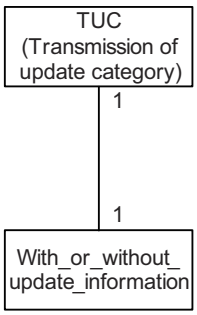



**Figure 22 — Class: With_or_without_data**

## 9.11 Class: Data_size

Class Data_size is a class used by a Service Centre to inform an In-vehicle System about the size of the data corresponding to the update request.

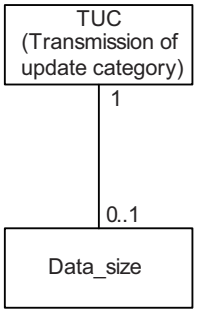



**Figure 23 — Class:Data_size**

## 9.12 Class: Kind_of_content

Class Kind_of_content is a class used by an In-vehicle System to inform a Service Centre about the kind of content of the data sent in the update request. It is then used to specify the kind of content of the update data.

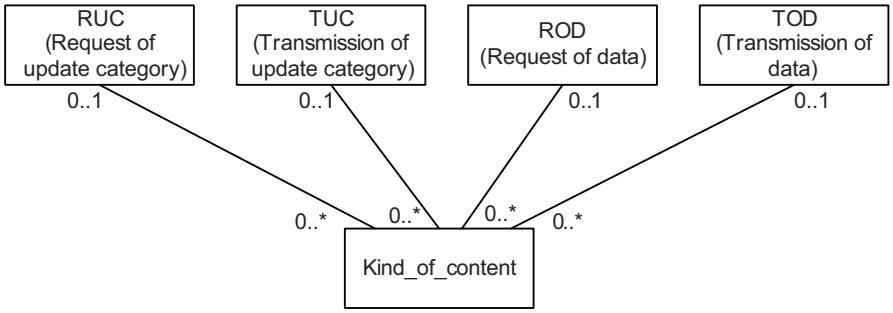



**Figure 24 — Class: Kind_of_content**

## 9.13 Class: Emergency_data_identifier

Class Emergency_data_identifier is a class used by a Service Centre to inform an In-vehicle System whether the data is emergency data or not.

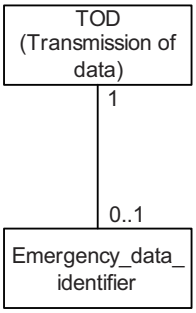



**Figure 25 — Class: Emergency_data_identifier**

## 9.14 Class: Main_data

Class Main_data is a body of the updating data that a Service Centre sends to an In-vehicle System.

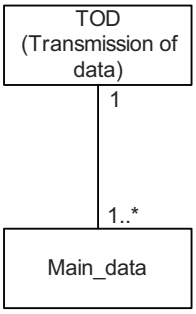



**Figure 26 — Class: Main_data**

# Annex A
(normative)

# Abstract test suite

## A.1 Abstract test suite

This abstract test suite applies to the comprehensive protocol and data derived from this International Standard.

## A.2 Test case identifier: Protocol test

a) Test Purpose: to determine conformance by the protocol.

b) Test Method: a comparison between this International Standard and a protocol to be tested shall be performed to determine if it matches one of the protocols described in 8.2 to 8.5.

c) Reference: Clause 8.

d) Test Type: Basic.

## A.3 Test case identifier: Data structure test

a) Test Purpose: to determine conformance by the data structure used in the protocol.

b) Test Method: a comparison between this International Standard and a data structure to be tested shall be performed to determine if it covers all the data elements needed for the protocol standard of the tested system, selected from 8.2 to 8.5.

c) Reference: Clauses 8 and 9.

d) Test Type: Basic.

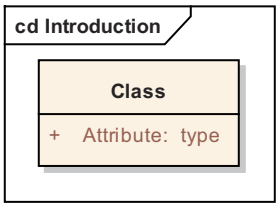
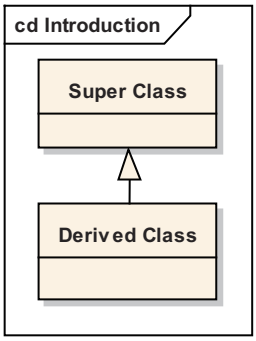
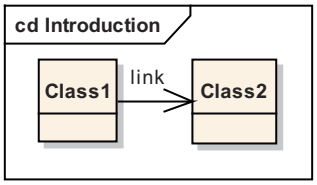
# Annex B
(informative)

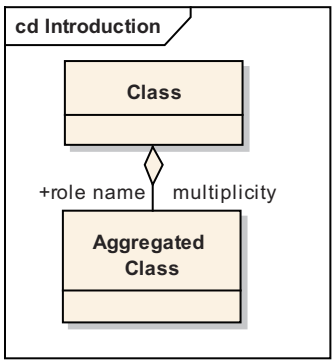
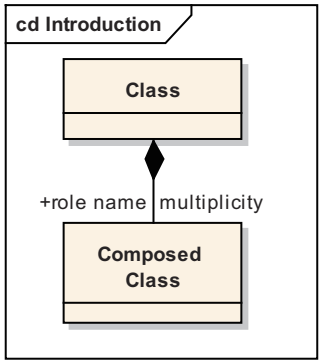
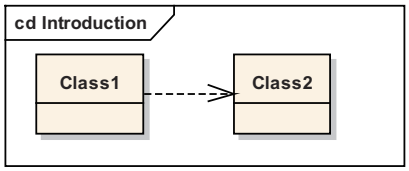
# Description of UML expression elements

This International Standard makes use of a newly developed methodology to express structural circumstances called UML. The following table shows a short description of UML diagram elements used to ensure that no misinterpretation may occur caused from further development of UML1.4, which is standardized in ISO/TS 19501; UML2 is standardized by the Object Management Group; see Reference [7].

In different class diagrams, light or dark colouring is used to express the intent of a particular diagram. The light colour implies that the diagram is of logical/explanatory nature; the dark colour implies that a particular instantiation will be introduced afterwards; that is for the description of the structure of the proposed physical format.

**Table B.1 — Description of UML expression elements**

| Element Name | Element | Description |
|---|---|---|
| Class |  | A class is a template for a given data element which can contain attributes. It is a rectangle divided into three compartments. The topmost compartment contains the name of the class. The middle compartment contains a list of attributes owned by that class and the bottom compartment contains a list of operations which is not shown here because operations are not used in this International Standard. In some diagrams, the bottom compartment of attributes may be omitted for the sake of clarity. An attribute line has a specified "+, # or –" for visibility (not used in this International Standard), a name of the attribute and after a colon a data type and in squared brackets the multiplicity which is described in aggregation hereunder. |
| Specialization |  | A specialization (i.e. inheritance) defines a general class (super class) whose properties are inherited from the derived class. In data structures, this implies that the derived class has at least the same attributes as the super class and normally will define more attributes to it. Reasons for using an inheritance in general is to have different specializations from one super class. |
| Association |  | The association shows that two classes do have a connection in between them. Associations are used in this International Standard to express a loose linkage. An arrow at the head shows the direction of the association. In the element example, class 1 is linked with a link to class 2 but no information is relayed from class 1 back to class 2. The association has no direct counterpart in data structures, but will indirectly be visible. |

| Element Name | Element | Description |
|---|---|---|
| Aggregation |  | The aggregation is a more explicit design element for describing attributes. It is a stronger association, demonstrating that the class on the side of the diamond “has” an instance of the aggregated class. The name of that instance is given on the left side of the connection and starts again with the “+”. On the right side, the multiplicity of that instance is given as a range of the allowed count of occurrences. An aggregation does open if the aggregated element has the same lifetime as the aggregating class. In data structures, the aggregation can be a reference to another data structure or an embedded data element. |
| Composition |  | The composition strengthens the type of aggregation in a way that the lifetime of the composed element is the same as the composing class, i.e. the structure can be seen as a “composition”. In data structures, composition is normally seen as an embedded data element. |
| Dependency |  | The dependency is an unspecific type of relationship between two classes. |

# Annex C
(informative)

# Use cases

## C.1 Purpose and the top-level package diagram

This International Standard contains the use cases which describe the functionality between an In-vehicle System and a Service Centre. The purpose of developing these use cases is to clear up the requirements of this International Standard by clearing the procedures for exchanging the data between an In-vehicle System and a Service Centre.

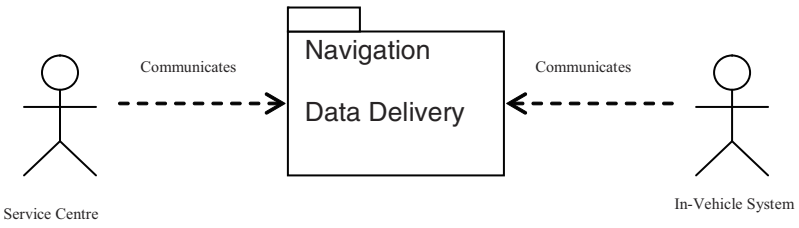
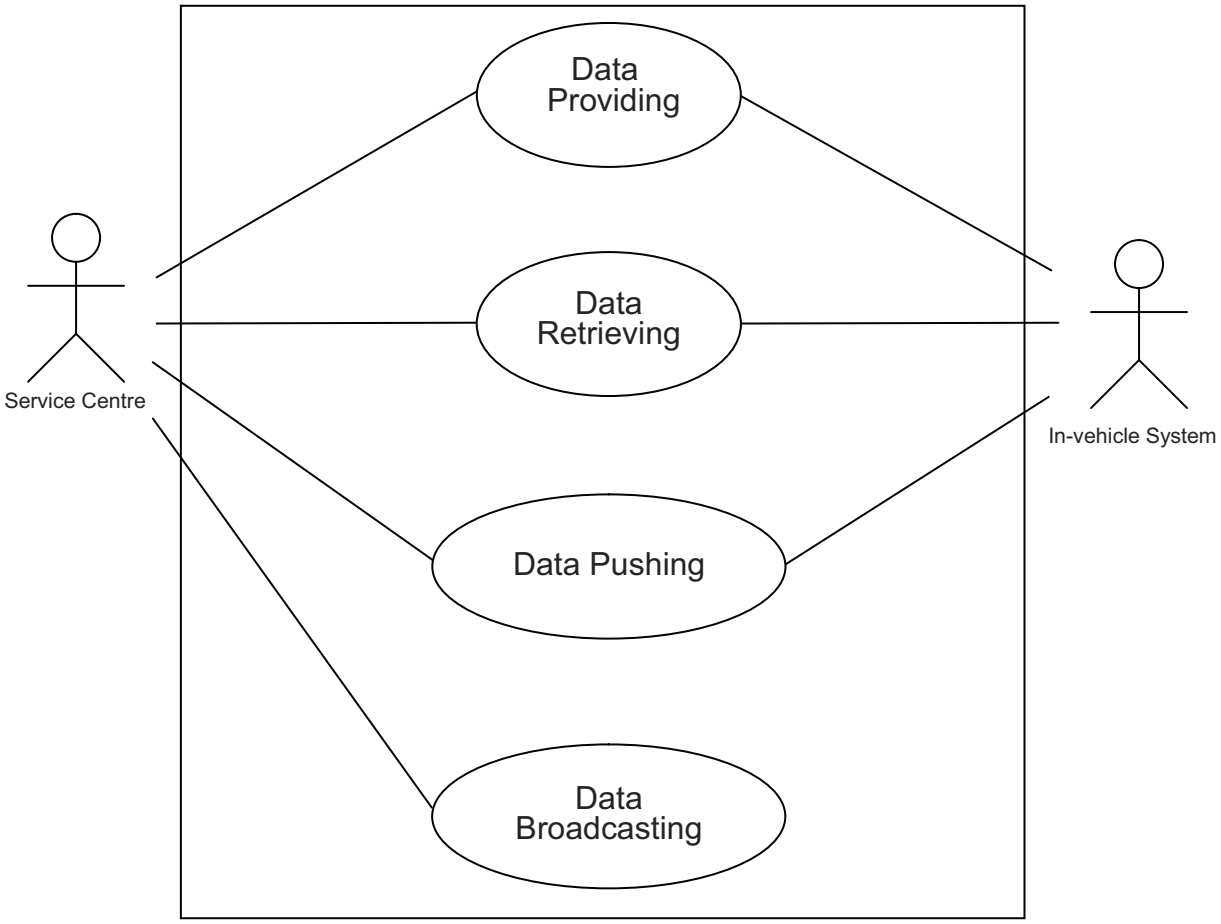



**Figure C.1 — Top-level package diagram**

## C.2 Navigation data delivery use case




NOTE Data Providing: two-way communication of data initiated by the In-vehicle System in which the version is controlled by the Service Centre.

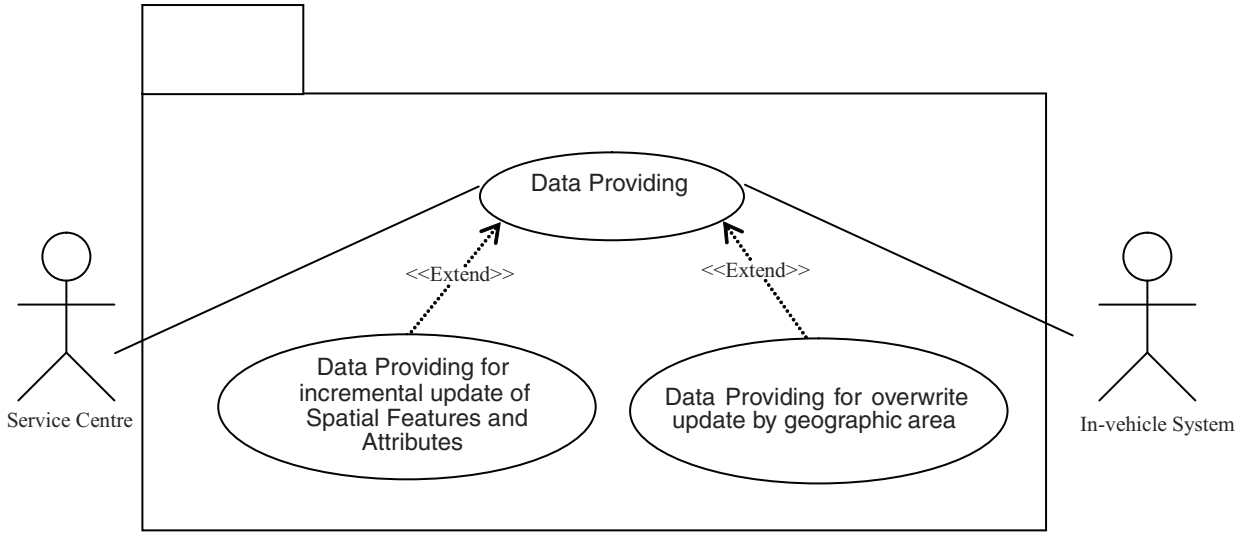
Data Retrieving: two-way communication of data initiated by the In-vehicle System in which the version is controlled by the In-vehicle System.

Data Pushing: two-way communication of data initiated by the Service Centre.

Data Broadcasting: one-way communication by the Service Centre.

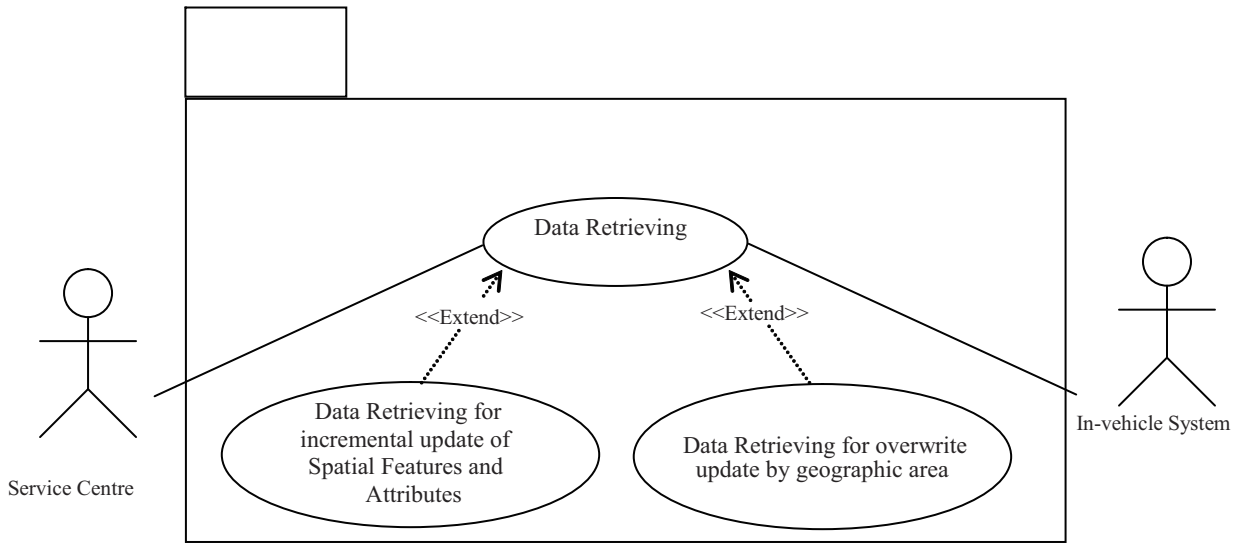
**Figure C.2 — Navigation data delivery use case**

## C.3 Data providing



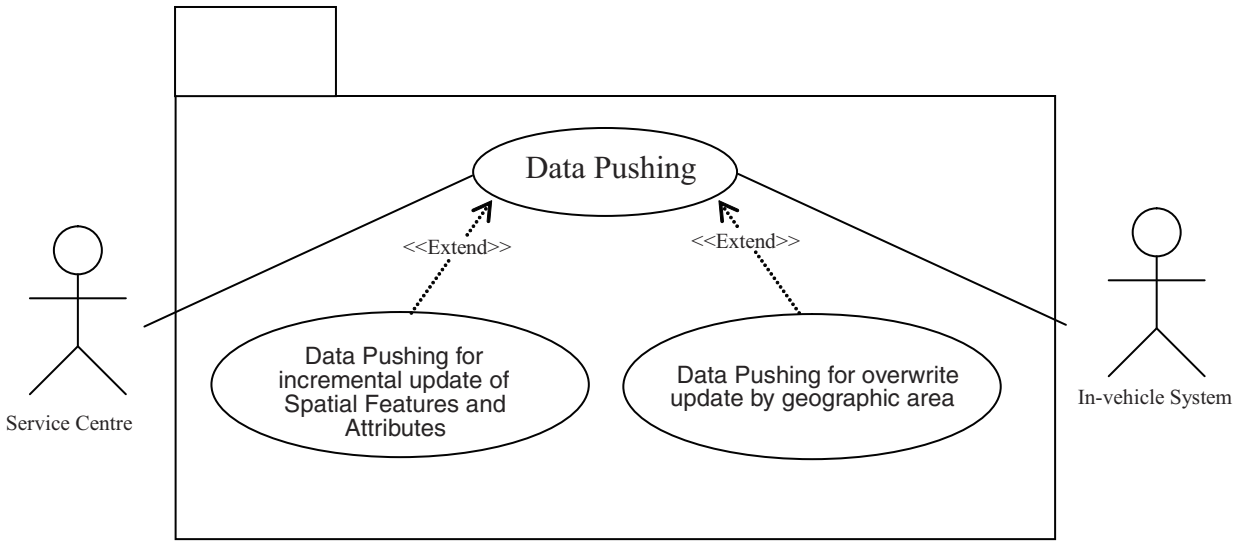

| **Use Case Name** | **Data Providing** | | | | |
|---|---|---|---|---|---|
| **Actors** | Service Centre | In-vehicle System | | | |
| **Description** | Service Centre provides the required content. | | | | |
| **Flow** | 1. An In-vehicle System specifies the content to update.<br>(E.g. specifies “Area” when the content to update is related to a location, or specifies “Data category” when the content to update is related to a service and POI information.)<br>2. An In-vehicle System sends the information that specifies content to update and the information that identifies user.<br>3. A Service Centre identifies user.<br>4. A Service Centre selects the content that needs to be updated.<br>(Select the content that is newer than that in the In-vehicle System)<br>5. A Service Centre ends the content specified in step 4. | | | | |
| **Dependencies** | Extends<br>Data Providing for overwrite update by geographic area<br>Data Providing for incremental update of Spatial Features and Attributes | | | | |
| **Preconditions/ Post-conditions** | A Service Centre manages the version of content. | | | | |
| **Alternative flow**<br>**(number indicates item in the flow above)** | — | | | | |
| **Notes** | Service Centre provides the content in a unit by geographic area or by Spatial Features and Attributes. | | | | |

## C.4 Data retrieving



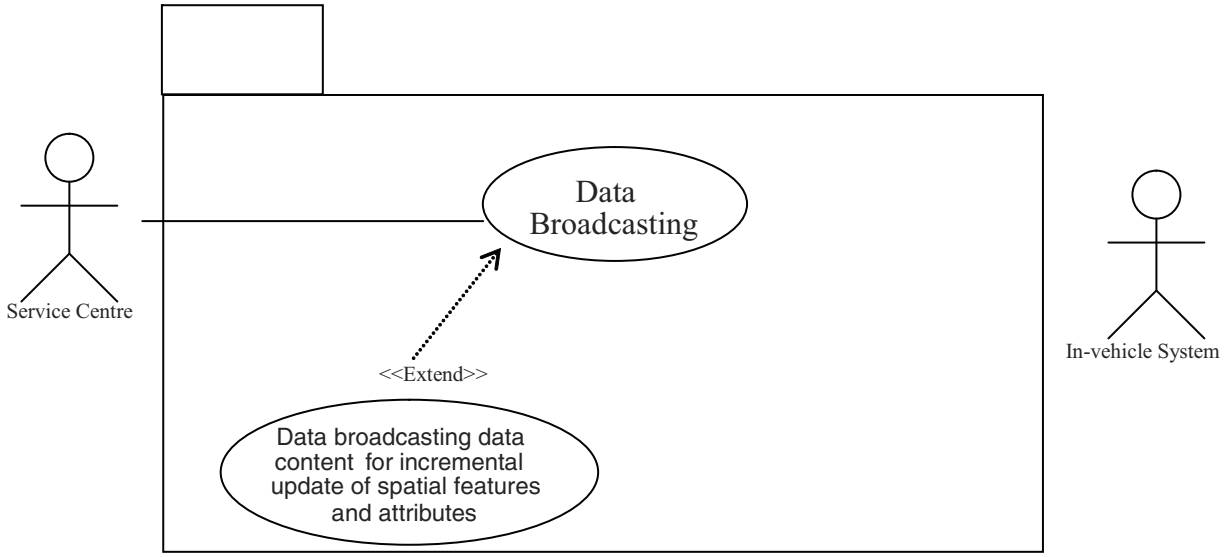

| **Use Case Name** | **Data Retrieving** | | | | |
|---|---|---|---|---|---|
| **Actors** | Service Centre | In-vehicle System | | | |
| **Description** | An In-vehicle System retrieves the required content. | | | | |
| **Flow** | 1. An In-vehicle System specifies the content to update.<br>(E.g. specifies “Area” when the content to update is related to a location, or specifies “Data category” when the content to update is related to a service and POI information.)<br>2. An In-vehicle System sends the information that specifies the content to update and the information that identifies the user.<br>3. A Service Centre ends the version of the specified content.<br>4. An In-vehicle System selects the content that needs to be updated.<br>(Select the content that is newer than that in the In-vehicle System)<br>5. An In-vehicle System requests the content specified in step 4.<br>6. A Service Centre ends the content specified in step 5. | | | | |
| **Dependencies** | Extends<br>Data Retrieving for overwrite update by geographic area<br>Extends<br>Data Retrieving for incremental update of Spatial Features and Attributes | | | | |
| **Preconditions/ Post-conditions** | An In-vehicle System manages the version of the content. | | | | |
| **Alternative flow**<br>**(number indicates item in the flow above)** | — | | | | |
| **Notes** | A Service Centre provides the content in a unit by geographic area or by Spatial Features and Attributes. | | | | |

## C.5 Data pushing




| **Use Case Name** | **Data Pushing** |
|---|---|
| **Actors** | Service Centre |
| **Description** | A Service Centre provides the updated information. |
| **Flow** | 1. A Service Centre ends the information of updated content.<br>2. An In-vehicle System makes a judgment whether it is possible to get the content or not.<br>(E.g. checking the contract of the service or the fitness of the In-vehicle System)<br>3. An In-vehicle System makes a decision whether to receive the content.<br>(Judging from the need of the content)<br>4. An In-vehicle System requests to receive the content.<br>5. A Service Centre ends the content. |
| **Dependencies** | — |
| **Preconditions/ Post-conditions** | The content of the Service Centre is updated. |
| **Alternative flow**<br>**(number indicates item in the flow above)** | 3. When an In-vehicle System makes a judgment that it is impossible to receive the content in step 2, the process terminates.<br>4. When an In-vehicle System makes a decision not to receive the content in step 3, the process terminates. |
| **Notes** | — |

## C.6 Data broadcasting




| **Use Case Name** | **Data Broadcasting** | | | | |
|---|---|---|---|---|---|
| **Actors** | Service Centre | | | | |
| **Description** | Distribute the Status content. | | | | |
| **Flow** | 1. A Service Centre ends the updated content. | | | | |
| **Dependencies** | — | | | | |
| **Preconditions/ Post-conditions** | The content of the Service Centre is updated. | | | | |
| **Alternative flow** **(number indicates item in the flow above)** | — | | | | |
| **Notes** | — | | | | |

# Annex D
(informative)

# Examples of protocols for each update

## D.1 Outline

This annex shows the example of the operation procedure of updating the data of an In-vehicle System that uses the ideas of Clause 6 and data structure described in Clause 8.

Table D.1 details the list of example protocols. These protocols are defined for each of the varieties of updates defined in 7.2.1.

Because the emergency data is data that is sent coercively by a provider, this cannot be sent by the initiatives which ask for the willingness of the data receiver. There are no protocols for emergency data with data providing or data retrieving initiatives.

**Table D.1 — Described protocol list**

| Update varieties | | | Clause |
|---|---|---|---|
| **Data Categories** | **Initiatives** | **Types** | |
| Map Data, POI Data | Data Providing | By Geographic Area | D.2 |
| | | Incremental | D.3 |
| | Data Retrieving | By Geographic Area | D.4 |
| | | Incremental | D.5 |
| Status Data | Data Providing | By Geographic Area | D.6 |
| | | Incremental | D.7 |
| | Data Retrieving | By Geographic Area | D.8 |
| | | Incremental | D.9 |
| Map Data, POI Data, Status Data | Data Pushing | By Geographic Area | D.10 |
| | | Incremental | D.11 |
| | Data Broadcasting | By Geographic Area | D.12 |
| | | Incremental | D.13 |
| Emergency Data | Data Pushing | By Geographic Area | D.14 |
| | | Incremental | D.15 |
| | Data Broadcasting | By Geographic Area | D.16 |
| | | Incremental | D.17 |

## D.2 Protocol for map data, POI data/data providing/geographic area

First, an In-vehicle System specifies the content to be updated. Then the In-vehicle System sends the information that specifies content to be updated. A Service Centre selects the content. A Service Centre ends the content information to be sent. The In-vehicle System requests the content. A Service Centre ends the content. The In-vehicle System executes the update. The In-vehicle System sends the update complete info. Finally, a Service Centre executes the Afterward Process.

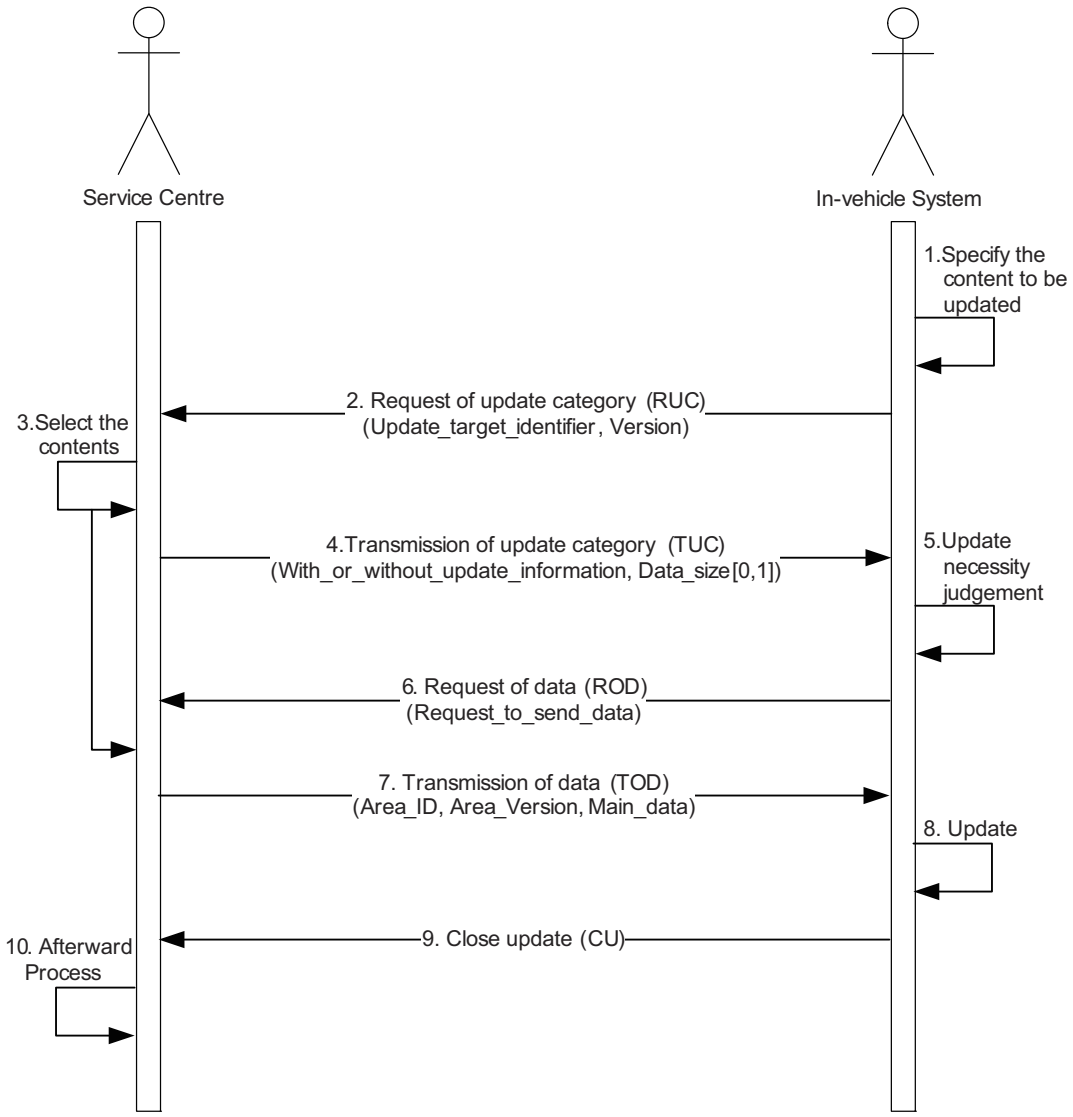



**Figure D.1 — Protocol for map data, POI data/data providing/geographic area**

## D.3 Protocol for map data, POI data/data providing/incremental update

First, an In-vehicle System specifies the content to be updated. Then an In-vehicle System sends the information that specifies content to be updated. A Service Centre selects the content. A Service Centre ends the content information to be sent. An In-vehicle System requests the content. A Service Centre ends the content. An In-vehicle System executes the update. An In-vehicle System sends the update complete info. Finally, a Service Centre executes the Afterward Process.

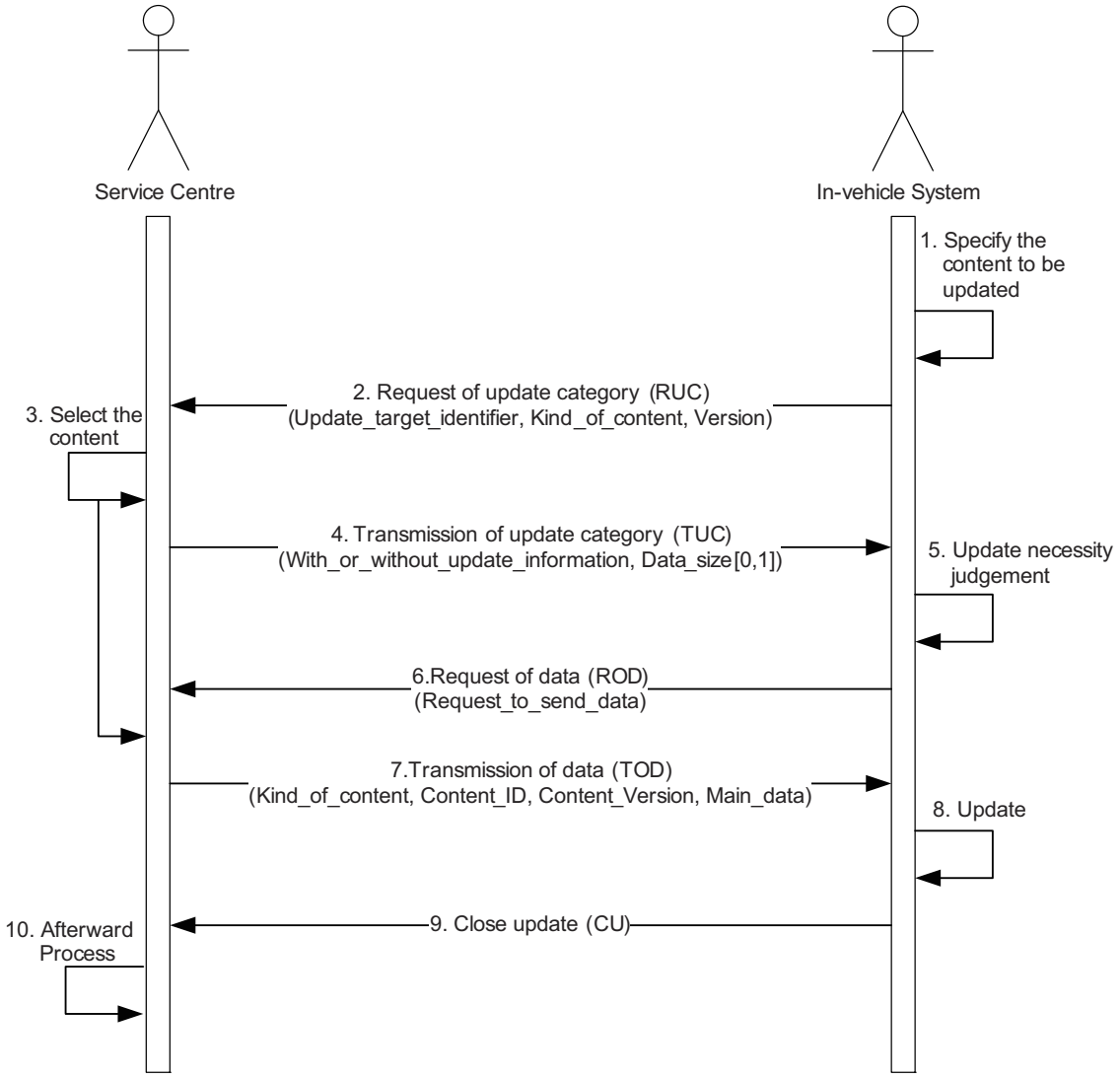



**Figure D.2 — Protocol for map data, POI data/data providing/incremental update**

## D.4 Protocol for map data, POI data/data retrieving/geographic area

First, an In-vehicle System specifies the content to be updated. Then an In-vehicle System sends the information that specifies content to be updated. A Service Centre selects the content. A Service Centre ends the content version. An In-vehicle System estimates the update necessity. An In-vehicle System requests the content to be updated. A Service Centre ends the content. An In-vehicle System executes the update. An In-vehicle System sends the update complete info. Finally, a Service Centre executes the Afterward Process.

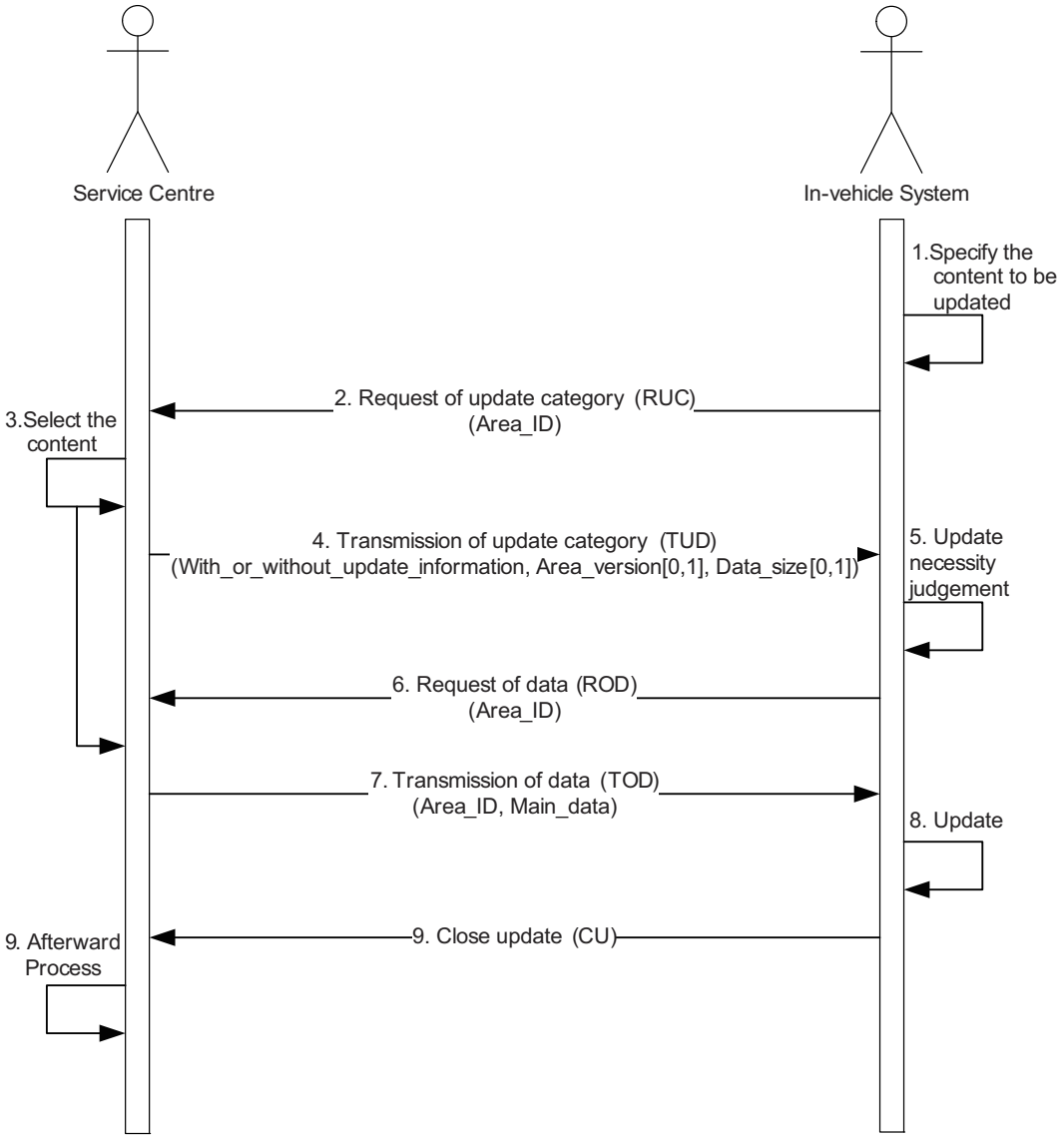



**Figure D.3 — Protocol for map data, POI data/data retrieving/geographic area**

## D.5 Protocol for map data, POI content/data retrieving/incremental update

First, an In-vehicle System specifies the content to be updated. Then an In-vehicle System sends the information that specifies content to be updated. A Service Centre selects the content. A Service Centre ends the content version. An In-vehicle System judges the update necessity. An In-vehicle System requests the content to be updated. A Service Centre ends the content. An In-vehicle System executes the update. An In-vehicle System sends the update complete info. Finally, a Service Centre executes the afterward process.

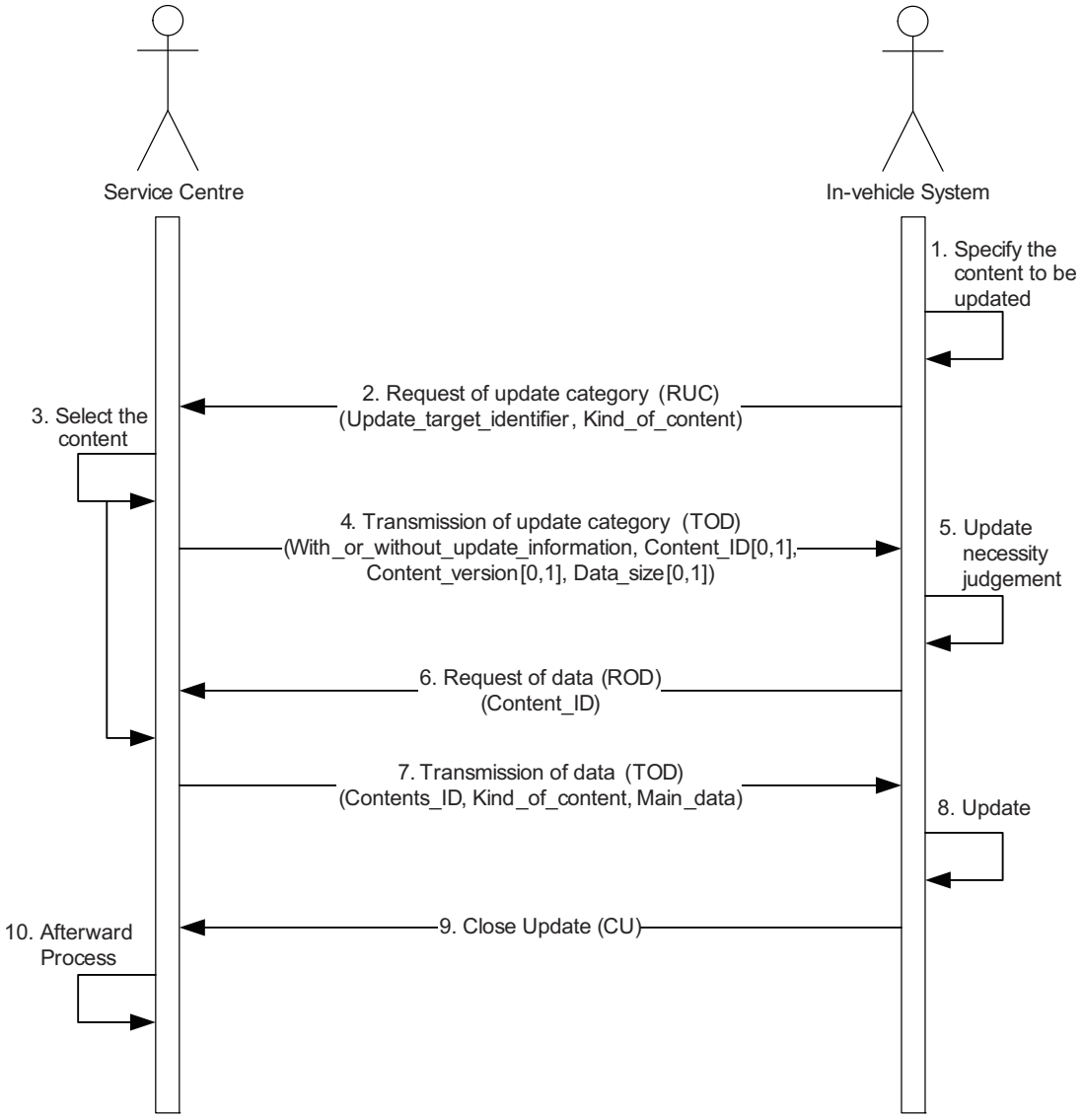



**Figure D.4 — Protocol for map data, POI content/data retrieving/incremental update**

## D.6 Protocol for status data/data providing/geographic area

First, an In-vehicle System specifies the content to be updated. Then an In-vehicle System sends the information that specifies content to be updated. A Service Centre selects the content. A Service Centre ends the content. Finally, an In-vehicle System executes the update.

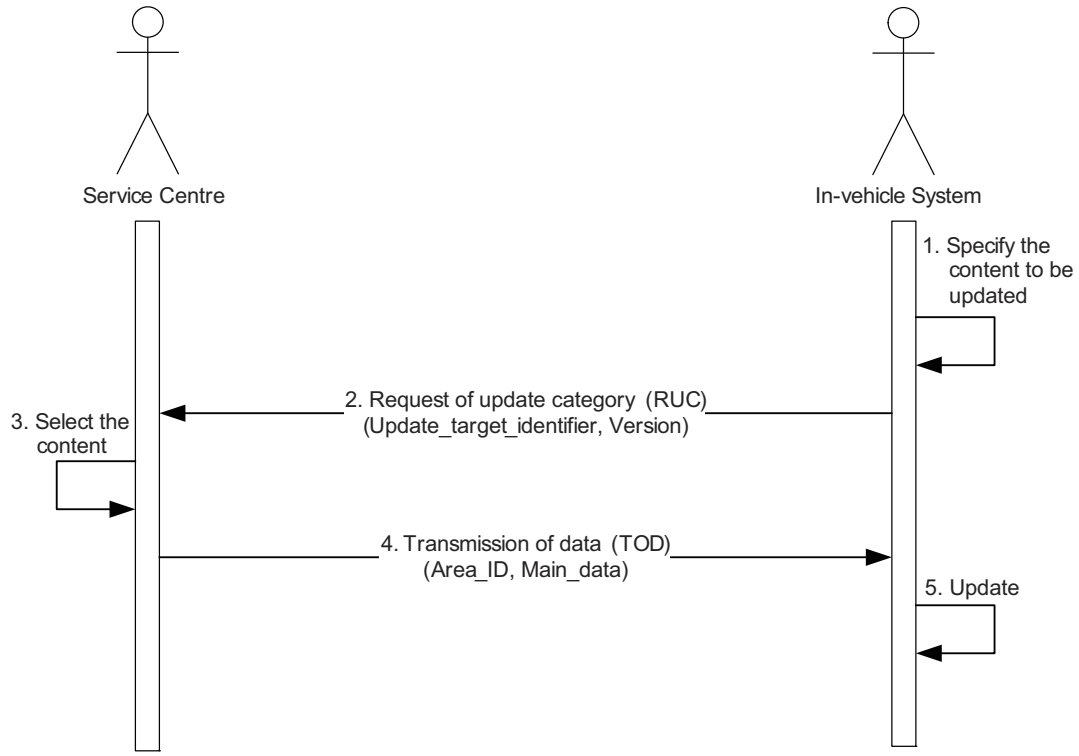



**Figure D.5 — Protocol for status data/data providing/geographic area**

## D.7 Protocol for status data/data providing/incremental update

First, an In-vehicle System specifies the content to be updated. Then an In-vehicle System sends the information that specifies the content to be updated. A Service Centre selects the content. A Service Centre ends the content. An In-vehicle System executes the update. Finally, an In-vehicle System sends the update complete info.

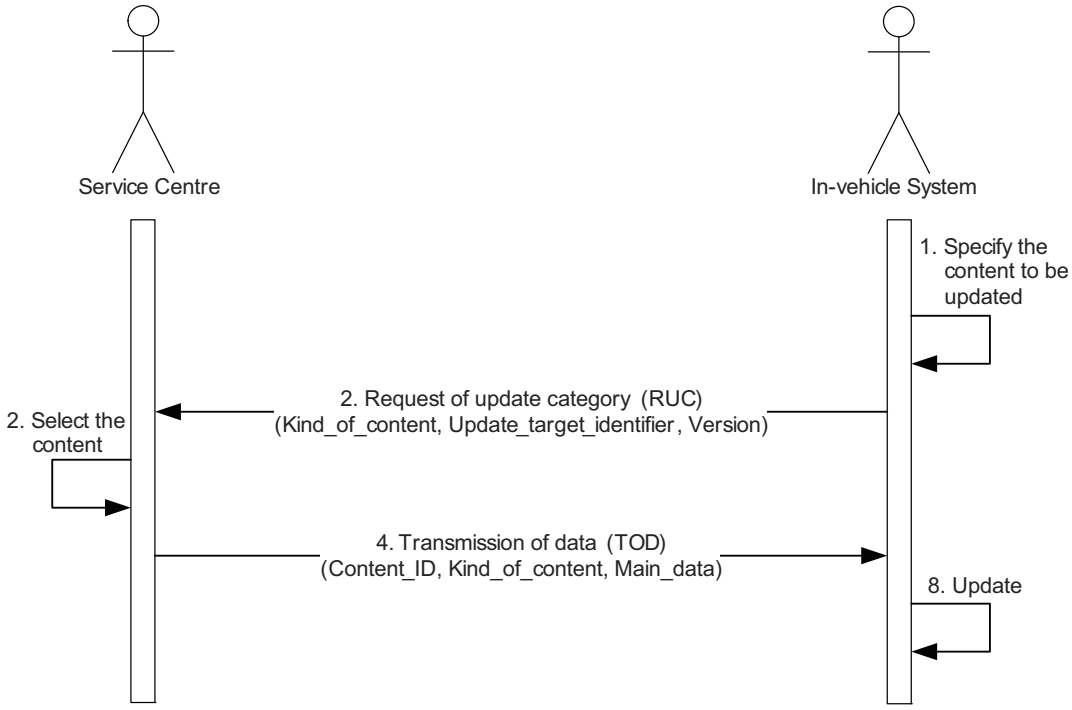



**Figure D.6 — Status data/data providing/incremental update**

## D.8 Protocol for status data/data retrieving/geographic area

First, an In-vehicle System specifies the content to be updated. Then an In-vehicle System sends the information that specifies content to be updated. A Service Centre selects the content. A Service Centre ends the content. Finally, an In-vehicle System executes the update.

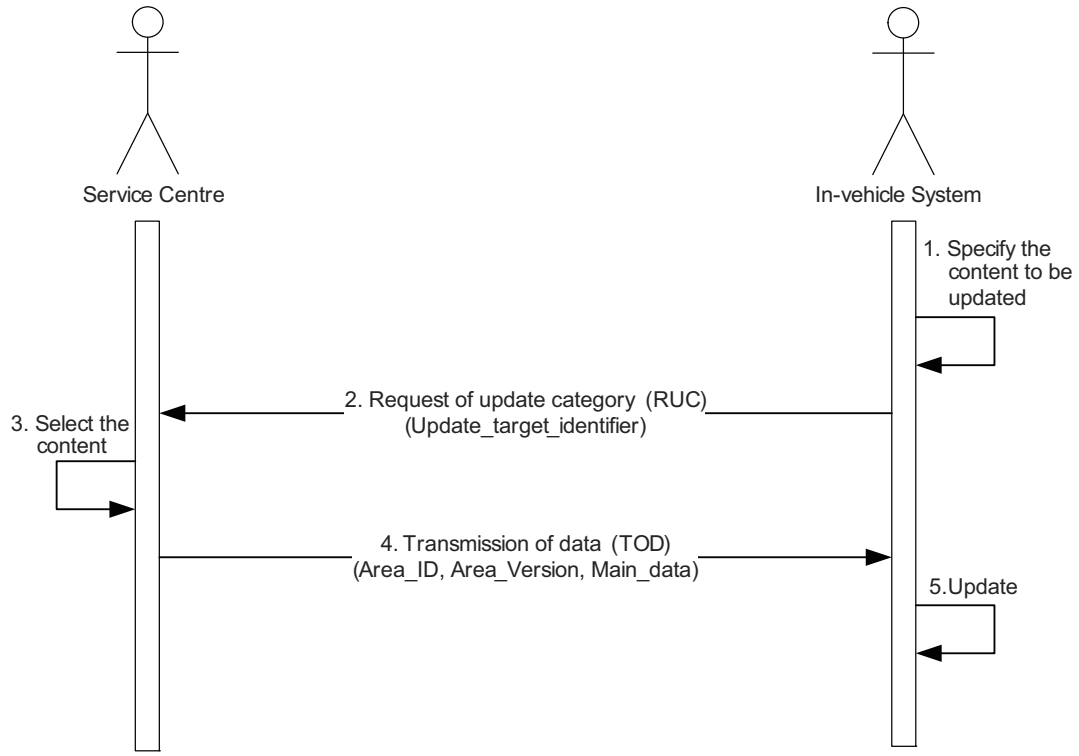



**Figure D.7 — Protocol for status data/data retrieving/geographic area**

## D.9 Protocol for status data/data retrieving/incremental update

First, an In-vehicle System specifies the content to be updated. Then an In-vehicle System sends the information that specifies content to be updated. A Service Centre selects the content. A Service Centre ends the content. An In-vehicle System executes the update. Finally, an In-vehicle System sends the update complete info.

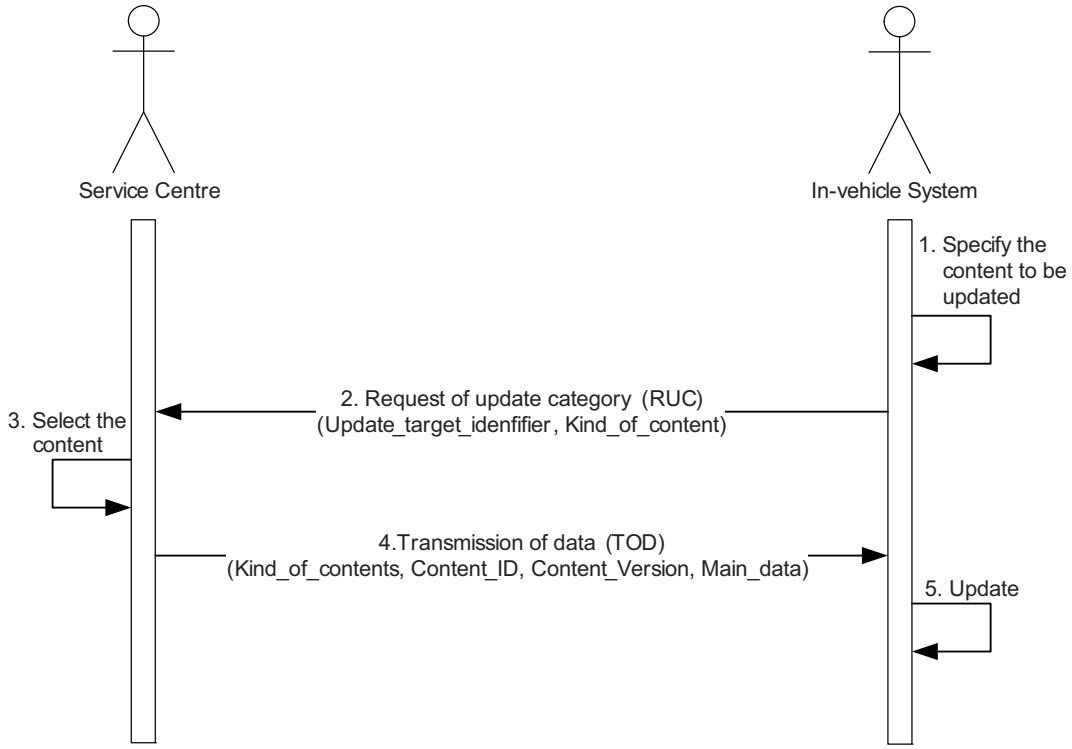



**Figure D.8 — Protocol for status data/data retrieving/incremental update**

## D.10 Protocol for all content (map data, POI data, status data)/data pushing/ geographic area

First, a Service Centre selects the content. A Service Centre ends the content information of update content. An In-vehicle System selects the content to be updated. An In-vehicle System requests the content. A Service Centre ends the content. An In-vehicle System executes the update. An In-vehicle System sends the update complete info. Finally, a Service Centre executes the Afterward Process.

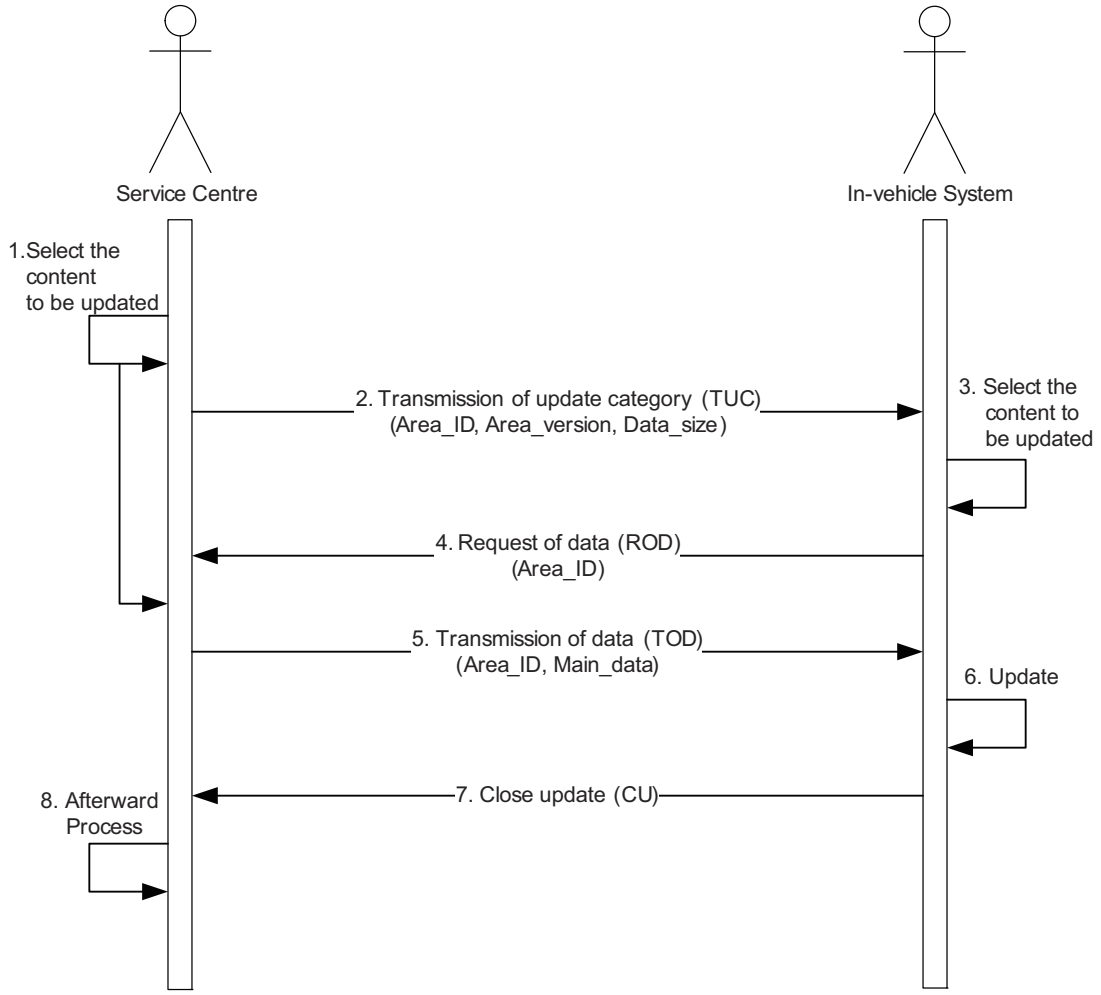



**Figure D.9 — Protocol for all content (map data, POI data, status data)/data pushing/geographic area**

## D.11 Protocol for all content (map data, POI data, status data)/data pushing/ incremental update

First, a Service Centre selects the content to be updated. A Service Centre ends the content information of update content. An In-vehicle System selects the content to be updated. An In-vehicle System requests the content. A Service Centre ends the content. An In-vehicle System executes the update. An In-vehicle System sends the update complete info. Finally, a Service Centre executes the Afterward Process.

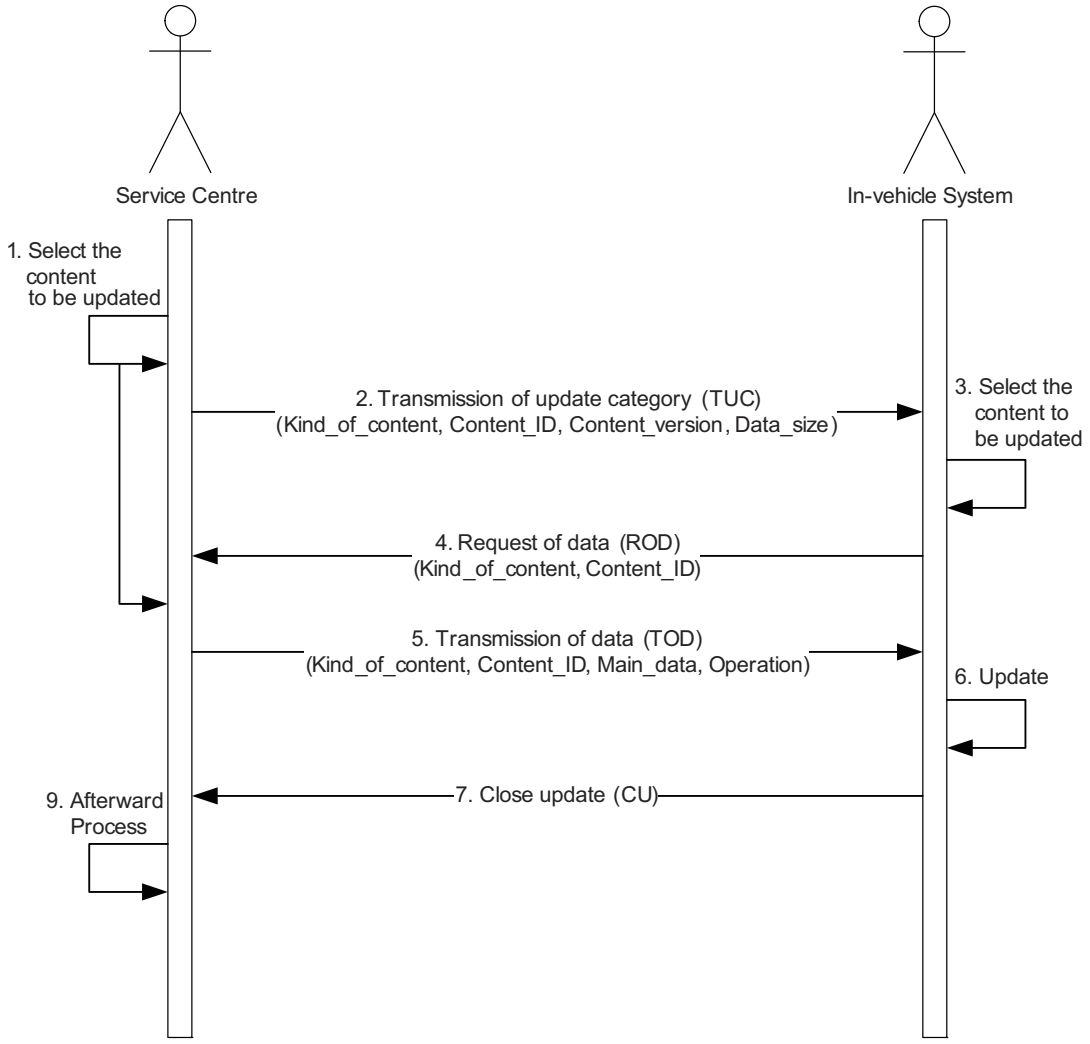



**Figure D.10 — All content (map data, POI data, status data)/data pushing/incremental update**

## D.12 Protocol for map data, POI data, status data/data broadcasting/ geographic area

First, a Service Centre ends the content. Then, an In-vehicle System executes the update.

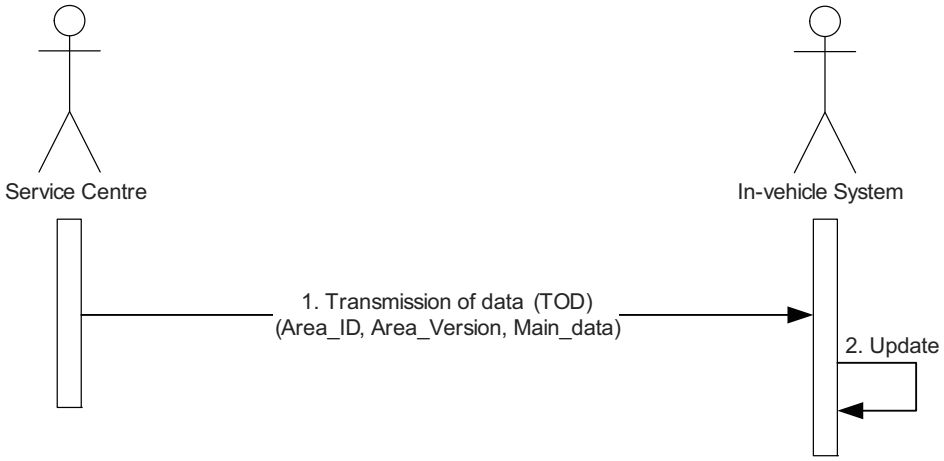



**Figure D.11 — Protocol for map data, POI data, status data/data broadcasting/geographic area**

## D.13 Protocol for map data, POI data, status data/data broadcasting/incremental update

First, a Service Centre ends the content. Then, an In-vehicle System executes the update.

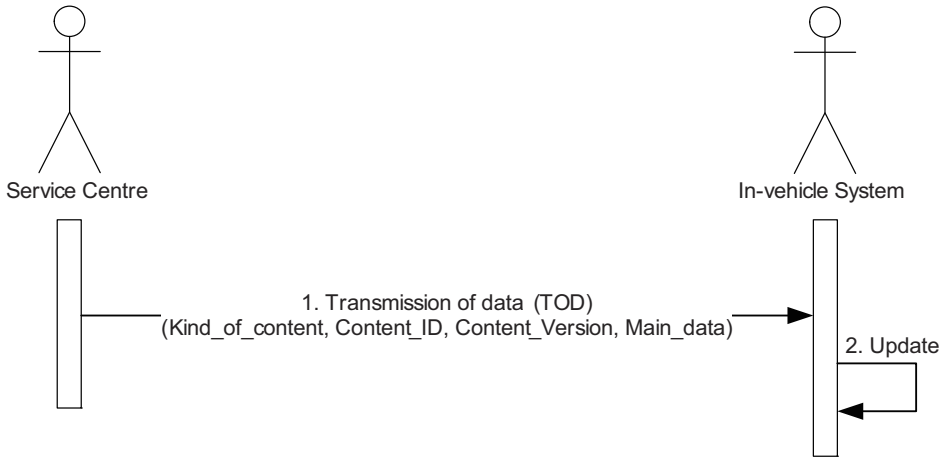



**Figure D.12 — Protocol for map data, POI data, status data/data broadcasting/incremental update**

## D.14 Protocol for emergency data/data pushing/geographic area

First, a Service Centre selects the content to be updated. A Service Centre ends the content. An In-vehicle System executes the update. An In-vehicle System sends the update complete info. Finally, a Service Centre executes the Afterward Process.

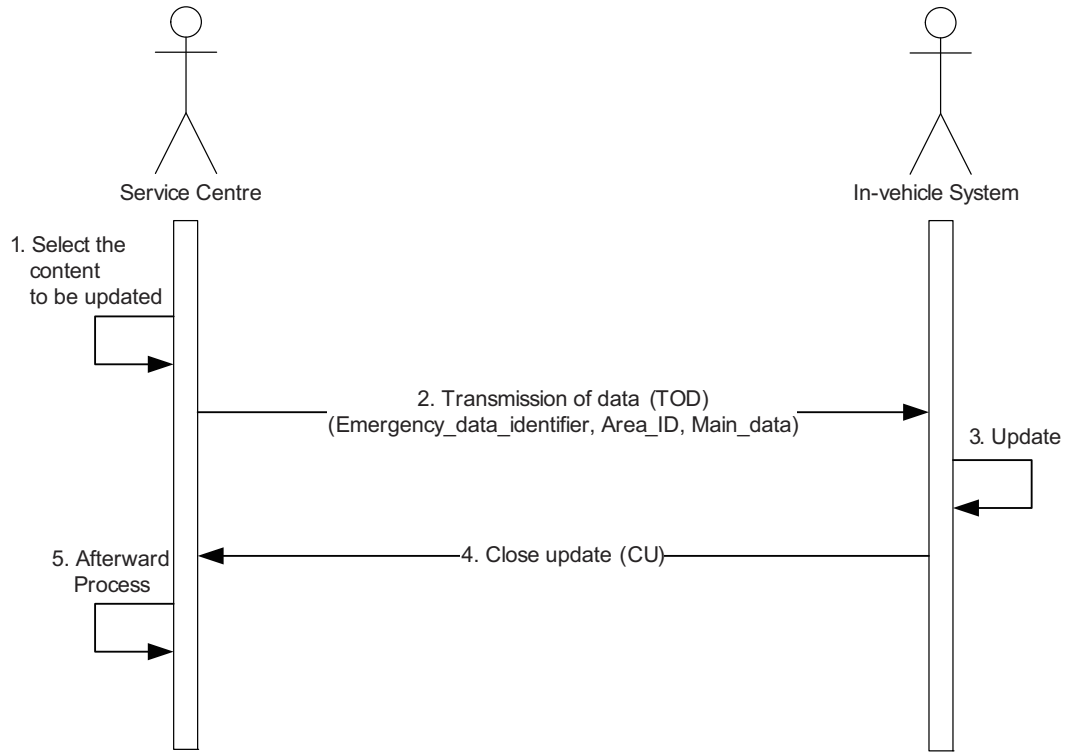



**Figure D.13 — Protocol for emergency/data/data pushing/geographic area**

## D.15 Protocol for emergency data/data pushing/incremental update

First, a Service Centre selects the content to be updated. A Service Centre ends the content. An In-vehicle System executes the update. An In-vehicle System sends the update complete info. Finally, a Service Centre executes the Afterward Process.

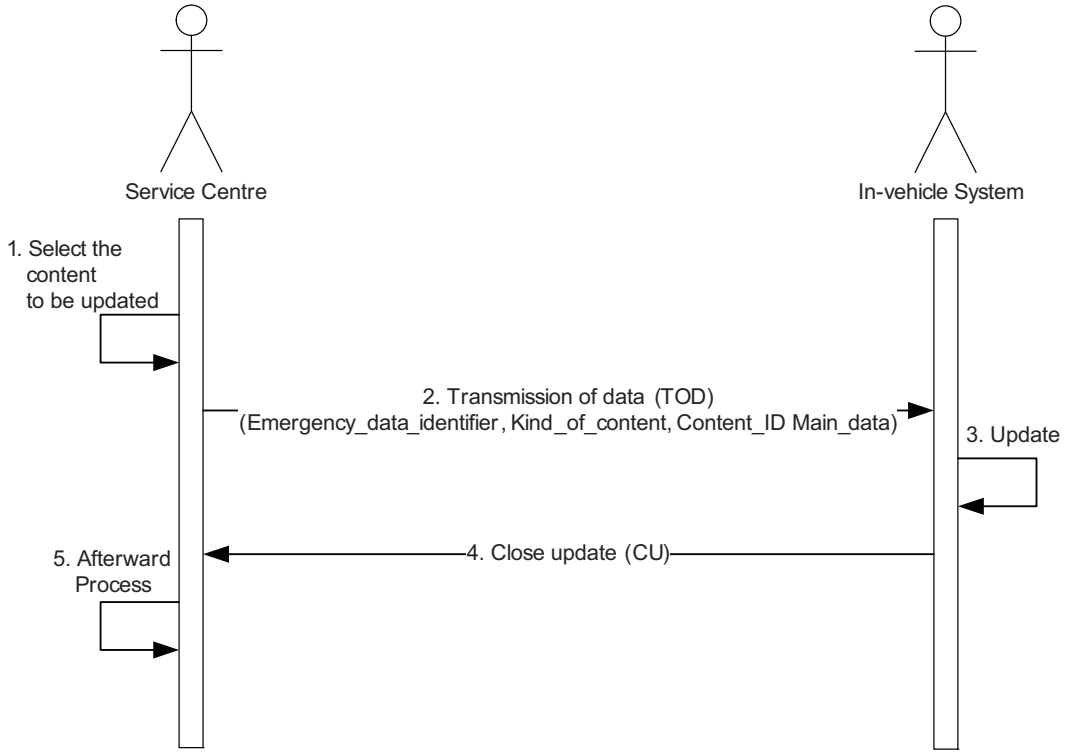



**Figure D.14 — Protocol for emergency data/data pushing/incremental update**

## D.16 Protocol for emergency data/data broadcasting/geographic area

First, a Service Centre ends the content. Then, the In-vehicle System executes the update.

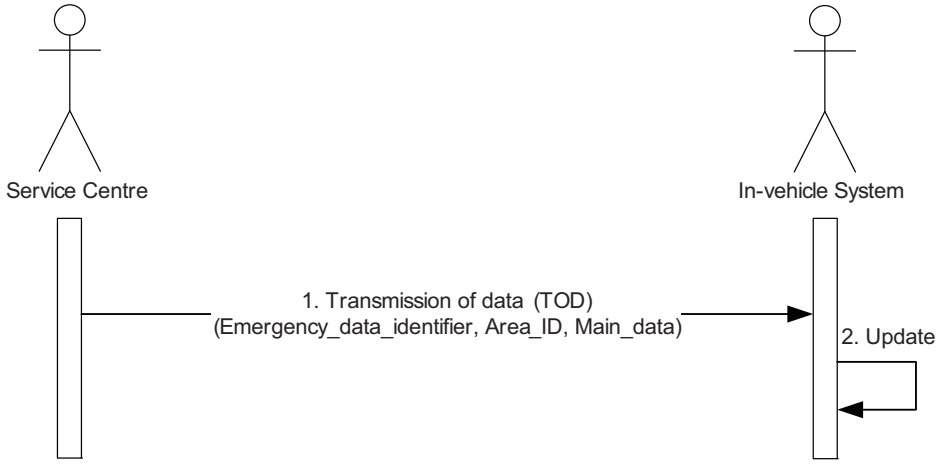



**Figure D.15 — Protocol for emergency data/data broadcasting/geographic area**

## D.17 Protocol for emergency data/data broadcasting/incremental update

First, a Service Centre ends the content. Then, the In-vehicle System executes the update.

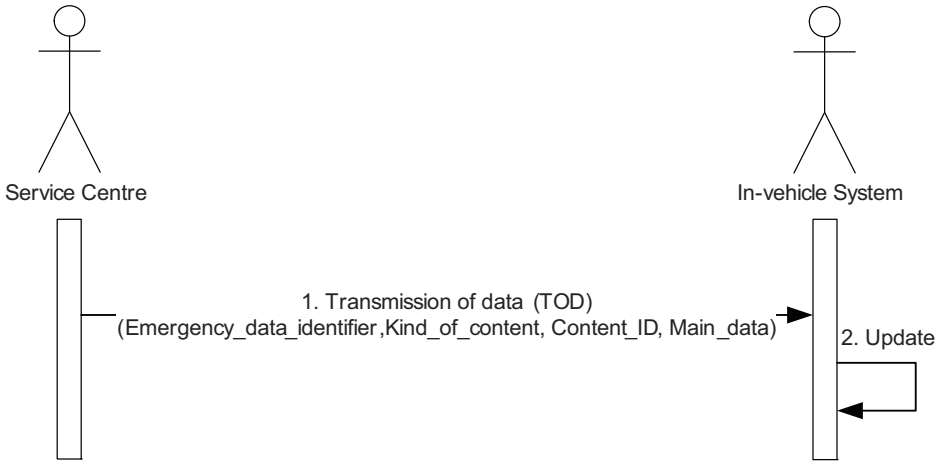



**Figure D.16 — Protocol for emergency data/data broadcasting/incremental update**

# Annex E
(informative)

# Example of a data update operation

## E.1 Outline

In this annex, a set of primitive update protocol elements are described to support exchanging messages between Service Centres and In-vehicle Systems. There are two types of processes depending on the initiation of update, which is triggered by either a Service Centre or an In-vehicle System. The primitives of the protocol are driven from the observation of these two processes.

If an In-vehicle System initiates the update process, there are several processes followed such as (1) initiation of update to start update process with the range of data to be updated, (2) request of update category to identify the range of update, (3) selection of update range, (4) transmission of the update data category, (5) decision of adapting update data in the category, (6) request of the data for update, (7) transmission of the data, (8) update upon reception of the data, (9) close update process.

Otherwise, if a Service Centre initiates update process, the process follows: (1) initiation of update to start update process with the range of data to be updated, (4) transmission of the update data category, (5) decision of adapting update data in the category, (6) request of the data for update, (7) transmission of the data, (8) update upon reception of the data, (9) close update process.

## E.2 Initiation of update (IOU)

If an update is initiated by either a Service Centre or an In-vehicle System, the initiator should establish the connection through communication media first. In this International Standard, low level protocol at the communication media is not covered. However, in this clause, Initiation of Update is described assuming that physical connection has been successfully established and the communication maintained.

First the initiator should identify the counterpart for update, and then the update category should be decided for further process. The identification of the counterpart should cover the compliance of the database for proper update, which should be reflected in the message to confirm compliance of the database in both sides in this process.

## E.3 RUC (Request of update category)

The range of data for update is decided by the initiator. Since the actual data transmitted is not identified until the initiator compares its data with the data transmitted from the counterpart, the range of data to be updated is selected at this stage. The range of data is presented in the form of update target_identifier, Kind_of_Content, etc.

After the selection of the data range to be updated, the initiator sends the information of the data range in terms of data category to the counterpart. Request of Update Category contains the information to identify the set of data as small as possible to be updated in the form of update target_identifier, Area_ID, Kind_of_Content, etc.

## E.4 Selection of update range (SUR)

When an initiator requests the counterpart for the data for update defined by the update range, the counterpart needs to decide the corresponding set of data before transmission. Since both initiator and counterpart may start the update process without knowing each other's version, this process could be terminated if both are identical in terms of update range defined by the initiator.

## E.5 Transmission of update category (TUC)

When the update category is sent, the information of update category is the same form of the data range recognizable to the receiver. Note that this process should be taken only after both sender and receiver have the compliant database. The update category contains the information to identify the set of data as small as possible to be updated in the form of Area_ID, Update target, Kind_of_Content, etc.

## E.6 Decision of adapting update data (DAU)

After receiving the information of the data range for update in terms of data category, it is necessary to decide whether the data range is acceptable or not. If the update data category is already reflected, it is no longer interested. However if the data range is new, it should be followed by further update procedures, i.e. receiving the set of data for update.

## E.7 Request of data (ROD)

The process is used to ask the data of content be updated. The message contains the data range based on Request_to_send_data, Area_ID, etc.

## E.8 Transmission of data (TOD)

Actual data transmission is committed through this process. The action sends out the data of the content for update of the counterparts' database.

## E.9 Update on reception (UOR)

The received data is used for update. The action conducts the actual data update upon reception of the data received.

## E.10 Close update (CU)

After update is finished, the update session is closed by confirming of sending and receiving completion message between both sides.

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