PD ISO/TR 13184-1:2013

BSI Standards Publication

Intelligent transport systems — Guidance protocol via personal ITS station for advisory safety systems

Part 1: General information and use case definitions

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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TECHNICAL REPORT

ISO/TR 13184-1

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Intelligent transport systems — Guidance protocol via personal ITS station for advisory safety systems —

Part 1: General information and use case definitions

Systèmes intelligents de transport — Protocole d'orientation par station ITS personnelle pour systèmes à avis de sécurité —

Partie 1: Information générale et définition des cas d'usage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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

ISO 13184 consists of the following parts, under the general title *Intelligent transport systems — Guidance protocol via personal ITS station for advisory safety systems*:

— *Part 1: General information and use cases definitions*

The following parts are under preparation:

— *Part 2: Road guidance protocol (RGP) requirements and specification*

— *Part 3: Protocol conformance test cases*

Introduction

This part of ISO 13184 specifies the requirements of a real-time decision support system for guidance information, designed to enhance mobility and vehicle safety and to provide a parking guide service using personal ITS stations. The purpose of the system is to transmit guidance or warning messages to drivers and pedestrians in real time, enhance the user's convenience, and avoid congestion in parking facilities by preventing accidents and enabling easy parking.

In addition, an application level guidance protocol for crossroads, safety warning and parking bay guidance services between roadside ITS stations, installed at the road side, and user's personal ITS stations, is defined.

This part of ISO 13184 considers a protocol, which covers all subjects related to traffic safety, including pedestrians and vehicle drivers. Therefore, this protocol describes how the safety-related services are provided using personal ITS stations.

This system is based on the following assumptions:

— Personal ITS stations have limited resources. Therefore, the protocol is designed in such way that it can be implemented with limited resources.

— The use cases related to the safety warning and parking bay guidance services can be classified in various ways. Also, these use cases can be enabled or disabled depending on the specific circumstances of roads and parking bays. Therefore, the protocol is designed to be flexible and extendable, which enables to add or delete use cases conveniently.

— The protocol contains core data elements to configure the messages transmitted by personal ITS stations and roadside ITS stations. The major use case includes safety warning at the road and the parking bay guidance.

— The protocol provided by this part of ISO 13184 does not take the network or transport level protocol into account. Instead, only the application level protocol for the safety warning and parking bay guidance services are presented.

TECHNICAL REPORT **ISO/TR 13184-1:2013(E)**

Intelligent transport systems — Guidance protocol via personal ITS station for advisory safety systems —

Part 1: General information and use case definitions

1 Scope

This part of ISO 13184 specifies guidance information protocol to provide real-time decision support system to drivers or pedestrians using personal ITS stations:

Reference architecture for the real-time decision support system

This reference architecture provides a general structure for real-time decision support systems and the method of message exchange between the personal ITS station and the roadside ITS station. This reference architecture is used to build the interconnections between personal ITS stations and roadside ITS stations.

Design method of application protocols for light-weighted devices

This method is a flexible application protocol for safety warning and parking guidance services. Unlike many other application protocols in the ITS and Telematics domains, this protocol makes the client part independent of use cases for supporting light-weighted devices.

Use cases at the road and parking bays for warning and parking guide

This part of ISO 13184 describes the use cases applicable to the communication services between personal ITS stations and roadside ITS stations for the purposes of providing safety warning and parking guidance.

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 21217, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO°21217 and the following apply.

3.1.1
document type definition
DTD
set of mark-up declarations that define a document type of SGML-family Mark-up languages (SGML, XML, HTML)

3.1.2
roadside ITS station
R-ITS-S
system that receives and processes vehicular and pedestrian information within a certain zone and determines the situation, in order to provide the safety warning and parking guide service to vehicles and pedestrians, and that is installed at the road side

3.1.3
ITS station
ITS-S
entity in a communication network, comprised of application, facilities, networking and access layer components specified in ISO°21217 that operate within a bounded secure management domain

3.1.4
light-weighted devices
client device such as a nomadic or mobile device

Note 1 to entry: In the ITS nomenclature, this is a P-ITS-S.

3.1.5
personal ITS station
P-ITS-S
implementation of an ITS station in a personal ITS subsystem

Note 1 to entry: Personal ITS station is used to send the information of each user (drivers and pedestrians) to the roadside ITS station, and receives the safety warning and parking guide service and transfers them to the users.

3.1.6
sensor
device designed to collect general information (e.g. road surface state, potential hazard vehicle's speed) within the server's zone

3.2 Abbreviated terms

RGP	road guidance protocol
DSRC	dedicated short range communications
DTD	document type definition
HTML	hypertext mark-up language
ITS-S	intelligent transport systems station
P-ITS-S	personal intelligent transport systems station
OSI	open systems interconnection
R-ITS-S	roadside intelligent transport systems station
RSE	roadside equipment
OBE	on-board equipment
SGML	standard generalized mark-up language
XML	eXtended mark-up language

4 Conventions

This part of ISO 13184 is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731:1994) as they apply for communication services. The ASN.1-based Road Guidance Protocol (RGP) is applicable to OSI layers 5, 6 and 7.

5 Series overview and structure

ISO 13184 provides all documents and references required to support the implementation of the requirements related to standardized access to guidance via personal ITS station for advisory safety systems. ISO 13184 consists of the following parts.

Part 1: General information and use case definition

Part 1 provides an overview of the document set and structure along with the use case definition and common set of resources (definitions, references), which are used for all subsequent parts.

Part 2: Road guidance protocol (RGP) requirements and specification

Part 2 specifies all technical requirements related to the application level Road Guidance Protocol (RGP) to be used between the personal ITS station and the roadside ITS station. The requirements will reflect the deriving needs from the use cases as specified in this part of the technical report. The protocol shall be defined according to the requirements as specified in ISO 14817 [2].

Part 3: Protocol conformance test cases

Part 3 specifies conformance test cases for a self-conformance test by the provider of the personal ITS station and the roadside ITS station. The conformance test cases will follow the use cases defined in part 1 as well as the requirements stated in Part 2.

The purpose of Part 3 is to provide the test procedure of the information flow between the personal ITS station and the roadside ITS station. The information is transferred only from the corresponding roadside ITS station to the personal ITS stations, where the personal ITS station locates within the communication range of the corresponding local sever. This final step in the development process enables to verify the system for all providers that their personal ITS station and/or the roadside ITS stations meet a high degree of functional requirements expected by the end user.

Figure 1 shows the structure of the ISO 13184 series.

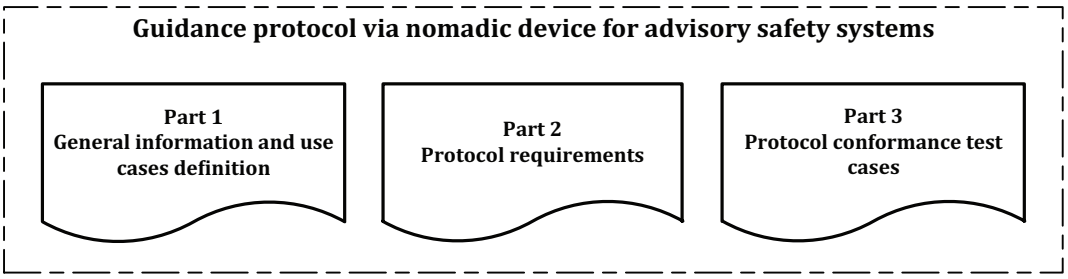


Figure 1 — ISO 13184 series structure

6 General information

6.1 Purpose of this part of ISO 13184

This part of ISO 13184 addresses three major areas:

— identification of the requirements of application level protocol for safety warning and parking guidance services, that can be frequently inserted, modified and deleted;

— identification of the method to describe the communication protocol for all subjects related to traffic safety, including warnings and the parking bay guidance services between the roadside ITS station and the personal ITS station;

— specification of the major use cases, that should be included for the advance warning of accidents at crossroads and the parking bay guidance.

6.2 Relevant standards

Application level protocols for ITS define some important applications, their services and message transmission sequences. These predefined applications are generally called use cases. The services and message sequences of an ITS application protocol are fixed and applications should implement a rigid-formatted message set and message sequences for each use case.

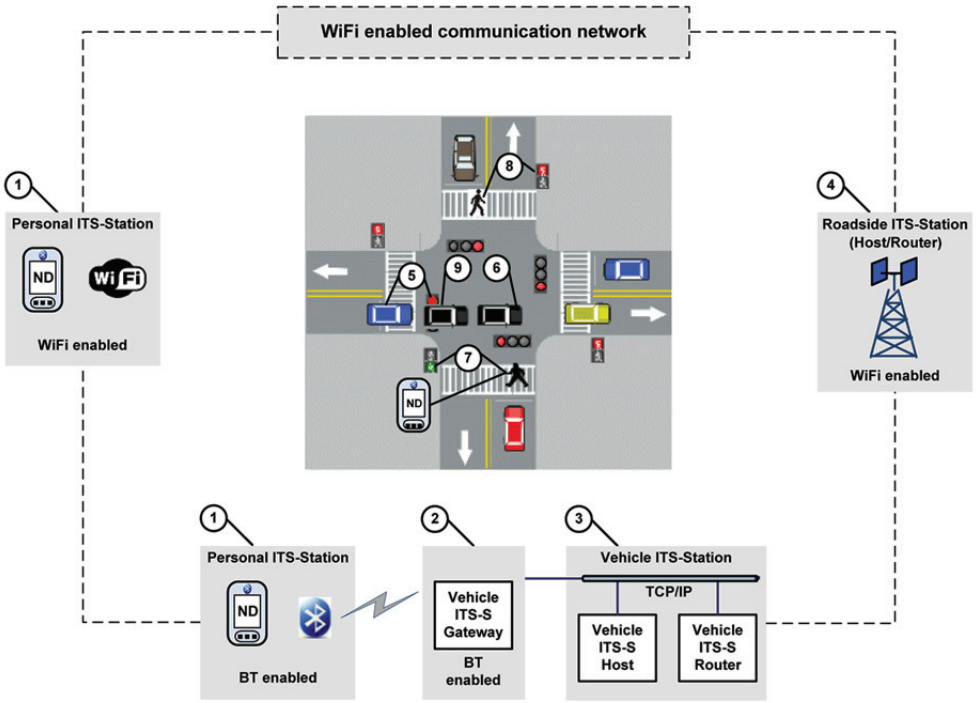
SAE J2735 [5] and EN 12795 [6] define the interoperability among DSRC applications through the use of standardized message sets, data frames and data elements.

These standards provide the message sets, data frames and data elements (if applicable) to produce interoperable DSRC applications between Roadside Equipment (RSE) and On-Board Equipment (OBE).

ISO 13184-2 proposes an ASN.1-based flexible application Road Guidance Protocol (RGP) via R-ITS-S and P-ITS-S for safety warning and parking guidance services.

6.3 Overview of crossroads safety warning guidance

Table 2 shows an overview of crossroads safety warning guidance.



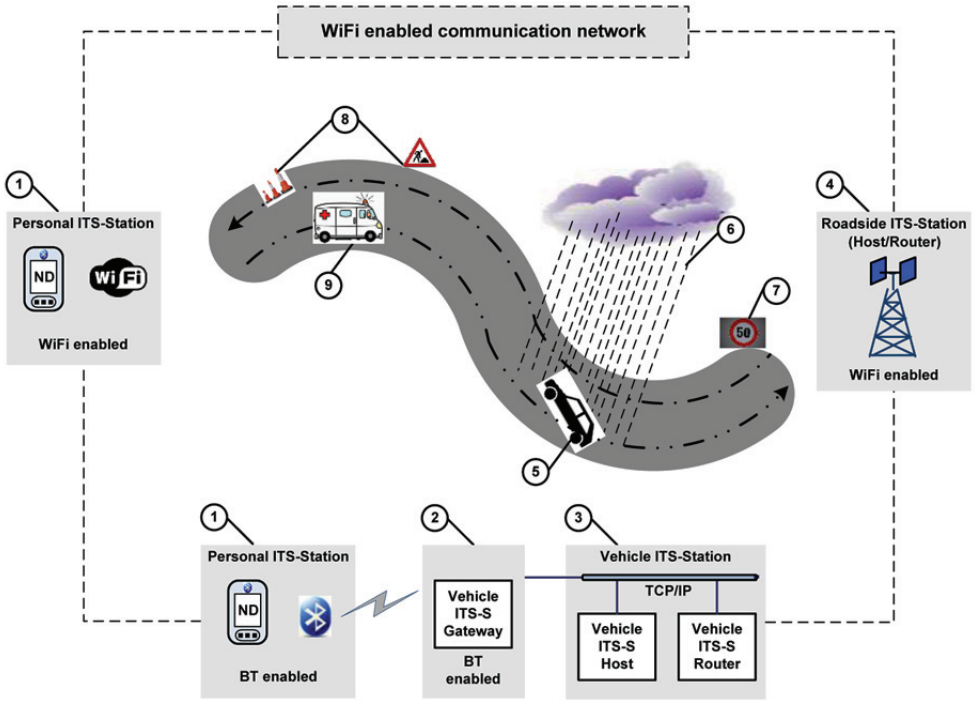
Key

1 P-ITS-S used by pedestrians and inside vehicle (connected to V-ITS-SG via Bluetooth)
2 V-ITS-SG connected to V-ITS-S
3 V-ITS-S
4 R-ITS-S
5 UC 1.1 — Vehicle violates a stop signal without stopping
6 UC 1.2 — Vehicle violates traffic signal and is inside the crossroads
7 UC 1.3 — Guiding the pedestrian on a pedestrian crossing
8 UC 1.4 — Pedestrians violate the traffic signal on a pedestrian crossing
9 UC 1.5 — Traffic is bumper to bumper on the crossroads

Figure 2 — Overview of crossroads safety warning guidance

6.4 Overview of risky environment alarm

Table 3 shows an overview of risky environment alarm.



Key

1 P-ITS-S used by pedestrians and inside vehicle (connected to V-ITS-SG via Bluetooth)

2 V-ITS-SG connected to V-ITS-S

3 V-ITS-S

4 R-ITS-S

5 UC 3.1 — Vehicle strays into the path of an oncoming vehicle; UC 3.2 — Vehicle approaches the curved road with overspeed

6 UC 3.3 — Risky environments alarm in severe weather condition

7 UC 3.4 — Risky environments alarm in the areas of speed limit enforcement

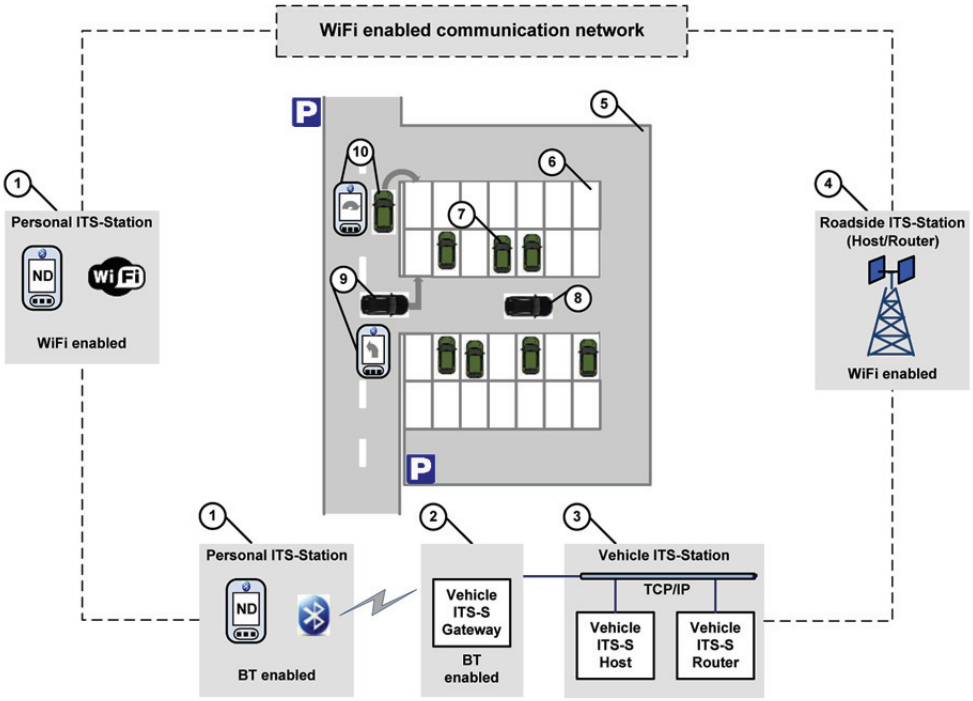
8 UC 3.5 — Vehicle approaches a temporary road occupation

9 UC 3.6 — Emergency vehicle approaches on its route

Figure 3 — Overview of risky environment alarm

6.5 Overview of parking bay guidance

Table 4 shows an overview of the parking bay guidance.



Key

1 P-ITS-S used by pedestrians and inside vehicle (connected to V-ITS-SG via Bluetooth)
2 V-ITS-SG connected to V-ITS-S
3 V-ITS-S
4 R-ITS-S
5 parking area
6 parking bay
7 parked vehicle
8 vehicle blocks parked vehicles and driveway
9 UC 4.1 — Parking guidance when the vehicle enters the parking area
10 UC 4.2 — Searching the path and parking bay on demand

Figure 4 — Overview of parking bay guidance

7 Use case overview and principles

7.1 Overview

7.1.1 Basic principles for use case definition

Basic principles have been established as a guideline to define the use cases:

— The use cases of guidance protocol to support the advisory safety systems describe the interaction between the personal ITS station and the roadside ITS station.

— The use cases in this part of ISO 13184 define sample cases to guide or give warnings required to support advisory safety systems for drivers and pedestrians, which are applicable for any personal ITS station.

7.1.2 Use case clusters

Table 1 provides an overview about the different use case categories. The use cases are grouped into use case clusters.

Table 1 — Use case clusters and associated use cases overview

# – Title of use case cluster	Brief description
1 – Crossroads with a traffic signal	This cluster is separated into five use cases by taking the signal violating vehicle as a risk factor. The driver of a vehicle at a crossroads is required to follow the traffic signals. The use cases presented in this cluster are designed to provide services for crossroads traffic control while complying with the signalling system and protecting pedestrians on a pedestrian crossing. — UC 1.1 — Vehicle violates a stop signal without stopping — UC 1.2 — Vehicle violates traffic signal and is inside the crossroads — UC 1.3 — Guiding the pedestrian on a pedestrian crossing — UC 1.4 — Pedestrians violate the traffic signal on a pedestrian crossing — UC 1.5 — Traffic is bumper to bumper on the crossroads
2 – Crossroads without a traffic signal	This cluster considers the scenario that the crossroad is not equipped with a traffic signal, which may cause a traffic congestion if several vehicles enter into the crossroads simultaneously. — UC 2.1 — Prevent heavy traffic congestion at crossroads This use case is designed to provide smooth traffic flow by preventing heavy traffic congestion or reducing waiting time.

Table 1 *(continued)*

# – Title of use case cluster	Brief description
3 – Risky environment alarm	This cluster describes two use cases that consider the frequent accidents area at the curved road. — UC 3.1 — Vehicle strays into the path of an oncoming vehicle — UC 3.2 — Vehicle approaches the curved road with overspeed The cluster considers the oncoming vehicle and speed limit regulation. The use cases focus on reducing and preventing the accident which can be caused by the geometric structure of the road. The following two use cases consider the speed limit of the vehicles with some special cases that contain school zones and severe weather conditions. — UC 3.3 — Risky environments alarm in severe weather condition — UC 3.4 — Risky environments alarm in the areas of speed limit enforcement The use cases help safe driving by informing of the presence of the school zone and the severe weather condition. The following two use cases consider temporary road occupation scenarios and the situation of an emergency vehicle to establish a clear path. — UC 3.5 — Vehicle approaches a temporary road occupation This use case addresses the situation when a vehicle approaches a temporary road occupation such as the road construction, accident/disabled vehicles or obstacles on the road. By informing the status of temporary road occupation, the road congestion will be prevented. — UC 3.6 — Emergency vehicle approaches on its route This use case addresses the situation when an emergency vehicle is moving to establish a clear path. This cluster handles the safety messaging procedure when an emergency vehicle is approaching. By announcing the emergency vehicle approaching information, an emergency vehicle can have a clear path.
4 – Parking bay guidance	This cluster describes two use cases for the parking guide. — UC 4.1 — Parking guidance when the vehicle enters the parking area — UC 4.2 — Searching the path and parking bay on demand The parking path guide in the parking bay use case refers to simple transmission of the path to the user's personal ITS station, not to the vehicle navigation system. When a vehicle enters the parking bay, it is difficult for the vehicle driver to check how many parking bays are available at which spot. Therefore, if the parking bay is full or if a parking bay is available but cannot be identified conveniently, the driver will waste time to park the vehicle or even be unable to find a parking bay for the vehicle. In addition, the driver may not be able to park the vehicle at the convenient spot.

The detailed definition of each use case is defined in Clause 8.

Figure 5 shows the use case clusters and associated use cases.

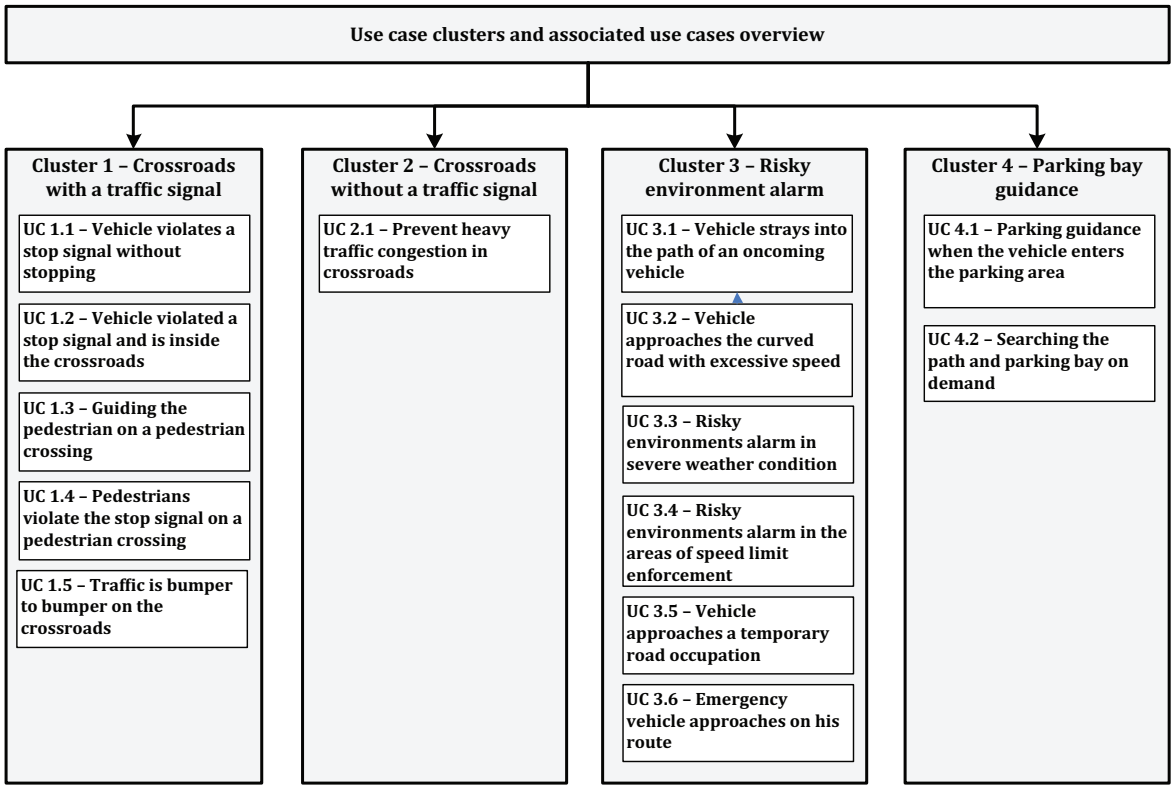


Figure 5 — Use case clusters and associated use cases

8 Use case definition

8.1 Overview

This clause describes the major use cases at the crossroads, frequent accidents and parking bay areas. The use cases at the crossroads are classified by the existence of a traffic signal. The use cases at the parking bay are classified as two cases where one case is that an available parking bay is notified only once a vehicle enters into the parking area, and the other case is that the parking bay guidance is provided on demand as the traffic flow in the given parking bay changes while a vehicle is being parked.

Use cases for areas of frequent accidents are:

— risky environment alarm in the curved road,

— environment alarm in the speed limit area,

— temporary road occupation, and

— emergency vehicle approaching.

8.2 UC cluster 1 — Crossroads with a traffic signal

8.2.1 UC 1.1 — Vehicle violates a stop signal without stopping

This use case describes the safety guidance procedure when a vehicle violates a stop (red light) signal at the crossroads.

Table 2 describes the UC 1.1 — Vehicle violates a stop signal without stopping (enters into the crossroads).

Table 2 — UC 1.1 — Vehicle violates a stop signal without stopping

Use case name	UC 1.1 — Vehicle violates a stop signal without stopping
Goal	Provide a "collision" notification/indication to the drivers of vehicles and pedestrians at a crossroads in case another vehicle is not able to stop at the line when violating the stop signal (red light).
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — A vehicle approaches the crossroads; — A forecast calculation, that the vehicle could potentially cross the stop line if the stop signal (red light) is overlooked by the driver; — If the vehicle is able to stop at the line.
Use case output	The following output signals need to be considered: — The R-ITS-S broadcasts an alarm signal/sound at the crossing; — The R-ITS-S broadcasts a "collision" notification/indication; — All P-ITS-S receive the "collision" notification/indication; — The R-ITS-S broadcasts a "release" indication if the vehicle was able to stop at the line.
Brief description	When a vehicle enters a crossroads and cannot stop at the line due to the long braking distance and velocity of the vehicle, a "collision" notification/indication is sent to all vehicles (P-ITS-S) and pedestrians at the same crossroads. Conversely, if the vehicle is able to stop on the line, a "release" notification/indication is broadcasted to all P-ITS-S.
Classification	Mandatory

8.2.2 UC 1.2 — Vehicle violated traffic signal and is inside the crossroads

This use case describes the handling procedure for when a vehicle violates the stop signal (red light) and locates (comes to a stillstand) inside the crossroads. This situation is similar to the use case described in 8.2.1. However, unlike 8.2.1, this use case considers the handling procedure when a vehicle has already violated the traffic signal (red light) and stops after the stop line inside the crossroads.

Table 3 describes the UC 1.2 — Vehicle violated traffic signal and is inside the crossroads (came to a standstill inside the crossroads).

Table 3 — UC 1.2 — Vehicle violated traffic signal and is inside the crossroads

Use case name	UC 1.2 — Vehicle violated traffic signal and is inside the crossroads
Goal	Provide a "blocked-road" notification/indication to the drivers of vehicles and pedestrians at a crossroads in case another vehicle came to a standstill after the stop line when violating the stop signal (red light) even though the surrounding vehicles and pedestrians have received a clear signal at the pedestrian crossing.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether an identified vehicle has come to a standstill after the stop line, that violated the stop signal at the crossroads when the traffic signal has changed; — R-ITS-S checks whether the identified vehicle, that came to a standstill after the stop line in the crossroads has left the crossroads
Use case output	The following output signals need to be considered: — The R-ITS-S broadcasts an extended alarm signal/sound at the crossing; — R-ITS-S broadcasts a "blocked-road" notification/indication as soon as the traffic signal has changed to stop and the vehicle in violation of the signal is identified; — The R-ITS-S broadcasts a "release" notification/indication if the vehicle, that came to a standstill after the stop line in the crossroads has left the crossroads
Brief description	If a vehicle crosses the stop line and locates inside the crossroads or the vehicle has violated the stop line and keeps moving even with the stop signal turned on, a "blocked-road" notification/indication is sent to the surrounding vehicles and pedestrians, which/who have received a clear signal at the pedestrian crossing.
Classification	Mandatory

8.2.3 UC 1.3 — Guiding the pedestrian on a pedestrian crossing

This use case describes the handling procedure if the remaining time of the clear signal is too short for the pedestrians to reach the other end of the pedestrian crossing.

Table 4 describes the UC 1.3 — Guiding the pedestrian on a pedestrian crossing.

Table 4 — UC 1.3 — Guiding the pedestrian on a pedestrian crossing

Use case name	UC 1.3 — Guiding the pedestrian on a pedestrian crossing
Goal	Provide a "guidance" notification/indication to pedestrians, walking on the pedestrian crossing, that the remaining time of the clear signal (green light) is too short to reach the other side of the pedestrian walkway.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S identifies clear signal (green light); — R-ITS-S identifies pedestrians walking on the pedestrian crossing; — R-ITS-S shall be calibrated to the average walking time of pedestrians, considering disabled people and people in wheel chairs
Use case output	The following output signals need to be considered: — R-ITS-S checks the remaining time of the clear signal (green light); — The R-ITS-S shows a notification signal/sound at the pedestrian crossing point showing the remaining time/showing time is too short; — R-ITS-S broadcasts a "guidance" notification/indication including the remaining time of clear signal (green light) to the pedestrian
Brief description	If a pedestrian accesses the pedestrian crossing, the remaining time of the clear signal (green light) is compared with the average walking time and a "guidance" notification/indication is sent. If the signalling time at a pedestrian crossing is too short, the remaining time of the clear signal (green light) is notified to the pedestrian at the pedestrian crossing.
Classification	Mandatory

8.2.4 UC 1.4 — Pedestrians violate the traffic signal on a pedestrian crossing

This use case describes the handling procedure if pedestrians violate a traffic signal on the pedestrian crossing.

Table 5 describes the UC 1.4 — Pedestrians violate the traffic signal on a pedestrian crossing.

Table 5 — UC 1.4 — Pedestrians violate the traffic signal on a pedestrian crossing

Use case name	UC 1.4 — Pedestrians violate the traffic signal on a pedestrian crossing
Goal	Provide a "pedestrian warning" notification/indication to the pedestrians violating the traffic signal, when the traffic signal indicates the stop signal (red light) or the traffic signal is changing (green to yellow light) during a pedestrian crossing.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — The R-ITS-S checks the existence of pedestrians on the pedestrian crossing when the traffic signal indicates the stop signal (red light); — The R-ITS-S immediately checks the status of pedestrians on the pedestrian crossing when the traffic signal changes (green to yellow)
Use case output	The following output signals need to be considered: — The R-ITS-S broadcasts a "pedestrian warning" notification/indication to the P-ITS-S of all vehicles using the lane the pedestrian crosses; — The R-ITS-S broadcasts an alarm signal/sound at the crossing; — The R-ITS-S broadcasts a "release" notification/indication if the pedestrians leave the pedestrian crossing
Brief description	If a pedestrian enters the pedestrian crossing even though the traffic signal indicates the stop (red light) signal or the traffic signal is changing (green to yellow light) during a pedestrian crossing, the "pedestrian warning" notification/indication is sent to the pedestrians. A "release" notification/indication is broadcasted if the pedestrians leave the pedestrian crossing.
Classification	Mandatory

8.2.5 UC 1.5 — Traffic is bumper to bumper on the crossroads

This use case describes the handling procedure for protecting traffic congestion and improving traffic flow if vehicles try to enter into crossroads when the traffic is bumper to bumper.

Table 6 describes the UC 1.5 — Traffic is bumper to bumper on the crossroads.

Table 6 — UC 1.5 — Traffic is bumper to bumper on the crossroads

Use case name	UC 1.5 — Traffic is bumper to bumper on the crossroads
Goal	Provide a "bumper to bumper" notification/indication to the vehicles to prevent vehicles from entering the crossroads even though the traffic signal is clear.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — The R-ITS-S checks the traffic congestion along the road and crossroads; — A bumper to bumper traffic status detection; — A smooth traffic status detection
Use case output	The following output signals need to be considered: — A bumper to bumper status detection causes a "bumper to bumper" notification/indication, which is broadcasted immediately by the R-ITS-S; — The R-ITS-S waits, changing the red crossing lights until crossing can be used normally; — A smooth traffic status detection causes a "release" notification/indication, which is broadcasted immediately by the R-ITS-S
Brief description	If the traffic is congested and it is expected that the current situation will be affecting the following vehicles, the "bumper to bumper" notification/indication is broadcasted to the following vehicles, which enables to improve the overall traffic situation. A "release" notification/indication is broadcasted to the P-ITS-S if a smooth traffic status is detected.
Classification	Mandatory

8.3 UC cluster 2 — Crossroads without a traffic signal

8.3.1 UC 2.1 — Prevent heavy traffic congestion at crossroads

This use case describes the heavy traffic handling procedure of vehicles at crossroads without a traffic signal.

Table 7 describes the UC 2.1 — Prevent heavy traffic congestion at crossroads.

Table 7 — UC 2.1 — Prevent heavy traffic congestion at crossroads

Use case name	UC 2.1 — Prevent heavy traffic congestion at crossroads
Goal	To prevent heavy traffic congestion of vehicles approaching crossroads without a traffic signal, a "vehicle priority" notification/indication according to the traffic regulations is broadcasted to all P-ITS-S carried in vehicles driving towards the crossroads.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks the vehicle speed and distance between the vehicles and crossroads; — The driver of the vehicle receives the "vehicle priority" notification/indication via the P-ITS-S
Use case output	The following output signals need to be considered: — R-ITS-S checks the vehicle priority according to traffic legislation and sends a "vehicle priority" notification/indication to the vehicle; — The driver of the vehicle passes the crossroads following the priority provided by the "vehicle priority" notification/indication
Brief description	When several vehicles enter into the crossroad simultaneously, the priority information of the vehicle is announced to the vehicles based on the traffic regulations, which enables the traffic flow smoothly by minimizing the waiting time and making the vehicles move consecutively. A vehicle, which violates the regulation while approaching the crossroads, is also sent the "vehicle priority" notification/indication.
Classification	Mandatory

8.4 UC cluster 3 — Risky environment alarm

8.4.1 UC 3.1 — Vehicle strays into the path of an oncoming vehicle

This use case describes the handling procedure of an oncoming vehicle that strays into the path of another vehicle. Using this use case, the vehicle can pass the curved road safely by preventing a collision.

Table 8 describes the UC 3.1 — Vehicle strays into the path of an oncoming vehicle.

Table 8 — UC 3.1 — Vehicle strays into the path of an oncoming vehicle

Use case name	UC 3.1 — Vehicle strays into the path of an oncoming vehicle
Goal	Collision avoidance with oncoming vehicle when approaching a curved road.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether a vehicle approaches the curved road; — R-ITS-S checks whether there is an oncoming vehicle, which strays into the path of the other vehicle; — R-ITS-S checks if the vehicle has left the curved road
Use case output	The following output signals need to be considered: — R-ITS-S generates the “oncoming vehicle alarm” notification/indication immediately after detection, that an oncoming vehicle has strayed into the path of the vehicle; — R-ITS-S generates and broadcasts an “oncoming vehicle advice” notification/indication to the vehicle to move to the outside lane and reduce the vehicle speed; — R-ITS-S generates and broadcasts a “release” notification/indication as soon as the vehicle has left the curved road
Brief description	When vehicles approach the curved road and an oncoming vehicle strays into the path of another vehicle on a curved road, an “oncoming vehicle alarm” notification/indication is broadcasted to all vehicles. If a driver receives the “oncoming vehicle alarm” notification/indication, he/she can avoid a collision by driving the vehicle to the outside lane and reducing the vehicle speed. The service will be terminated when the vehicle has left the curved road.
Classification	Mandatory

8.4.2 UC 3.2 — Vehicle approaches the curved road with overspeed

This use case describes the handling procedure when a vehicle approaches the curved road and violates the speed limit regulation. An overspeed warning with a predetermined vehicle speed is sent to the vehicle driver in order to enable the vehicle to pass the curved road smoothly.

Table 9 describes the UC 3.2 — Vehicle approaches the curved road with overspeed.

Table 9 — UC 3.2 — Vehicle approaches the curved road with overspeed

Use case name	UC 3.2 — Vehicle approaches the curved road with overspeed
Goal	When driver of the vehicle is exceeding the speed limit and approaching a curved road, advise him/her to reduce the driving speed according to the speed limit regulation in order to safely pass the curved road.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether a vehicle violates the speed limit regulation when the vehicle approaches the curved road; — R-ITS-S monitors the vehicle's speed in order to generate a "release" notification/indication
Use case output	The following output signals need to be considered: — R-ITS-S generates a "speed limit" notification/indication immediately after detection and sends it to the P-ITS-S in the vehicle; — P-ITS-S generates guidance information to reduce the vehicle speed; — R-ITS-S generates a "release" notification/indication when the vehicle's speed reaches the regulated speed limit
Brief description	When vehicles approach the curved road and if the approaching vehicles violate the speed limit regulation, the "speed limit" notification/indication is sent to the P-ITS-S of the corresponding vehicle. If a driver receives the "speed limit" notification/indication, he/she can reduce the vehicle speed and drive through the curved road following the speed limit regulation. This results in a smooth and safe driving through the curved road. The service will be terminated when the driver passes the curved road.
Classification	Mandatory

8.4.3 UC 3.3 – Risky environments alarm in severe weather conditions

This use case describes the handling procedure of a bad weather warning alarm when unexpected weather conditions occur. Using this use case, the bad weather conditions, such as heavy rain, thick fog or freezing road information, is sent to a driver in advance, which guides the driver of the vehicle to drive safely.

Table 10 describes the UC 3.3 — Risky environments alarm in severe weather conditions.

Table 10 — UC 3.3 — Risky environments alarm in severe weather conditions

Use case name	UC 3.3 — Risky environments alarm in severe weather conditions
Goal	Advise driver of the vehicle, when approaching a frequent accident zone during bad weather conditions, to adjust the vehicle speed according to the weather conditions and to establish a safety distance to the vehicle driving in the front.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S continuously monitors the weather conditions; — R-ITS-S is calibrated to "accident zone"
Use case output	The following output signals need to be considered: — R-ITS-S generates a "bad weather" notification/indication and sends it to the P-ITS-S in the vehicle; — P-ITS-S generates guidance information to adjust the vehicle speed according to the weather conditions; — R-ITS-S generates a "release" notification/indication when the weather conditions have turned to a non-critical status
Brief description	When vehicles approach a frequent accident zone during bad weather conditions, the "bad weather" notification/indication is sent to the P-ITS-S in the vehicle. If a driver receives the "bad weather" notification/indication, he/she can adjust to the risky environment and reduce the risk of an accident by reducing the vehicle's speed and by establishing a safety distance to the vehicle driving in the front. The P-ITS-S provides guidance information related to adjusted speed to pass the unknown on-road weather condition area. The service will be terminated when the driver has left the potential accident zone.
Classification	Mandatory

8.4.4 UC 3.4 – Risky environments alarm in areas of speed limit enforcement

This use case describes the handling procedure of warning alarm when a vehicle approaches the area of speed limit enforcement. Using this use case, the area of speed limit enforcement such as school zone and temporary speed limit reduction is informed to a driver in advance, which enables him/her to drive the vehicle in safety and prevent accidents.

Table 11 describes the UC 3.4 — Risky environments alarm in the areas of speed limit enforcement.

Table 11 — UC 3.4 — Risky environments alarm in areas of speed limit enforcement

Use case name	UC 3.4 — Risky environments alarm in areas of speed limit enforcement
Goal	Advise driver of the vehicle approaching a speed limit enforcement area to slow down the vehicle in order to reduce the risk of causing an accident.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether a vehicle approaches a speed limit enforcement area; — R-ITS-S monitors the vehicle's speed in order to generate a "release" notification/indication
Use case output	The following output signals need to be considered: — R-ITS-S generates and sends a "speed limit" notification/indication immediately after detection to the P-ITS-S in the vehicle; — P-ITS-S generates guidance information to reduce the vehicle speed; — R-ITS-S generates a "release" notification/indication when the vehicle's speed reaches the regulated speed limit
Brief description	When vehicles approach the area of a speed limit enforcement, the "speed limit" notification/indication is sent to the P-ITS-S of the approaching vehicles. If a driver receives the "speed limit" notification/indication, he/she can prepare to reduce the speed of the vehicle and reduce the risk of causing an accident. The service will be terminated when the driver has left the designated area.
Classification	Mandatory

8.4.5 UC 3.5 – Vehicle approaches a temporary road occupation

This use case describes the handling procedure of a road occupation warning when the temporary road occupation occurs. Using this use case, the temporary road occupation, such as the road construction ahead, accident ahead or disabled vehicle ahead, information is announced to the following vehicles to enable them to reduce the vehicle speed.

Table 12 describes the UC 3.5 — Vehicle approaches a temporary road occupation.

Table 12 — UC 3.5 — Vehicle approaches a temporary road occupation

Use case name	UC 3.5 — Vehicle approaches a temporary road occupation
Goal	Advise drivers of vehicles approaching a temporary road occupation. e.g. road construction, accident, disabled vehicle ahead, to reduce the vehicle speed.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether a vehicle approaches the temporary road occupation or a congested unknown area; — R-ITS-S checks the road conditions such as reported accidents, road construction information, existence of disabled vehicle
Use case output	The following output signals need to be considered: — R-ITS-S generates and broadcasts a “road occupation” notification/indication to the P-ITS-S in the vehicles with remaining time to clear the road occupation; — P-ITS-S generates guidance information to avoid road congestion; — R-ITS-S generates and broadcasts a “release” notification/indication, when the road occupation is cleared
Brief description	When the unexpected situation related to the road conditions occurs, the “road occupation” notification/indication is broadcasted to the following vehicles. The message announces the road construction ahead, accident ahead, disabled vehicle ahead information, etc. If a driver (P-ITS-S) receives the “road occupation” notification/indication, he/she can perceive the road status and prevent the congestion/accident by reducing the vehicle speed or changing the drive lane. The service will be terminated when the driver has left the designated area.
Classification	Mandatory

8.4.6 UC 3.6 – Emergency vehicle approaches on its route

This use case describes the handling procedure of warning alarm when an emergency vehicle approaches on one’s route. Using this use case, the vehicles make way for the path of the emergency vehicle following the guidance information on the P-ITS-S.

Table 13 describes the UC 3.6 — Emergency vehicle approaches on its route.

Table 13 — UC 3.6 — Emergency vehicle approaches on its route

Use case name	UC 3.6 — Emergency vehicle approaches on its route
Goal	Advise drivers of vehicles that an emergency vehicle is approaching on one's route and provide guidance information to make way for the emergency vehicle. Inform the vehicle drivers when the emergency vehicle has passed along.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether an emergency vehicle approaches one's route; — R-ITS-S checks whether the emergency vehicle has passed along one's route
Use case output	The following output signals need to be considered: — R-ITS-S generates and broadcasts an "emergency vehicle" notification/indication for the designated path to be cleared by other vehicles; — P-ITS-S generates guidance information to make way for the path of the emergency vehicle; — R-ITS-S generates and broadcasts a "release" notification/indication when the emergency vehicle passes along one's route
Brief description	When an emergency vehicle approaches, the "emergency vehicle" notification/indication is broadcasted to the vehicles on its route. If a driver receives the "emergency vehicle" notification/indication, he/she can prepare to clear the path for the emergency vehicle. The service will be terminated after an emergency vehicle has passed along the driver's vehicle.
Classification	Mandatory

8.5 UC cluster 4 — Parking bay guidance

8.5.1 UC 4.1 — Parking guidance when the vehicle enters the parking area

This use case describes the handling procedure of parking bay guidance using the parking guidance service. Using this use case, the driver can select the preferred parking bay, so the vehicle driver is guided to the parking bay.

Table 14 describes the UC 4.1 — Parking guidance when the vehicle enters the parking area.

Table 14 — UC 4.1 — Parking guidance when the vehicle enters the parking area

Use case name	UC 4.1 — Parking guidance when the vehicle enters the parking area
Goal	Provide the driver of the vehicle a route to be displayed on the P-ITS-S to the optimal (closest) parking bay when entering the parking area.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether a vehicle is entering the parking area; — R-ITS-S monitors available and occupied parking bays; — R-ITS-S checks whether a vehicle leaves the parking area
Use case output	The following output signals need to be considered: — R-ITS-S chooses the algorithm for selecting the optimal (closest) parking bay; — R-ITS-S generates and sends an “optimal parking bay” notification/indication to the P-ITS-S in the vehicle entering the parking area; — P-ITS-S generates guidance information to the optimal (closest) parking bay; — R-ITS-S internally updates available parking bay status once the vehicle occupies the parking bay; — R-ITS-S internally updates available parking bay status once the vehicle leaves the parking bay
Brief description	When vehicles approach the parking area, the available parking bays, depending on the handicapped vehicle and vehicle types (passenger vehicles, small vehicles, SUVs, buses, etc.), are identified and notified to the driver. After the driver chooses the preferred parking bay among the notified parking bays based on the guidance information, the path information to the designated parking bay is sent to the P-ITS-S. The service will be terminated when the driver finds the target parking bay and parks the vehicle according to the guided path.
Classification	Mandatory

8.5.2 UC 4.2 — Searching the path and parking bay on demand

This use case describes the handling procedure of parking guidance when some obstacles hinder normal movement of the vehicle on the movement path or parking bay while the vehicle is travelling to the parking bay under the guidance of the P-ITS-S.

Table 15 describes the UC 4.2 — Searching the path and parking bay on demand.

Table 15 — UC 4.2 — Searching the path and parking bay on demand

Use case name	UC 4.2 — Searching the path and parking bay on demand
Goal	Provide the driver of the vehicle with a new route to be displayed on the P-ITS-S to the next parking bay when the optimal (closest) parking bay is not reachable because an obstacle is blocking the path of the vehicle.
Actor	R-ITS-S, P-ITS-S
Use case input	The following input signals need to be considered: — R-ITS-S checks whether a vehicle is entering the parking area; — R-ITS-S monitors available and occupied parking bays; — P-ITS-S generates and sends “obstacle blocks path” notification/indication to the R-ITS-S; — R-ITS-S checks whether a vehicle leaves the parking area
Use case output	The following output signals need to be considered: — R-ITS-S chooses the algorithm for selecting the next parking bay; — R-ITS-S generates and sends a “next parking bay” notification/indication to the P-ITS-S in the vehicle after P-ITS-S generated and sent “obstacle blocks path” notification/indication to the R-ITS-S; — P-ITS-S generates guidance information to the next parking bay; — R-ITS-S internally updates available parking bay status once the vehicle occupies the next parking bay; — R-ITS-S internally updates available parking bay status once the vehicle leaves the parking bay
Brief description	If any vehicle or obstacle blocks the movement path due to abnormal situation in a parking area or if any other factor disturbs normal parking at the designated parking bay, the new (next) parking bay and movement path will be sent to the P-ITS-S.
Classification	Mandatory

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