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Intelligent transport systems (ITS) — Nomadic device service platform for micro-mobility —

Part 1: General information and use case definitions

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Foreword

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

A list of all parts in the ISO 22085 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO/TC 204/Working Group 17, *Nomadic Devices in ITS systems*, is designed to facilitate the development, promotion and standardisation of the use of nomadic and portable devices to support ITS service provisions and multimedia use, e.g. passenger information, automotive information, driver advisory and warning systems, and entertainment system interfaces to ITS service providers and motor vehicle communication networks. This document fosters the introduction of nomadic devices in the public transport and automotive world.

Intelligent transport systems (ITS) — Nomadic device service platform for micro-mobility —

Part 1:
General information and use case definitions

1 Scope

This document provides the service framework to identify the connectivity between nomadic devices, cloud servers and micro-mobility in pre-trip, en-route and post-trip. The service framework can promote micro-mobility as a new type of urban and rural transport mode and increase the possibility to be included in an integrated mobility system.

Micro-mobility can be defined as a small or compact sized electric vehicle. Normally, it is designed to be used as a first-mile and last-mile service connecting public transit routes or to provide personal mobility with one or two passengers for a short distance trip. The vehicle types of micro-mobility are very wide, including three or four wheeled micro electric vehicle, electric utility task vehicle, electric bike, electric kick scooter, electric skateboard, and electric self-balancing unicycles. This document focuses on three or four wheeled micro electric vehicle.

The nomadic device service framework aims to accommodate the specific needs of integrated mobility services for either urban or rural areas. The service framework focuses on the use of data exchange interface standards between micro-mobility and nomadic devices to enable the development of cloud-based intelligent transport systems (ITS) using wireless networks.

A nomadic device needs to be connected with micro-mobility reliably and consistently. In addition, it is necessary to provide power supply interface for stable nomadic device operation.

The service framework and use cases described in this document include:

— The service framework architecture between nomadic devices, micro-mobility and cloud servers.

— Use cases that are are divided into three categories including pre-trip, en-route, and post-trip:

  — Pre-trip service configuration: the pre-trip use cases provide micro-mobility information, on-demand navigation service with charging station and available parking lots, and reserving micro-mobility car sharing services.

  — En-route service configuration: the en-route use cases provide ITS information, e.g. traffic conditions, safety information, and toll service. The use cases also provide information on available parking lots and charging stations when the micro-mobility vehicle approaches a destination.

  — Post-trip service configuration: the post-trip use cases provide micro-mobility driving records, battery level, parking location information, and a return service for shared micro-mobility.

— Guidance documents to facilitate the practical implementation of diverse ITS service providers including related use cases.

This work includes the identification of existing ISO/TC 204 International Standards in ITS and existing vehicle communication network access standards.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
nomadic device
ND
implementation of a personal ITS station which provides communication connectivity via portable equipment, e.g. cellular telephones, wireless communication networks (3G, 4G and 5G), mobile wireless broadband (WIMAX, HC-SDMA), IEEE 802.11, and includes short range links, e.g. IEEE 802.15.1, IEEE 802.15.4, to connect portable devices to the motor vehicle communications system network

3.1.2
micro-mobility
MM
new concept of eco-friendly personal electric vehicles for one or two passengers

3.1.3
in mobility network
IMN
local network bus among electrical control units (ECUs) in *micro-mobility* (MM) (3.1.2), providing diagnostics information to *nomadic device* (ND) (3.1.1) through short-range links, e.g. IEEE 802.15.1, IEEE 802.15.4

3.1.4
micro-mobility service provider
MMSP
vendor or organization that provides IT solutions and/or services related with public transportation to end users

3.1.5
micro-mobility cloud server
MMCS
network server between the *nomadic device* (ND) (3.1.1) and the *micro-mobility service provider* (MMSP) (3.1.4)

3.1.6
micro-mobility communication network
MMCN
communication network between the *nomadic device* (ND) (3.1.1) and the *micro-mobility cloud server* (MMCS) (3.1.5)

3.1.7
public communication network
PCN
communication network between the *micro-mobility cloud server* (MMCS) (3.1.5) and the service providers which provides various *micro-mobility* (MM) (3.1.2) information services, e.g. charging stations, parking lots, traffic congestion

3.2 Abbreviated terms

ARMS	adaptive route management service
BMS	battery management system
CSLPS	charging station location providing service
ECU	electrical control unit
IMN	in mobility network
ITIPS	interconnected transfer information providing service
KGSSMM	keyless go service for shared micro-mobility
MM	micro-mobility
MMCN	micro-mobility communication network
MMCS	micro-mobility cloud server
MMDB	micro-mobility database
MMIMS	micro-mobility as an integrated mobility service
MMIPS	micro-mobility information providing service
MDPS	motor driven power steering-wheel
MMFMS	micro-mobility fault management service
MMG	micro-mobility gateway
MMSS	micro-mobility sharing service
MMTIPS	micro-mobility trip information providing service
MTS	mobile tolling service
ND	nomadic device
PAPSS	pre-scanning available parking space service
PCN	public communication network
PMMPPS	parked micro-mobility position providing service
SAPSS	searching available parking space service on the way
SMMRS	shared mico-mobility return service

SOC	states of charge
TIPS	traffic information providing service
Wi-Fi	wireless fidelity

4 Document overview and structure

This document provides all information and references required to support the implementation of the requirements related to standardized access to nomadic device service platforms for micro-mobility. The rest of the document consists of the following information.

— General information is described in Clause 5.

This clause provides the purpose of this document and an overview of the nomadic device service platform for micro-mobility, which includes a service framework architecture.

— Use case overview and definitions are described Clause 6.

This clause specifies all technical requirements related to nomadic device service platforms for micro-mobility to be interfaced with micro-mobility cloud servers and micro-mobility service providers. The requirements reflect the user services from the use cases as specified in this document.

5 General information

5.1 Purpose of this document

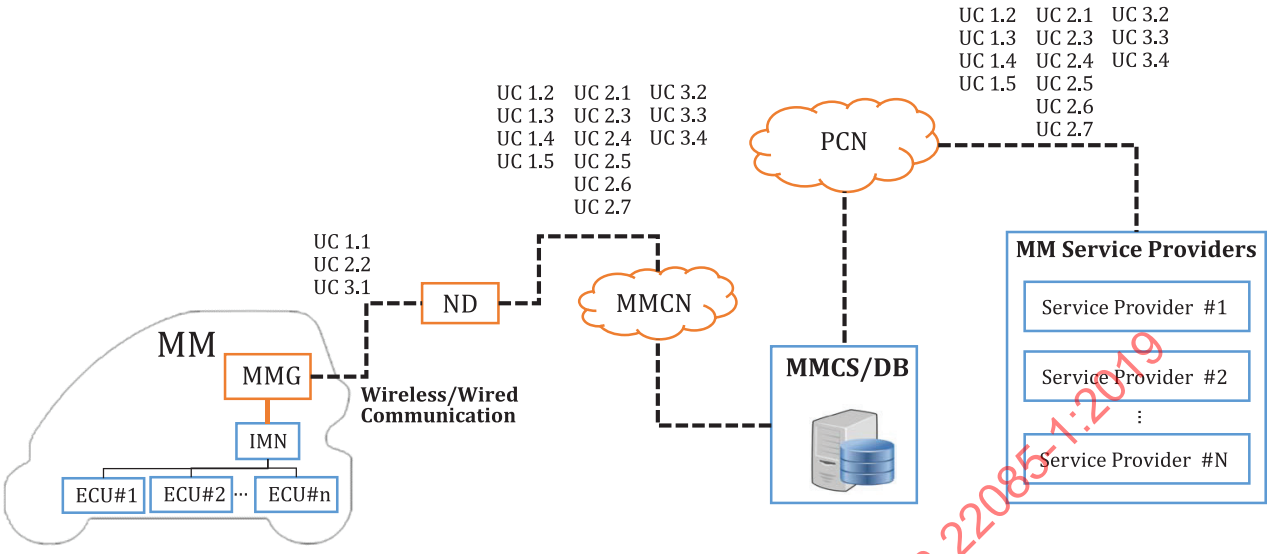
This document addresses two major areas:

— Identifies the method to describe the ND interfaced with MMG and MMCS, and ND service platform for micro-mobility.

— Specifies the general use cases that should be included in the ND service platform for micro-mobility.

5.2 Overview of ND service platform for micro-mobility

Conceptual aspects of the general use cases should be included in the ND service platform for micro-mobility, and should be considered as illustrated in Figure 1.



Key

MM	micro-mobility
MMG	micro-mobility gateway
ND	nomadic device
IMN	in mobility network
MMCN	micro-mobility communication network
MMCS	micro-mobility cloud server
PCN	public communication network

Figure 1 — Service framework architecture

5.3 Background and challenges

The background and challenges of the ND service platform for micro-mobility are:

— various services use micro-mobility, e.g. first/last mile service and sharing service, are commercialized;

— applying micro-mobility to delivery and to postal services is considered;

— because of a battery with small capacity, micro-mobility has challenges, e.g. connection with charging stations, fault diagnosis and management, connection with public transportation, providing seamless service;

— the ND service platform for micro-mobility aims to induce the continued use of MM by providing the driver with status information about MM and status information of destination to find the optimal path of movement of MM;

— new service models and standards framework related to the ND service platform for micro-mobility would be under discussion in the existing business areas influenced by MM and information and communication technologies.

5.4 Issues for proposition

The issues for the proposition of the ND service platform for micro-mobility are as follows.

— MMG: micro-mobility gateway

The MMG provides the ND the mechanical information of MM, by connecting with the IMN to provide MM status information requested by the driver.

— ND: nomadic device

The ND collects the MM's mechanical and location information, sends it to the MMCS, and provides the driver services related to the operation of the MM. The ND includes both the MMG and the MMCS data interfaces and services to provide MM status and optimal route guidance.

— MMCS: micro-mobility cloud server

The MMCS plays the role of storing and providing the data required for operation to the MM, in order to provide the services requested by the MM driver.

It includes both cloud servers and other service providers for MMCS data storage and services.

6 Use case overview and definitions

6.1 General

The main objective of this document is to define the service platform with the related use cases.

6.2 Use case overview

6.2.1 Basic principles for use cases

Basic principles have been established as a nomadic device service platform for micro-mobility to define the use cases.

— The use cases of nomadic device service platform for micro-mobility describe the interaction between the micro-mobility gateway (MMG), the nomadic device (ND), and the MM cloud server.

— The use cases in this document define sample cases of the nomadic device service platform for micro-mobility for pre-trip, en-route, and post-trip MM users.

The nomadic device service platform for micro-mobility may include the following groups of use cases.

— **Pre-trip:** MM information providing services, on-demand navigation service linked with information on charging stations, pre-scanning available parking space service, micro-mobility sharing service, and micro-mobility as an integrated mobility service.

— **En-route:** Traffic information providing services, safety warning service, mobile tolling service, adaptive route management service, available parking space service, micro-mobility lock service, and interconnected transfer information and notification service.

— **Post-trip:** micro-mobility driving information providing service, charge station information service, parking location providing service, SMMRS.

6.2.2 Use case clusters

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

Table 1 — Use case clusters and associated use case overview

# – Title of use case cluster	Brief description
1. Pre-trip	This cluster specifies the details of use cases of the pre-trip stage for micro-mobility. It includes five different use cases, including micro-mobility (MM) information providing service, on-demand navigation service linked information of charging stations, micro-mobility sharing services, and micro-mobility as an integrated mobility service. — UC 1.1 – Micro mobility information providing service — UC 1.2 – Navigation service linked information of charging station — UC 1.3 – Pre-scanning available parking space service — UC 1.4 – Micro mobility sharing service — UC 1.5 – Micro mobility as an integrated mobility service
2. En-route	This cluster specifies the details of the use cases of the en-route stage for micro-mobility. It includes seven different use cases, including traffic information providing service, safety warning service, mobile tolling service, adaptive route management service, available parking space service and micro-mobility lock service, interconnected transfer information and notification service. — UC 2.1 – Traffic information providing service — UC 2.2 – Micro-mobility fault management service — UC 2.3 – Mobile tolling service — UC 2.4 – Adaptive route management service — UC 2.5 – Searching available parking space service on the way — UC 2.6 – Keyless go service for shared micro-mobility — UC 2.7 – Interconnected transfer information providing service
3. Post-trip	This cluster specifies the details of the use cases of the post-trip stage for micro-mobility. It includes four different use cases, including micro-mobility driving information providing service, charge station information service, parking location providing service, sharing micro-mobility return service. — UC 3.1 – Micro mobility driving information providing service — UC 3.2 – Charge station information service — UC 3.3 – Parked micro-mobility position providing service — UC 3.4 – Shared micro-mobility return service

6.3 Use case definitions

6.3.1 Use case cluster 1: Pre-trip

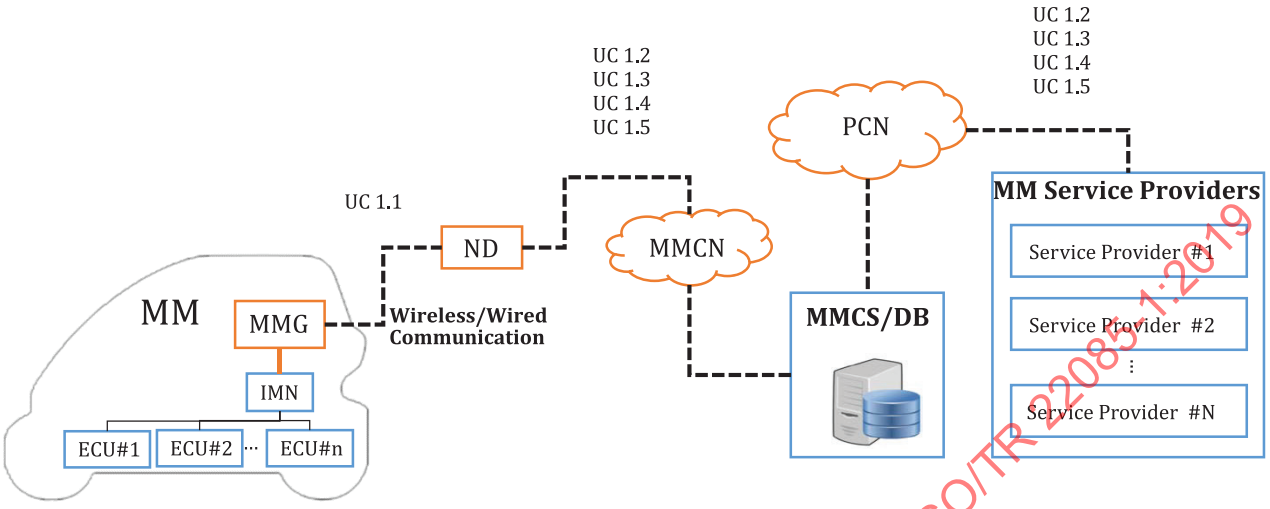


Figure 3 — UC cluster 1: System architecture

6.3.1.1 UC 1.1 micro-mobility (MM) information providing service (MMIPS)

Table 2 shows use case 1.1 MM information providing service, in order to provide MM status information to the driver prior to driving the car.

Table 2 — UC 1.1 micro-mobility information providing service (MMIPS)

Use case name	micro-mobility information providing service
Actor	micro-mobility driver, ND, MMG
Goal	Providing MM status information to driver
Use case input	Automatic request by ND or manual request by MM driver
Use case output	MM status data displayed on ND
Brief description	MM information including MM status data, SOC (states of charge), diagnostics of major electronic components, etc. is provided to MM driver, who utilizes it to make a decision on repair or charging service. This information may include: — Diagnostics of MM electronic component conditions; — SOC.

6.3.1.2 UC 1.2 navigation service linked to location of charging station

Table 3 shows use case 1.2 navigation service linked to location of charging station, in order to support the driver with route choice related to charging station information near or on the way to the destination.

Table 3 — UC 1.2 navigation service linked to information on charging station

Use case name	Navigation service linked information on charging station
Actor	MM Driver, ND (initiated by driver interaction), MMCS, MMSP (e.g. charging service provider)
Goal	Navigation service to destination with information on charging station
Use case input	Route request by MM driver
Use case output	Route guidance with information on charging station on ND
Brief description	The route to destination is guided with the information of charging station on ND. The location of charging station may include the nearest or one on the way to destination. This information may include: — Route choices to destination; — Information on charging location near or on the way to destination; — Road driving and accessibility conditions (e.g. speed limit, motorway, etc.); — Types of charging connector, availability of charging station; — Number of passengers; — Total weight of goods.

6.3.1.3 UC 1.3 pre-scanning available parking space service (PAPSS)

Table 4 shows use case 1.3 pre-scanning service for available parking space linked to destination, in order to provide real time parking space information to the driver when preparing to drive.

Table 4 — UC 1.3 pre-scanning available parking space service (PAPSS)

Use case name	Pre-scanning available parking space service
Actor	MM driver, ND (initiated by driver interaction or automatic request), MMCS, MMSP (e.g. parking service provider)
Goal	Available parking space information to destination
Use case input	Destination, estimated arrival time to destination (automatically generated by ND)
Use case output	Availability of parking space on ND
Brief description	Prior to driving, available parking space information near to the destination is scanned and provided on the ND related to the navigation service defined in UC 1.2. This information may include: — Available parking space near to the destination; — Reservation of parking space.

6.3.1.4 UC 1.4 micro-mobility sharing service (MMSS)

Table 5 shows use case 1.4 micro-mobility sharing service, in order to provide seamless travel from origin to destination by combining public transit services and MM sharing service providers. The sharing service is enabled by the ND which includes a unified gateway for managing (e.g. search, reservation, and payment) the sharing service.

Table 5 — UC 1.4 micro-mobility sharing service (MMSS)

Use case name	Micro-mobility sharing service
Actor	MM sharing user, ND, MMCS, MMSPs (e.g. micro-mobility sharing service provider)
Goal	Reservation of MM
Use case input	micro-mobility sharing reservation request by ND

Table 5 *(continued)*

Use case output	Reserved sharing MM information
Brief description	MMSS reserves MM for sharing service and displays reserved information on the ND. Available MM information is provided by MMCS. This information may include: — MM sharing service request; — Sharing service provision including availability and reservation; — MM information related to sharing service; — Number of passengers; — Total weight of goods.

6.3.1.5 UC 1.5 micro-mobility as an integrated mobility service (MMIMS)

Table 6 shows use case 1.5 micro-mobility as an integrated mobility service, in order to provide interconnected transfer information. Usually, MM can be used as a first- or last-mile transport mode, which is combined with public transit service, providing seamless travel from origin to destination.

Table 6 — UC 1.5 micro-mobility as an integrated mobility service (MMIMS)

Use case name	Micro mobility as an integrated mobility service
Actor	MM driver, ND, MMCS, MMSPs (e.g. public transit service providers)
Goal	Providing interconnected transfer information
Use case input	Final destination, Transfer station
Use case output	Interconnected transfer information
Brief description	MMIMS provides interconnected transfer information to MM driver on the ND. This information may include: — Transferable transit modes information; — Arrival and departure time; — Number of passengers; — Total weight of goods.

6.3.2 Use case cluster 2: En-route

6.3.2.1 UC 2.1 Traffic information providing service (TIPS)

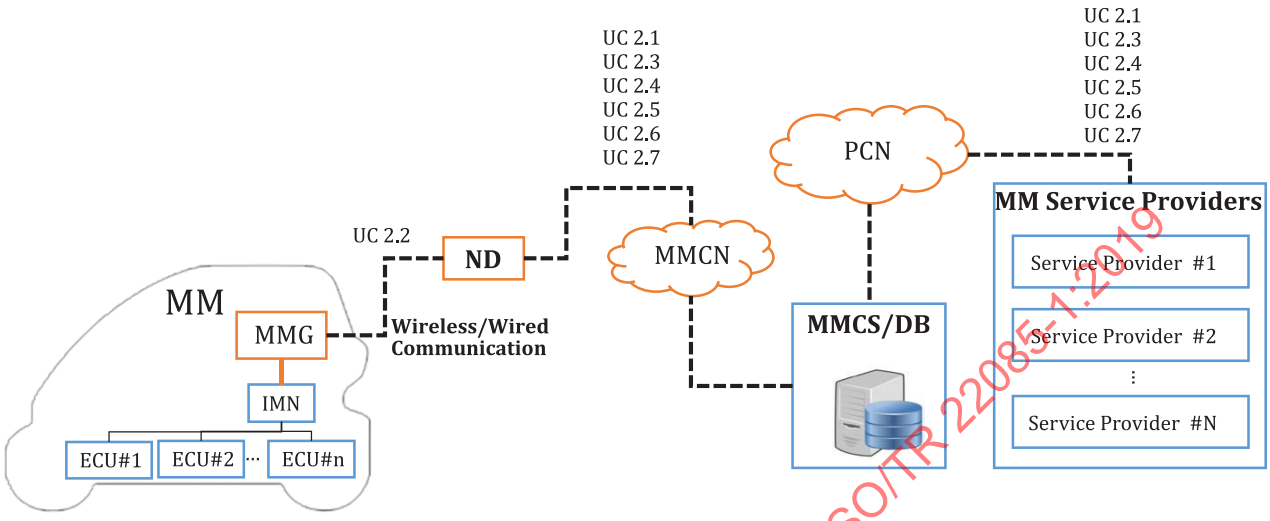


Figure 4 — UC cluster 2: System architecture

Table 7 shows use case 2.1 TIPS, in order to provide real-time traffic information to the driver while driving.

Table 7 — UC2.1 traffic information providing service (TIPS)

Use case name	Traffic information providing service
Actor	ND, MMCS, PCN
Goal	Providing real-time traffic information to MM driver
Use case input	Route information to destination
Use case output	Real-time traffic information display on ND
Brief description	While driving, traffic information is provided by MMCS in real time. To provide traffic information, route information on ND is sent to MMCS. Then, MMCS requests the relevant traffic information provider through PCN. This information may include: — Route information; — Traffic information, e.g. traffic congestion, traffic accident, danger zone; — Current location of MM.

6.3.2.2 UC 2.2 micro-mobility fault management service (MMFMS)

Table 8 shows use case 2.2 SWS, in order to provide MM diagnostic information to the driver while driving.

Table 8 — UC 2.2 micro-mobility fault management service (MMFMS)

Use case name	Micro mobility fault management service
Actor	ND, MMG
Goal	Providing MM malfunction information to driver
Use case input	MM diagnostic information from MMG

Table 8 *(continued)*

Use case output	MM malfunction warning display on ND
Brief description	MM diagnostic information is provided to driver by MMG while driving when major electric components such as invertor, battery, etc. are in fault or malfunction status. To provide MM diagnostic information, MMG broadcasts MM diagnostic information to ND. This MM diagnostic information may include: — BMS fault; — Invertor fault; — MDPS fault; — Other main electric components.

6.3.2.3 UC 2.3 mobile tolling service (MTS)

Table 9 shows use case 2.3 STS, in order to pay a toll when MM passes a toll road in an urban area.

Table 9 — UC 2.3 mobile tolling service (MTS)

Use case name	Mobile tolling service
Actor	ND, MMCS
Goal	Toll payment by ND
Use case input	MM location (GPS information provided by ND)
Use case output	Toll payment by ND
Brief description	Toll payment is requested through MMCS when MM passes toll roads. MTS is provided to MM driver by the combination of following service providers, e.g. payment service provider, communication service operator, and toll road management service provider. This information may include: — Current MM location; — Payment information.

6.3.2.4 UC 2.4 adaptive route management service (ARMS)

Table 10 shows use case 2.4 ARMS, in order to suggest a new route to the destination when MM deviates from the planned route.

Table 10 — UC 2.4 adaptive route management service (ARMS)

Use case name	Adaptive route management service
Actor	ND, MMCS
Goal	Providing new route to the destination
Use case input	MM location (GPS information provided by ND)

Table 10 *(continued)*

Use case output	New route to destination
Brief description	New route to destination is provided by MMCS when MM deviates from planned route while driving. To suggest new route to destination, MMCS receives traffic conditions and charging station information from relevant service providers. Then, MMCS sends the information to ND. This traffic information may include: — Traffic congestion; — Traffic accident; — Charging station location; — Number of passengers; — Total weight of goods.

6.3.2.5 UC 2.5 searching available parking space service on the way (SAPSS)

Table 11 shows use case 2.5 searching service for available parking space linked to destination, in order to provide real time parking space information to the driver before approaching the destination.

Table 11 — UC 2.5 searching available parking space service on the way (SAPSS)

Use case name	Searching available parking space service on the way
Actor	MM Driver, ND (initiated by driver interaction or automatic request), MMCS
Goal	Available parking space information to destination
Use case input	Destination, estimated arrival time to destination (automatically generated by ND)
Use case output	Availability of parking space on ND
Brief description	Before MM approaches the destination, available parking space information near to the destination is searched and provided on ND. If necessary, navigation routes could be re-searched to available parking spaces. SAPSS automatically requests to search the available parking space near to the destination. This information may include: — Available parking space; — Estimated arrival time to destination; — Real-time MM location; — Reservation of parking space.

6.3.2.6 UC 2.6 keyless go service for shared micro-mobility (KGSSMM)

Table 12 shows use case 2.6 KGSSMM, in order to ensure the safety of the MM when the ND leaves the MM.

Table 12 — UC 2.6 keyless go service for shared micro-mobility (KGSSMM)

Use case name	Keyless go service for shared micro-mobility
Actor	ND, MMG, MMCS
Goal	Locking MM and warning information to ND
Use case input	Disconnection between ND and MMG