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

Part 3: Data structure and data exchange procedures

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Part 3: Data structure and data exchange procedures

Systèmes de transport intelligents (ITS) — Plate-forme de services via appareils nomades pour la micro-mobilité —

Partie 3: Structure des données et procédures d'échange de données

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Foreword

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Introduction

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

This document fosters the introduction of nomadic devices in the public transport and automotive world. It specifies the data structure and data exchange procedure based on Data eXchange Messages (DXMs) at the application level regarding pre-trip, post-trip and while driving, in order to identify connectivity among a user's personal ITS station (P-ITS-S, for example nomadic devices), vehicle-ITS-station gateway (V-ITS-S) and central ITS station (C-ITS-S).

This document covers subjects related to mobility services using micro mobility, including micro mobility sharing, parcel delivery and first-mile and last-mile connections in urban areas. This DXM implementation describes how such mobility services based on micro mobility are provided using a P-ITS-S.

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

Part 3: Data structure and data exchange procedures

1 Scope

This document specifies the data structure and data exchange procedure related to micro mobility service applications utilizing a P-ITS-S (i.e. nomadic devices), including car sharing, parcel delivery and first-mile and last-mile connections. In addition, this document delivers related requirements for the development and operation of the service platform between nomadic devices and micro mobility with intelligent transport systems (ITS) technologies.

This document defines a data structure and data exchange procedure based on the datasets and messages which are defined in ISO 22085-2.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 — Station and communication architecture*

3 Terms, definitions and abbreviated terms

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

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

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

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

3.1 Terms and definitions

3.1.1
central ITS station
C-ITS-S
ITS station assuming a central role

3.1.2
personal ITS station
P-ITS-S
implementation of an ITS station as a personal ITS subsystem (e.g. nomadic device or mobile device) which provides communication connectivity via a wireless communication network (3G, 4G, and 5G), mobile wireless broadband (WIMAX, HC-SDMA, etc.), WiFi and short-range links, such as Bluetooth, Zigbee, etc. to connect portable devices to the motor vehicle communications system network

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3.1.3
micro mobility
MM
eco-friendly personal electric vehicle for one or two passengers

3.1.4
in mobility network
IMN
local network bus among electrical control units in *micro mobility* (3.1.3), providing diagnostics information to a *P-ITS-S* (3.1.2) through a *V-ITS-SG* (3.1.8)

3.1.5
micro mobility service provider
MMSP
service provider for *micro mobility* (3.1.3), including parking lot management service, public transit authority, charging station management service, tolling service authority, car sharing service and traffic information service, amongst others

3.1.6
micro mobility communication network
MMCN
communication network between *P-ITS-S* (3.1.2) and *C-ITS-S* (3.1.1)

3.1.7
public communication network
PCN
network between micro mobility cloud servers (MMCS) and *micro mobility service providers* (3.1.5) used to provide *micro mobility* (3.1.3) services information on, for example, charging stations, parking lots and traffic congestion

3.1.8
vehicle-ITS-station gateway
V-ITS-SG
ITS-S node used to interconnect two different OSI protocol stacks at layers 5 through to 7 between an *in mobility network* (3.1.4) and a *P-ITS-S* (3.1.2)

3.2 Abbreviated terms

C	conditional
DTC	diagnostic trouble code
DXM	data exchange message
EXE	executor
IMN	in mobility network
ITIPS	interconnected transfer information providing service
ITS	intelligent transport systems
ND	nomadic device
M	mandatory
MM	micro mobility
MMCS	micro mobility cloud server

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MMIMS Micro mobility as an integrated mobility service

MMSRS micro mobility sharing service

O optional

SAPSS searching available parking space service

SOC state of charge

4 Overview

4.1 Introduction

Conceptual aspects of the general use cases in ISO/TR 22085-1 are depicted in Figure 1 and are summarized in Table 1. Details of ITS-S (i.e. V-ITS-S, P-ITS-S, and C-ITS-S) are specified in ISO 21217.

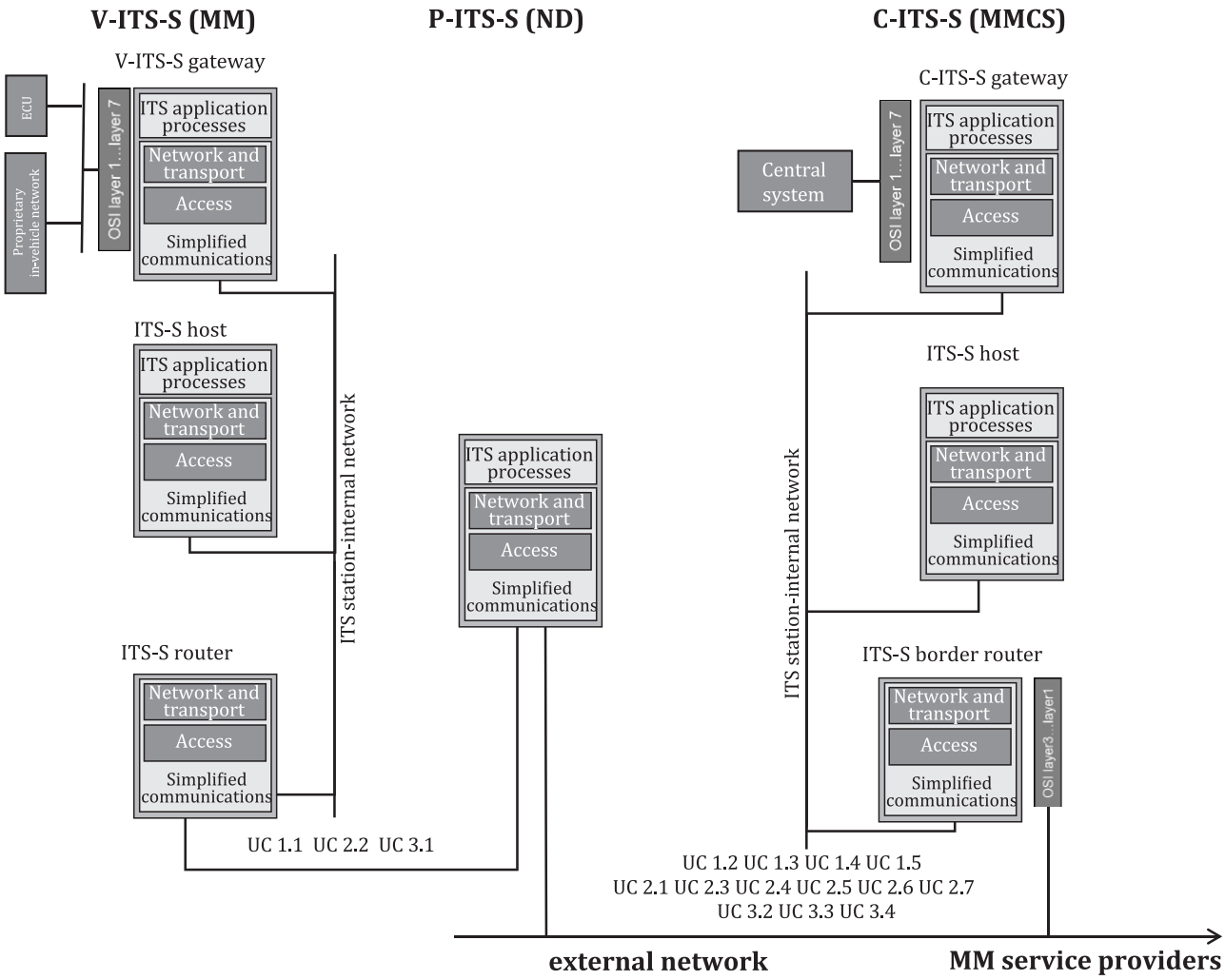

Figure 1 — Conceptual aspects of the general use cases

Table 1 — Use cases clusters and associated use cases overview

Title of use cases cluster	Brief description
1. Pre-trip	This cluster specifies the detailed use cases of pre-trip stage for MM. It includes 5 different use cases:

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Table 1 *(continued)*

Title of use cases cluster	Brief description
	— UC 1.1 – MM information providing services — UC 1.2 – Navigation service linked information on charging station — UC 1.3 – Pre-scanning available parking space service — UC 1.4 – MM sharing service — UC 1.5 – MM as an integrated mobility service
2. En-route	This cluster specifies the detailed use cases of the en-route stage for MM. It includes 7 different use cases. — UC 2.1 – Traffic information providing service — UC 2.2 – MM status monitoring 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 detailed use cases of post-trip stage for MM. It includes 4 different use cases. — UC 3.1 – MM driving information providing service — UC 3.2 – Charging station information service — UC 3.3 – Parked MM position providing service — UC 3.4 – Sharing MM return service

4.2 Message overview

DXMs regarding the use cases defined in ISO/TR 22085-1 are summarized in Table 2.

Table 2 — DXMs for mobility service using MM

	ID	DXM name	Exe	Description
	1	request-mm-status	P	Request V-ITS-S to notify MM status with SOC, DTC, mileage, V-ITS-S-ID.
	2	mm-status-response	V	Send MM status information (V-ITS-S-ID, SOC, DTC, mileage) to P-ITS-S.
	3	stop-notify-mm-status	P	Stop sending MM status information to P-ITS-S.
	4	notify-mm-service	P	Send MM status information, V-ITS-S-ID, position and user information to C-ITS-S. After the first contact, send only the P-ITS-S position, MM status information and V-ITS-S-ID in a predefined time interval.
	5	stop-notify-mm-service	P	Stop the communication to the C-ITS-S.
	6	charging-station-information	C	Send charging station location to P-ITS-S.
	7	parking-space-information	C	Send parking location information to P-ITS-S.

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Table 2 *(continued)*

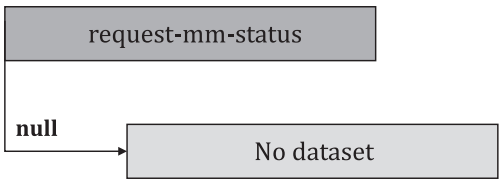
	ID	DXM name	Exe	Description
	8	reservation-information	C	Send sharing service reservation information to P-ITS-S.
	9	public-transit-schedule	C	Send public transit information with arrival/departure time and transit type to P-ITS-S.
	10	public-transit-reserved-information	C	Send reserved information to P-ITS-S.
	11	navigation-route-information	C	Send navigation route information to P-ITS-S.
	12	traffic-information	C	Send traffic information to ND (P-ITS-S) from server (C-ITS-S).
	13	accident-information	C	Send accident information from server (C-ITS-S) to ND (P-ITS-S).
	14	danger-zone-information	C	Send danger zone location information to P-ITS-S.
	15	warning-message	C	Send warning message if DTC error has occurred.
	16	toll-balance-information	C	Definition of toll-balance-information.
	17	disconnection-warning-message	C	Send connection lost warning message where connection between V-ITS-S and P-ITS-S has been disconnected.
	18	return-information	C	Send returning MM information.
	19	payment-information	C	Send sharing service reservation information to P-ITS-S.
	20	request-public-transit-schedule	P	Send public transit schedule request from ND (P-ITS-S) to server (C-ITS-S).
	21	request-public-transit-reservation	P	Reserve public transit schedule from ND (P-ITS-S) to server (C-ITS-S).

5 Data structure

5.1 Data structure for request-mm-status

Table 3 shows the data structure for the DXM request-mm-status to request MM status information and V-ITS-S ID from the ND (P-ITS-S).

Table 3 — Data structure for request-mm-status

Msg	**ID**	**1**	Request that V-ITS-S notifies MM status with SOC, DTC, mileage and V-ITS-S-ID.
	name	**request-mm-status**	
	exec	**P-ITS-S**	
Data structure			

5.2 Data structure for mm-status-response

Table 4 shows the data structure for the DXM mm-status-response to send MM status information to the ND (P-ITS-S).

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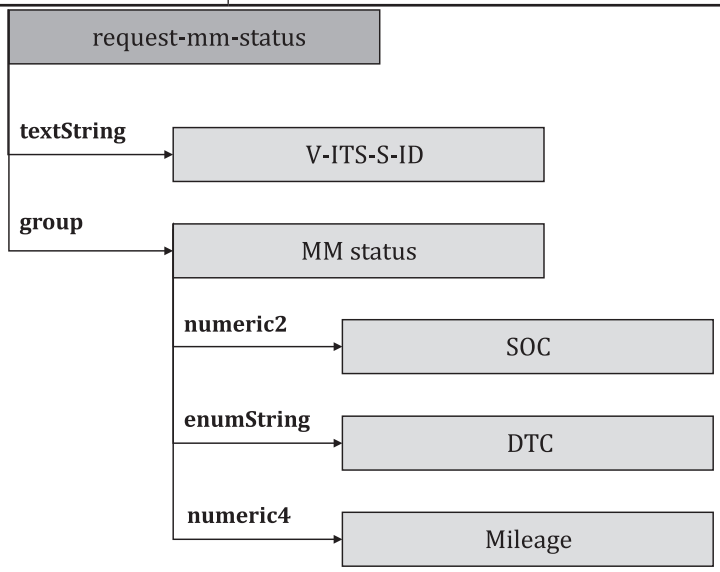
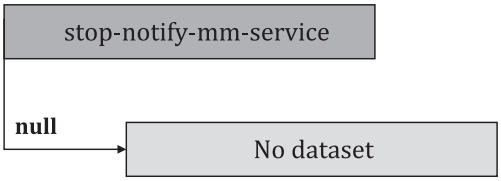
Table 4 — Data structure for mm-status-response

Msg	**ID**	**2**	Send MM status information (V-ITS-S-ID, SOC, DTC, mileage) to the P-ITS-S
	name	**mm-status-response**	
	exec	**V-ITS-S**	
Data structure			

5.3 Data structure for stop-notify-mm-status

Table 5 shows the data structure for the DXM stop-notify-mm-status to stop the communication from the vehicle (V-ITS-S).

Table 5 — Data structure for stop-notify-mm-status

Msg	**ID**	**3**	Stop sending MM status information to the P-ITS-S.
	name	**stop-notify-mm-status**	
	exec	**P-ITS-S**	
Data structure			

5.4 Data structure for notify-mm-service

Table 6 shows the data structure for the DXM notify-mm-service to send MM status information, V-ITS-S-ID, position, user information from the P-ITS-S to the C-ITS-S.

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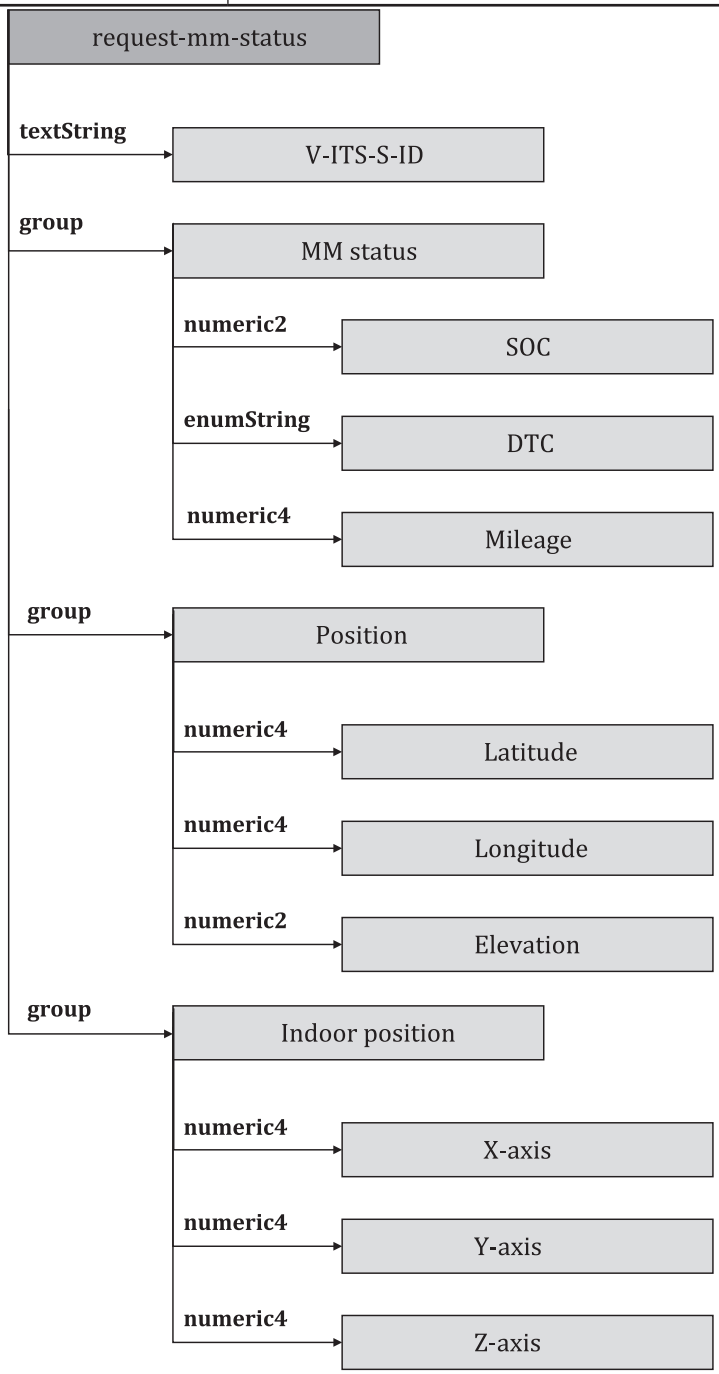
Table 6 — Data structure for notify-mm-service

Msg	**ID**	**4**	Send MM status information, V-ITS-S-ID, position and user information to the C-ITS-S. After the first contact, send only the P-ITS-S position, MM status information and V-ITS-S-ID in a predefined time interval.
	name	**notify-mm-service**	
	exec	**P-ITS-S**	

Data structure



5.5 Data structure for stop-notify-mm-service

Table 8 shows the data structure for the DXM stop-notify-mm-service to send MM status information, V-ITS-S-ID, position and user information from the P-ITS-S to the C-ITS-S.

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