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Intelligent transport systems — Framework for green ITS (G-ITS) standards —

Part 1: General information and use case definitions

Systèmes de transport intelligents — Cadre pour les normes relatives aux systèmes de transport intelligents écologiques —

Partie 1: Informations générales et définitions des cas d'utilisation

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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 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

Introduction

The nomadic and portable devices for ITS services in ISO/TC204 are defined to facilitate the development, promotion and standardisation of the use of nomadic and portable devices to support ITS service provision and multimedia use such as passenger information, automotive information, driver advisories and warning systems, and entertainment system interfaces to ITS service providers and motor vehicle communication networks. This document fosters the introduction of multimedia and telematics nomadic devices in the public transport and automotive world.

This document provides the framework guidelines to identify cost-effective technologies and related standards required to deploy, manage and operate sustainable "green" intelligent transport systems (ITS) technologies in surface transportations with eco-mobility.

Intelligent transport systems — Framework for green ITS (G-ITS) standards —

Part 1:
General information and use case definitions

1 Scope

This document provides the framework guideline for identifying cost-effective technologies and related standards required to deploy, manage and operate sustainable "green" intelligent transport systems (ITS) technologies in surface transportations with eco-mobility. These ITS technologies can increase operational efficiencies and unlock enhanced transportation safety and eco-mobility applications.

The green ITS standard framework builds on the existing standards and best practices of transport operation and management systems, as well as ITS applications, and aims to accommodate to the specific needs of eco-mobility in either mega cities or developing countries.

The G-ITS standards would expect to focus on the use of data exchange interface standards to enable the deployment of cloud-based multi-modal mobility solutions using wireless networks and nomadic devices. These forward-looking solutions are "infrastructure light" and thus can impact developing regions with little or no legacy transportation infrastructure.

The framework described in this document includes:

— G-ITS standard common framework including gap analysis of existing ITS standards;

— Guidance documents to facilitate the practical implementation of identified standards by policy makers and engineers including related use cases.

This document includes the identification of existing International Standards for ITS in ISO/TC 204 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:

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

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

3.1.1
nomadic device
ND
personal ITS station which provides communication connectivity via equipment such as cellular telephones, mobile wireless broadband (WIMAX, HC-SDMA, etc.), WiFi etc. and includes short range links, such as Bluetooth, Zigbee, etc. to connect portable devices to the motor vehicle communications system network

3.1.2
personal ITS station
P-ITS-S
ITS station in a personal ITS subsystem

3.1.3
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

3.1.4
green ITS
G-ITS
new-concept transportation system, which is expected to arise following the paradigm shift toward eco-friendly, low-carbon green growth in the transportation sector, as a global policy

3.1.5
eco-mobility
eco transport systems and services based on eco vehicles and their related facilities

3.2 Abbreviated terms

AEI	automatic equipment identification
CALM	communication access for land mobile
CAN	controller area network
DMB	digital multimedia broadcasting
DSRC	dedicated short range communication
DTG	digital tachograph
ERI	electronic registration and identification
ETC	electronic toll collection
EV	electric vehicle
FCEV	fuel cell electric vehicle
HMI	human machine interface
IP	internet protocol
ITS	intelligent transport systems
MaaS	mobility as a service

MaT	mobile all transit
MoD	mobility on demand
MOST	media oriented systems transport
MVCI	modular vehicle communication interface
ND	nomadic device
OBE	on-board equipment
ODX	open diagnostic data exchange
OSGi	open services gateway initiative
TCP	transport control protocol
PDA	personal digital assistant
PHEV	plug-in hybrid electric vehicle
P-ITS-S	personal – intelligent transport system – station
PM	personal mobility
RSE	road side equipment
UDP	user datagram protocol
V-ITS-SG	vehicle – intelligent transport system – station gateway
WAVE	wireless access for vehicular environment
WiFi	wireless fidelity
WIMAX	worldwide interoperability for microwave access
XML	extensible mark-up language

4 Document overview and structure

This document provides all documents and references in order to support the implementation of the applications related to standardized access to framework for green ITS (G-ITS) personal ITS station. This document consists of the following documents.

— Part 1: General information and use case definitions

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

— Part 2: Integrated mobile service application and specification

This part specifies all technical guidelines related to the integrated mobile service application for G-ITS to be used on the personal ITS station and to be interfaced with central ITS station, vehicle ITS station, and roadside ITS station. The guidelines will reflect the user services from the use cases as specified in this document. The protocol will be defined according to the requirements as specified in ISO 14817-1 and ISO 14817-2.

5 General information about this document

5.1 Purpose

This document:

— identifies the requirements of application level framework for green ITS (G-ITS) services, that can be frequently inserted, modified and deleted;

— identifies the method to describe the general information for all subjects related to G-ITS services on the personal ITS station interfaced with central ITS station, vehicle ITS station, and roadside ITS station;

— specifies the general use cases that should be included for the G-ITS services.

5.2 Overview of G-ITS services

Conceptual aspects of the green ITS (G-ITS) services should be considered as illustrated in Figure 1.

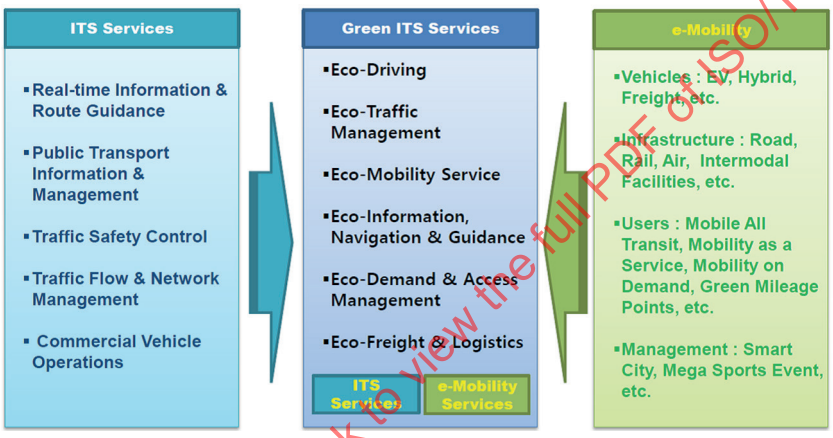

Figure 1 — G-ITS service concept

ISO/TC 204 plans to develop standards, specifications and informational reports for central and local government officials who intend to manage and operate green ITS in their respective cities with eco-mobility.

Examples include the delivery and management of ITS services using wireless networks and personal nomadic devices, as well as the use of commercial off-the-shelf technologies and services such as smartphone apps for public transit route planning and obtaining road congestion information for use by traffic management centres and personal route planning.

The green ITS standard framework will build on the existing standards and best practices transport operation and management systems and ITS applications, but will be customized to accommodate specific needs of eco-mobility in countries and cities. This includes:

— survey and identification of appropriate ITS technologies and corresponding standards required to deploy eco-mobility systems, services and infrastructure in the cities;

— identification of gaps and proposed revisions/amendments to existing standards where appropriate;

— development of a standard framework for the deployment and management of green ITS standards.

The background and challenges of G-ITS standards are:

— as increased urbanization and traffic congestion contribute to climate change, impact the quality of life and economic activities in many cities, Intelligent Transport Systems (ITS) hold the promise of a better future;

— creation of a mobility ecosystem where consumers can avail themselves of various mobility services through the use of mobile applications or web interfaces through nomadic devices that can allow them to plan, travel and pay for mobility services that best fit their needs;

— evolution of transportation in regions from an isolated, stove-piped network of public transit, toll, parking, taxi, and other transportation services to a more integrated, multi-modal, convergence of publicly delivered and privately delivered mobility services;

— addressing the new mobility ecosystem in grass roots partnerships between public transport and shared mobility services, as well as through mobile mobility and demand management application providers that provide multi-modal trip planning, targeted traveller information, and mobile payment.

The issues for the proposition of G-ITS standards are as follows:

— **Vehicles**:

Vehicles which rely on plug-in electricity for their primary energy, whether or not they have an auxiliary internal combustion engine for range extension or for keeping the battery charged up (electric vehicles, plug-in hybrid electric vehicles, and fuel cell electric vehicles), and which is not necessarily limited to cars, but embraces power-two-wheelers, vans, quadricycles (personal mobility), etc.

— **Infrastructure**:

Roadway facilities related to eco-mobility vehicles, users, and management, i.e. charging stations, parking zones, eco-mobility designated roadway for driving, carbon free zones, etc.

— **Management**:

Transportation management by national authorities and local municipalities for supporting the introduction of such eco-mobility, giving them specific fiscal treatment or favouring their use over conventional cars (parking facilities, access to restricted urban areas, access to bus lanes, etc.), with respect to eco-mobility performance measures and evaluation methods, business models and use cases, services, operation and management, and interfaces between centers, infrastructure, vehicles, and users.

— **Users**:

Seamless traveller eco-mobility services with traveller information, open payment system with green "points".

— **Commercial/Public transport vehicles**:

Green functions, green measures, green services and interfaces between infrastructure, mobile, centers, and public and commercial vehicles.

6 Use case overview and definitions

The main purpose for developing standards is to define the service platform with the related use cases.

6.1 Use case overview

6.1.1 Basic principles for use cases

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

— the use cases of G-ITS services describe the interaction between the conventional ITS services and eco-mobility for eco transport systems and services based on eco vehicles and their related facilities;

— the use cases in this document define a sample case to G-ITS services for transport users including drivers, public transport trippers, and pedestrians, which are applicable for any personal ITS station.

The G-ITS services may include the following group of use cases:

— **eco-driving:** EV driving, on-trip eco driving support, post-trip eco driving notice, intelligent speed adaptation, idle stop, cooperative adaptive cruise control (CACC), etc.;

— **eco-traffic management:** traffic signal coordination, adaptive signal control, variable speed limit, ramp metering, incident management, etc.;

— **eco-mobility service:** car sharing, last mile connecting, bike sharing, ride sharing, EV charging information, etc.;

— **eco-information, navigation and guidance:** EV charging station, intermodal journey planning, eco routing and navigation, personalized multi-modal eco navigating, etc.;

— **eco-demand and access management:** variable/dynamic road pricing, variable parking fee charging, green travel mileage points, carbon free zones, park and ride guidance, etc.;

— **eco-freight and logistics:** electronic equipment identification, electronic registration and identification, variable/dynamic freight tolling, digital tachograph, etc.

6.1.2 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 case overview

# – Title of use case cluster	Brief description
1. Eco driving	This cluster specifies green ITS services focused on vehicle driving eco-friendly to reduce greenhouse gas development. It includes not only EV car driving itself but also combustion engine vehicle driving support. A few functions of reducing emissions while driving, i.e. intelligent speed adaptation and cooperative adaptive cruise control, should be included in this use case cluster. — UC 1.1 – Electric vehicle (EV) driving — UC 1.2 – On-trip eco driving support and post-trip eco driving notice — UC 1.3 – Intelligent speed adaptation — UC 1.4 – Idle stop — UC 1.5 – Cooperative cruise control system
2. Eco traffic management	This cluster describes traffic management issues with respect to green measures of effectiveness (MOE) in transportation, which may reduce traffic congestion in transport networks. These use cases are designed to provide smooth traffic flow by preventing inefficient waiting time on roadways due to heavy traffic congestion. — UC 2.1 – Traffic signal coordination — UC 2.2 – Adaptive signal control — UC 2.3 – Variable speed limit — UC 2.4 – Ramp metering — UC 2.5 – Incident management
3. Eco mobility service	This cluster deals with consumers who can avail themselves of various mobility services through the use of mobile applications or web interfaces through nomadic devices that can allow them to plan, travel and pay for mobility services that best fit their needs. — UC 3.1 – Car sharing or bike sharing — UC 3.2 – Last mile or first mile connecting — UC 3.3 – Ride sharing — UC 3.4 – EV charging information — UC 3.5 – Mobility as a service or mobility on demand — UC 3.6 – Mobile all transit

Table 1 *(continued)*

# – Title of use case cluster	Brief description
4. Eco information, navigation and guidance	This cluster describes information provision to drivers. — UC 4.1 – EV charging station — UC 4.2 – Intermodal journey planning — UC 4.3 – Route guidance and navigation — UC 4.4 – Personalized multi-modal navigating
5. Eco demand and access management	This cluster specifies a few policy issues for controlling traffic demand and management in order to reduce the number of vehicles accessing a specific area. — UC 5.1 – Variable/dynamic road pricing — UC 5.2 – Variable parking fee charging — UC 5.3 – Green travel mileage points — UC 5.4 – Carbon free zones setting and management — UC 5.5 – Park and ride guidance
6. Eco freight and logistics	This cluster describes specific services for freight and/or commercial vehicle operation in order to monitor and manage vehicles accessing a specific area. — UC 6.1 – Electronic registration identification — UC 6.2 – Variable/dynamic freight tolling — UC 6.3 – Electronic equipment identification — UC 6.4 – Digital tachograph

The detailed definition of each use case is defined in 6.2.

6.2 Use case definition

6.2.1 Use case cluster 1: Eco driving

6.2.1.1 Electric vehicle (EV) driving

Table 2 — UC 1.1 EV driving

Use case name	EV driving
Actor	EV driver, nomadic device, cloud server
Goal	Eco driving identification and notification through EV
Use case input	EV identification
Use case output	EV driving notification
Brief description	Electric vehicle (EV) uses one or more electric motors or traction motors for propulsion, that could not produce air pollution during the operation compared to the internal combustion engine (ICE) cars. This information may include: — Vehicle Identification Number (VIN); — EV driving mileage.

6.2.1.2 On-trip eco driving support and post-trip eco driving notice

Table 3 — UC 1.2 On-trip eco driving support and post-trip eco driving notice

Use case name	On-trip eco driving support and post-trip eco driving notice
Actor	Vehicle driver, nomadic device, cloud server
Goal	Eco driving identification and notification through eco driving requests
Use case input	Eco driving request by nomadic device
Use case output	Eco driving display and notification
Brief description	On-trip eco driving support might provide drivers with better fuel efficiency while driving by combining several one mile trips by reducing the number of engine stops, following the speed limit, maintaining the vehicles, etc. This information may include: — Vehicle Identification Number (VIN); — Drivers' requests for eco-driving modes.

6.2.1.3 Intelligent speed adaptation (ISA)

Table 4 — UC 1.3 Intelligent speed adaptation (ISA)

Use case name	Intelligent speed adaptation (ISA)
Actor	Vehicle driver, nomadic device, roadside equipment (RSE), cloud server
Goal	Eco driving identification and notification through ISA
Use case input	ISA operation
Use case output	Eco driving display and notification
Brief description	Intelligent speed adaptation (ISA) is an in-vehicle system that supports drivers' compliance with the speed limit. It might be considered as an eco-driving function that increases fuel efficiency while driving. This information may include: — Vehicle Identification Number (VIN); — Activation and deactivation of ISA while driving.

6.2.1.4 Idle stop

Table 5 — UC 1.4 Idle stop

Use case name	Idle stop
Actor	Vehicle driver, nomadic device, cloud server
Goal	Eco driving identification and notification through idle stop
Use case input	Idle stop operation
Use case output	Eco driving display and notification
Brief description	Automatically stops and restarts the engine to help maximize the fuel economy, depending on environmental and vehicle conditions. Activating auto idle stop when the vehicle stops with the gear position in Drive (D) and the brake pedal is pressed, the engine turns off and the auto idle stop indicator appears if conditions permit. This information may include: — Vehicle Identification Number (VIN); — Activation and deactivation of auto idle stop when vehicle stops.

6.2.1.5 Cooperative adaptive cruise control (CACC) system

Table 6 — UC 1.5 Cooperative adaptive cruise control (CACC) system

Use case name	Cooperative adaptive cruise control (CACC) system
Actor	Vehicle driver, nomadic device, cloud server
Goal	Eco driving identification and notification through CACC
Use case input	CACC operation
Use case output	Eco driving display and notification
Brief description	Cooperative Adaptive Cruise Control (CACC) is an extension to the Adaptive Cruise Control (ACC) system, which realizes longitudinal automated vehicle control utilizing DSRC or WAVE technology providing connectivity between vehicle and infrastructure (V2I). CACC may improve stability and fuel efficiency by reducing the delay of the response to the preceding vehicle. This information may include: — Vehicle Identification Number (VIN); — Activation and deactivation of CACC.

6.2.2 Use case cluster 2: Eco traffic management

6.2.2.1 Traffic signal coordination

Table 7 — UC 2.1 Traffic signal coordination

Use case name	Traffic signal coordination
Actor	Local signal controllers, central controller
Goal	Eco traffic management by traffic signal coordination to facilitate smooth traffic flow
Use case input	Signal coordination phasing
Use case output	Effectiveness of traffic flow
Brief description	Traffic signal coordination is a method of timing groups of traffic signals along an arterial to provide for the smooth movement of traffic with minimal stops. The coordination of traffic signals to facilitate smooth traffic flow (progressed movement) along a corridor is one type of eco traffic management in urban networks. The quality of the resulting progression is a function of the spacing of the signals, the prevailing speed, and the amount of traffic coming in and out of driveways between traffic signals, the uniformity of intersection sizes, and the traffic signal cycle length. This information may include: — Green signal progression; — Signal phasing and timing (SPaT).

6.2.2.2 Adaptive signal control

Table 8 — UC 2.2 Adaptive signal control

Use case name	Adaptive signal control
Actor	Local signal controllers, central controller, vehicle detection system
Goal	Eco traffic management by adaptive signal control based on actual traffic demand
Use case input	Green phasing and timing
Use case output	Effectiveness of traffic flow
Brief description	Adaptive traffic control is an eco-traffic management strategy in which traffic signal phasing and timing changes or adapts based on actual traffic demand utilizing a vehicle detection system installed in the signal intersections. This information may include: — Vehicle detection system; — Signal phasing and timing (SPaT).

6.2.2.3 Variable speed limit

Table 9 — UC 2.3 Variable speed limit

Use case name	Variable speed limit
Actor	Central traffic management system, vehicle detection system, variable message sign
Goal	Eco traffic management by variable speed limit on major arterials
Use case input	Variable speed limit
Use case output	Effectiveness of traffic flow
Brief description	Variable speed limits are applied on major arterials as an element of controlled traffic management to improve traffic flows for certain prevailing conditions in response to weather, traffic levels, time of day or for other reasons with the currently applicable speed limit displayed using a variable message sign. This information may include: — Variable speed limit; — Variable message sign.

6.2.2.4 Ramp metering

Table 10 — UC 2.4 Ramp metering

Use case name	Ramp metering
Actor	Central traffic control system, local control system, vehicle detection system
Goal	Eco traffic management by ramp metering on highways
Use case input	Ramp metering signal and timing
Use case output	Effectiveness of traffic flow
Brief description	Ramp metering is the use of traffic signals at highway on-ramps to manage the rate of automobiles entering the highway as a proven technology in decreasing traffic congestion on highways by reducing demand and by breaking up platoons of vehicle. This information may include: — Traffic signals on ramp; — Ramp metering timing.

6.2.2.5 Incident management

Table 11 — UC 2.5 Incident management

Use case name	Incident management
Actor	Central traffic control system, incident detection system
Goal	Eco traffic management by incident management on highways
Use case input	Incident detection
Use case output	Effectiveness of traffic flow
Brief description	Traffic incident management is a planned and coordinated traffic management technology to detect, respond to, and remove traffic incidents and restore traffic capacity as safely and quickly as possible in some sections of highway. This information may include: — Incident detection and management; — Incident information provision.

6.2.3 Use case cluster 3: Eco mobility service

6.2.3.1 Car sharing or bike sharing

Table 12 — UC 3.1 Car sharing or bike sharing

Use case name	Car sharing or bike sharing
Actor	EV car sharing provider, car sharing user, nomadic device, cloud server
Goal	Eco mobility service by car or bike sharing
Use case input	Eco mobility service request by car sharing or bike sharing
Use case output	Eco mobility utilization by car sharing
Brief description	Car sharing or bike sharing utilizing electric vehicles is a model of an eco mobility service where people rent cars for short periods of time, often by the hour, which is attractive to customers who make only occasional use of a vehicle, as well as others who would like occasional access to a vehicle of a different type than they use day-to-day. This information may include: — Car sharing or bike sharing request; — Eco mobility service provision.

6.2.3.2 Last mile or first mile connecting

Table 13 — UC 3.2 Last mile or first mile connecting

Use case name	Last mile or first mile connecting
Actor	EV last mile connecting provider and/or user, nomadic device, cloud server
Goal	Eco mobility service by last mile or first mile connecting
Use case input	Eco mobility service request by last mile or first mile connecting
Use case output	Eco mobility utilization by last mile or first mile connecting
Brief description	Last mile and/or first mile connecting utilizing electric vehicles is a model of an eco mobility service where people rent cars to connect to their destinations right after getting off public transport in the hub, e.g. bus stops, terminals, train stations, etc. and/or from their original point of departure before getting on public transport. This information may include: — Last mile or first mile connecting request; — Eco mobility service provision.

6.2.3.3 Ride sharing

Table 14 — UC 3.3 Ride sharing

Use case name	Ride sharing
Actor	Ride sharing provider, ride sharing user, nomadic device, cloud server
Goal	Eco mobility service by ride sharing
Use case input	Eco mobility service request by ride sharing
Use case output	Eco mobility utilization by ride sharing
Brief description	Ride sharing utilizing electric vehicles is a type of carpooling as a way to better utilize the empty seats in most passenger cars, thus lowering fuel usage and transport costs, which is considered a model of an eco mobility service. Ridesharing is also capable of serving one-time trips, not only recurrent commute trips or scheduled trips. This information may include: — Ride sharing request; — Eco mobility service provision.

6.2.3.4 EV charging information

Table 15 — UC 3.4 EV charging information

Use case name	EV charging information
Actor	EV charging provider, EV driver, nomadic device, cloud server
Goal	Eco mobility service by EV charging information
Use case input	EV charging request
Use case output	EV charging information
Brief description	EV charging stations are on-street facilities provided by electric utility companies or located at retail shopping centers, and operated by many public or private companies. Charging station information includes locations, types of electric charging connector, availability of charging and charging time, etc. This information may include: — EV charging station information requests; — Charging station location, types of charging connector, availability of charging.

6.2.3.5 Mobility as a service or mobility on demand

Table 16 — UC 3.5 Mobility as a service or mobility on demand

Use case name	Mobility as a service (MaaS) or mobility on demand (MoD)
Actor	MaaS or MoD provider, nomadic device, cloud server
Goal	Eco mobility service by MaaS or MoD
Use case input	Eco mobility service request by nomadic devices
Use case output	Eco mobility utilization
Brief description	Mobility as a service (MaaS) describes a shift away from personally owned modes of transportation and towards mobility solutions that are consumed as a service. This is enabled by combining transportation services from public and private transportation providers through a unified gateway that creates and manages the trip, which users can pay for with a single account. The key concept behind MaaS is to offer the travellers mobility solutions based on travel needs. This information may include: — MaaS or MoD requests; — Eco mobility service provision.

6.2.3.6 Mobile all transit

Table 17 — UC 3.6 Mobile all transit

Use case name	Mobile all transit (MaT)
Actor	MaT provider, nomadic device, cloud server
Goal	Eco mobility service by MaT
Use case input	Eco mobility service request by nomadic devices
Use case output	Eco mobility utilization
Brief description	Mobile all transit (MaT), a model similar to MaaS describes a shift away from personally owned modes of transportation and towards mobility solutions that are consumed as a service. This is enabled in Korea by combining transportation services from public and private transportation providers through a unified gateway that creates and manages the trip, which users can pay for with a single account. This information may include: — MaT requests; — Eco mobility service provision.

6.2.4 Use case cluster 4: Eco information, navigation and guidance

6.2.4.1 EV charging station

Table 18 — UC 4.1 EV charging station

Use case name	EV charging station
Actor	EV charging provider, EV driver, nomadic device
Goal	Eco information, navigation and guidance by EV charging
Use case input	EV charging station information
Use case output	Eco information, navigation and guidance
Brief description	EV charging station information including locations, types of electric charging connector, availability of charging and charging time, etc. on digital map is to be provided to EV driver who utilizes it to make a decision of route guidance and intermodal connection. This information may include: — EV charging information; — Eco navigation and route guidance.

6.2.4.2 Intermodal journey planning

Table 19 — UC 4.2 Intermodal journey planning

Use case name	Intermodal journey planning
Actor	Public transport provider, nomadic device
Goal	Eco information, navigation and guidance by intermodal journey planning
Use case input	Intermodal journey planning information
Use case output	Eco route guidance and journey planner
Brief description	Intermodal journey planning involves using two or more transport modes in a journey. Travellers can choose a smart way to complete the trip by taking the options of a variety of intermodal journey planners that have been devised to help travellers to plan and schedule their route guidance, where they reduce dependence on driving vehicles as the major mode of ground transportation and increase the use of public transport. This information may include: — Intermodal journey planning information; — Eco route guidance and journey planner.

6.2.4.3 Route guidance and navigation

Table 20 — UC 4.3 Route guidance and navigation

Use case name	Route guidance and navigation
Actor	In-vehicle navigation, nomadic device
Goal	Eco information, navigation and guidance by in-vehicle navigation
Use case input	Eco route guidance requests
Use case output	Eco route guidance and navigation
Brief description	Eco route guidance and navigation may require a driver to enter a destination code into the in-vehicle system in terms of eco measures prior to time and cost measures. This information may include: — Route guidance information; — Eco route guidance and navigation.

6.2.4.4 Personalized multi-modal navigating

Table 21 — UC 4.4 Personalized multi-modal navigating

Use case name	Personalized multi-modal navigating
Actor	Public transport provider, nomadic device
Goal	Eco information, navigation and guidance by personalized multi-modal navigating
Use case input	Multi-modal connecting preference
Use case output	Personalized eco route guidance and journey planner
Brief description	Personalized multi-modal navigating is capable of planning with the full spectrum of mobility services; combining individual and collective, fixed-schedule as well as on-demand modes of transport, while taking into account individual user preferences and the availability of transport services. Also, it is able to personalize journey planning for each individual user by employing a recommendation engine that builds a contextual model of the user from the observation of user's past travel choices. This information may include: — User preferences; — Personalized eco route guidance and journey planner.

6.2.5 Use case cluster 5: Eco demand and access management

6.2.5.1 Variable/dynamic road pricing

Table 22 — UC 5.1 Variable/dynamic road pricing

Use case name	Variable/dynamic road pricing
Actor	Traffic management centre, nomadic device
Goal	Eco demand and access management through road pricing
Use case input	Road pricing strategy
Use case output	Eco demand management
Brief description	Variable and/or dynamic road pricing is designed to discourage use of certain classes of vehicles, fuel sources or more polluting vehicles with respect to time and location. It may be used primarily for revenue generation, usually for road infrastructure financing, or as a transportation management tool to reduce peak hour travel demand and the associated traffic congestion or other social and environmental effects related to road driving such as air pollution, greenhouse gas emissions, noise and road accidents. This information may include: — Road pricing by time and location; — Eco demand control information.