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Intelligent transport systems (ITS) — Network based precise positioning infrastructure for land transportation —

Part 1: General information and use case definitions

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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).

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For an explanation of 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 www.iso.org/iso/foreword.html.

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

A list of all parts in the ISO 22086 series can be found on the ISO website.

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Introduction

This document provides the framework guidelines to identify lane-level positioning technologies with the land transportation service requirements and related standards required to deploy, manage, and operate network-based precise positioning infrastructure for land transportation. The purpose of the system is to generate and transmit the GNSS correction and integrity information to land transportation users including drivers, pedestrians, riders, etc. in order to enable them to perform lane-level positioning with low-cost GNSS receivers on nomadic devices at a high confidence level. The system design following the requirements of ITS and automotive services that are closely related to traffic safety and traffic efficiency is defined.

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Intelligent transport systems (ITS) — Network based precise positioning infrastructure for land transportation —

Part 1: General information and use case definitions

1 Scope

This document provides the framework guidelines on technologies related to the network-based precise positioning infrastructure for land transportation (NETPPI-LT) that allows land transportation users or objects carrying nomadic devices, equipped with low-cost global navigation satellite systems (GNSS) receivers and wireless communication transceivers, to perform lane-level positioning and integrity monitoring. These technologies will unlock enhanced intelligent transport systems (ITS) services and applications and will increase traffic operation/management efficiencies and traffic safety by reducing economic and social costs from traffic jams, traffic accidents, and environmental pollution.

The framework described in this document includes:

— reference architecture for the NETPPI-LT enabling lane-level positioning and integrity monitoring on personal ITS devices;

— guidelines for providing a real-time lane-level positioning service based on GNSS with the aid of the NETPPI-LT;

— guidelines to facilitate the practical implementation of the NETPPI-LT for engineers including related use cases.

2 Normative references

There are no normative references in this document.

3 Terms, definitions 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
reference station
implementation of a NETPPI-LT subsystem which captures signals/data from visible GNSS satellites and monitoring information (pressure, temperature, humidity, image, etc.) at a known position with clear sky view and no radio interferences, and includes wired or wireless links to send the collected data to the control station

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3.1.2
control station
implementation of a NETPPI-LT subsystem which generates the GNSS carrier phase measurement correction and integrity information based on the information received from multiple reference stations, and sends the correction and integrity information to wireless communication/broadcast systems (cellular networks, WAVE, DMB, etc.) for data transmission to drivers or pedestrians with nomadic devices

3.1.3
monitoring station
implementation of a NETPPI-LT subsystem which tests validity of the information, originated by the control station, and gives feedback to the control station for the system management

3.1.4
base station
implementation of a NETPPI-LT subsystem which is a part of wireless communication/broadcast systems and provides the correction and integrity information, originated by the control station, to drivers or pedestrians carrying nomadic devices

3.1.5
nomadic device
implementation of any type of nomadic device which captures carrier phase measurements for ranging to visible GNSS satellites, receives the correction and integrity information, originated by the control station, via wireless links including cellular networks (LTE families, 5G), WAVE, DSRC, DAB, DMB, etc., and determines its own position along with integrity by using the received data

3.2 Abbreviated terms

5G	fifth-generation mobile communications
C-ITS-S	central intelligent transportation system station
DAB	digital audio broadcasting
DMB	digital multimedia broadcasting
DSRC	dedicated short-range communications
GNSS	global navigation satellite systems
IMU	inertial measurement unit
ITS	intelligent transportation system
LTE	long term evolution
NETPPI-LT	network based precise positioning infrastructure for land transportation
R-ITS-S	roadside intelligent transportation system station
RTCA	Radio Technical Commission for Aeronautics
RTCM	Radio Technical Commission for Maritime Services
WAVE	wireless access for vehicular environment

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V2I vehicle-to-infrastructure

V2V vehicle-to-vehicle

V2X vehicle-to-everything

4 Document overview and structure

This document provides all documents and references required to support the implementation of the requirements related to GNSS-based positioning with lane-level accuracy on nomadic devices. This series of standards consists of the following parts.

— 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[1)]: Functional requirements and data interface

This part provides functional requirements of nomadic devices for the NETPPI-LT services and data interface between the infrastructure side and nomadic device.

5 General information

5.1 Purpose of this document

This document addresses three major areas:

— Identify the requirements of application level framework for the NETPPI-LT (lane-level positioning and integrity monitoring) services that can be frequently inserted, modified, and deleted;

— Identify the general information for all subjects related to the NETPPI-LT services from the perspectives of infrastructure and personal station (nomadic device);

— Specify the general use cases that should be included for the NETPPI-LT services.

5.2 Overview of NETPPI-LT

Existing ITS services and applications require road-level (meter) positioning accuracy, and commercial nomadic devices or ITS stations meet this requirement with low-cost standalone GNSS receivers that exploit code phase measurements for ranging to the satellites and may have the aid of mobile networks.

Emerging ITS services and vehicle technologies including autonomous vehicles, platooning, and collision avoidance demand lane-level (sub-meter) positioning accuracy, which cannot be achieved with the low-cost standalone GNSS receivers on the nomadic devices at a high level (95 % or more) of confidence. Integrity is another requirement to provide reliable services, but it cannot be provided on the standalone receivers.

The concept of the NETPPI-LT is to provide GNSS-based lane-level positioning and integrity monitoring services to land transportation users and objects carrying nomadic devices including cellular (smart) phones, navigators, etc. that are able to receive GNSS carrier phase measurements and to receive the GNSS correction and integrity information, originated by the control station, via wireless links (e.g. DAB, DMB, LTE, 5G, WAVE). The nomadic devices might be connected to external positioning personal stations that have the above functionalities. The correction information assists the nomadic devices to mitigate the effects of ionospheric and tropospheric delays, satellite clock errors, and ephemeris errors etc. in the range measurements. The integrity information provides reliability of the correction information and is used to determine integrity of the positioning result.

1) Under development. Current stage 0.00.

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