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Space systems — Global navigation satellite system (GNSS) receiver class codes

Systèmes spatiaux — Codification des récepteurs de systèmes mondiaux de satellites de navigation (GNSS)

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Foreword

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations.*

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

This document is a specification of downstream space-based services. Space systems provide a huge merit for the society and economy in each country today; and downstream space-based services contribute to people's quality of life across the world. Space systems should be utilized furthermore in the industry worldwide in the future. Space systems are utilized in other areas as well. Therefore, this document has harmonized the content in areas relevant to the global navigation satellite system (GNSS) as shown in Figure 1.

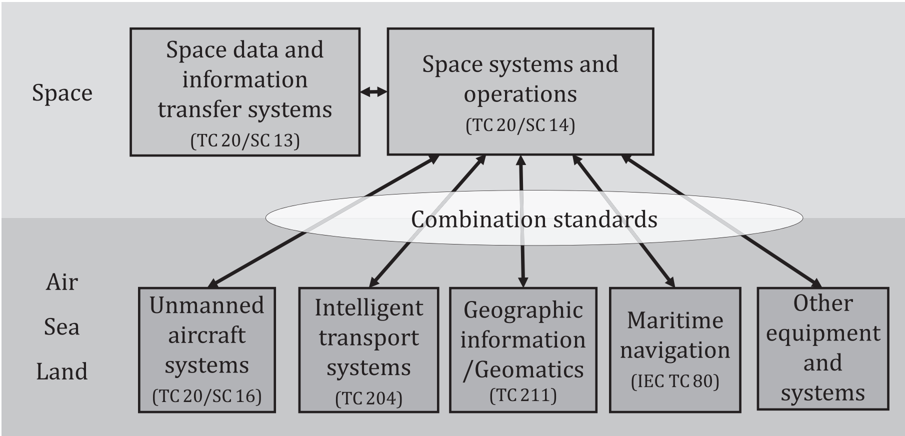

Figure 1 — Standardization of space-based services (GNSS-relevant areas)

In the initial decades of the 21st century, several countries have provided their constellations of GNSS, and it has been utilized as an international public service. GNSS technology has progressed and become more complicated, for example, to handle multiple frequencies from multiple constellations, and to provide services such as carrier-phase measurement, precise point positioning, and so on.

As a result, for users who want to try new GNSS technology, there are too many GNSS receivers to choose from to find the product matching their needs.

In order to solve this problem, a set of GNSS receiver class codes has been developed. It was released into the market as a trial program and has received high evaluation from GNSS stakeholders in commercial and governmental scenes in a certain region. It is recognized to be contributable to the promotion of GNSS utilization.

The set of GNSS receiver class codes facilitates easier choice for users and sales expansion for sellers; it also provides the direction of development and business strategies for manufactures and the framework of policy making for governments and public sectors.

This document aims to promote the utilization of GNSS receiver class codes in the international market for stakeholders of space-based positioning, navigation and timing services around the world.

The GNSS environment has been drastically improved and more widely used in recent years with the development GNSS space system infrastructure by several countries.

Against this background, GNSS receivers become diverse and accept multi-constellation. One receiver also equips various functions. There are receivers for specified regions and timing-dedicated receivers.

This document symbolizes "receiver class" to "codes" from the point of view of positioning, timing, and messaging functions. Regarding these functions, positioning is for determining the position, timing is for determining the time or time interval or both, and messaging is for transmitting or receiving message or both.

By using this document, it is expected that end users can understand the types of GNSS signal their devices receive from navigation satellites. On the other hand, receiver providers can easily present their products' features which depend on the signals of the receiver. Figure 2 represents the above effects.

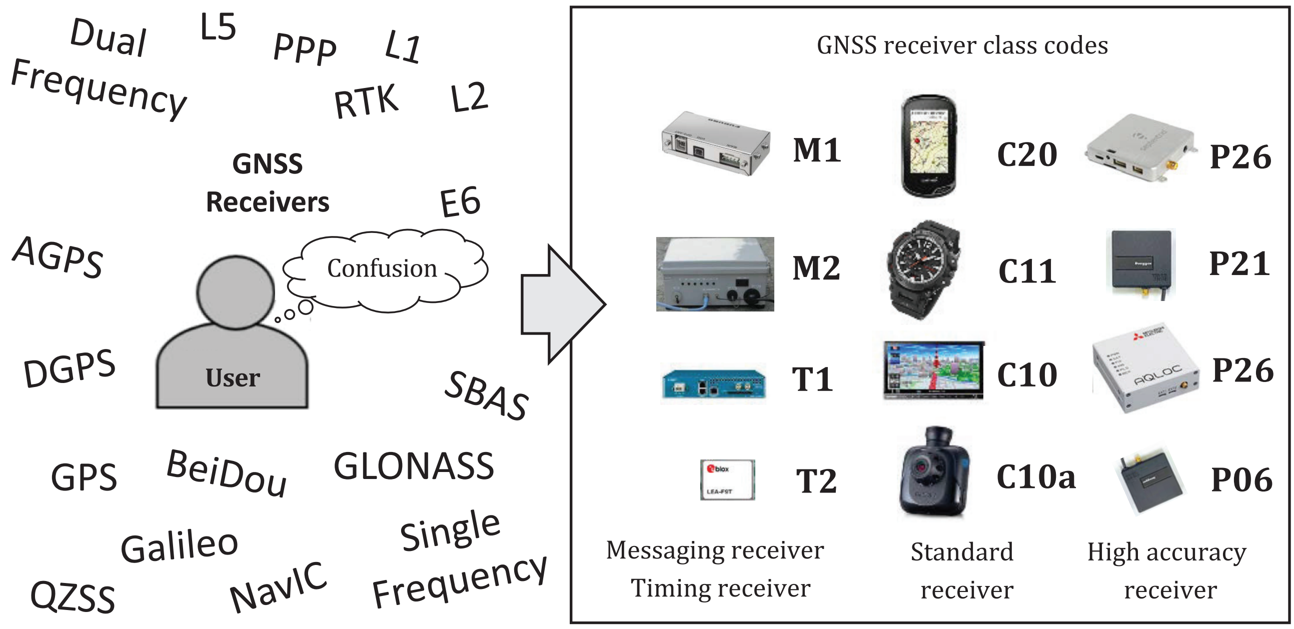

Figure 2 — GNSS receiver class codes for an efficient market

Some GNSS receivers are equipped with the following functions: detection of attitude, mobile communication using Wi-Fi, etc. This document does not treat these functions.

Space systems — Global navigation satellite system (GNSS) receiver class codes

1 Scope

This document specifies class codes to classify global navigation satellite system (GNSS) receivers. The class codes represent how signals transmitted from radionavigation satellites are processed.

This document applies to all types of GNSS receiver devices.

The class codes in this document are not applicable to the following items:

— condition of radionavigation satellites;

— radio propagation environment including multipath, masking and obstacle;

— additional antenna of a receiver device;

— additional application software in a receiver device.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
receiver
device (3.2) with associated antenna or including an antenna, used to select the desired radio-frequency signals from the incident radio-frequency radiation, to amplify them, demodulate them and if necessary, convert the recovered signals into a directly usable form

[SOURCE: IEC 60050-713:1998, 713-10-02, Modified — "such as sounds or pictures" has been deleted at the end of the definition.]

3.2
device
material element or assembly of such elements intended to perform a required function

Note 1 to entry: A device may form part of a larger device.

[SOURCE: IEC 60050-151:2001, 151-11-20]

3.3
GNSS receiver
receiver (3.1) to determine the user position, velocity, and/or precise time by processing the signals broadcasted by *radionavigation* (3.6) satellites

3.4
radiodetermination
determination of the position, velocity and/or other characteristics of an object, of the obtaining of information relating to these characteristics, by means of radio waves

[SOURCE: IEC 60050-725:1994, 725-12-48]

3.5
satellite radiodetermination
radiodetermination (3.4) which makes use of a satellite system

[SOURCE: IEC 60050-725:1994, 725-12-49]

3.6
radionavigation
radiodetermination (3.4) used for the purpose of navigation, including obstruction warning

[SOURCE: IEC 60050-725:1994, 725-12-50]

3.7
satellite radionavigation
satellite radiodetermination (3.5) used for *radionavigation* (3.6)

[SOURCE: IEC 60050-725:1994, 725-12-51]

3.8
code-based positioning
positioning based on code-phase measurement without integer ambiguity resolution

Note 1 to entry: A code-based positioning *receiver* (3.1) may be equipped with the carrier-smoothing function.

3.9
phase-range
range measured by using carrier-phase with integer ambiguity resolution

Note 1 to entry: See RTCM standard 10403.3, 3.5.

3.10
state space
space defined by the state variables as axes of a vector space, in which every vector represents a state of the system

[SOURCE: IEC 60050-351:2013, 351-41-09]

3.11
observation space
space defined by the observation variables as axes of a vector space, in which every vector represents a observation variable of the system

3.12
SSR
state space representation
representation of a valuable in a *state space* (3.10)

Note 1 to entry: See RTCM standard 10403.3, 3.5.13.

Note 2 to entry: SSR is a mathematically orthogonal representation of parameters.

3.13
OSR
observation space representation
representation of a valuable in an *observation space* (3.11)

Note 1 to entry: See RTCM standard 10403.3, 3.5.13.

3.14
GNSS authentication
function to authenticate the signal from GNSS

4 Abbreviated terms

3GPP	third generation partnership project (mobile communication)
BDS	BeiDou Navigation Satellite System (China)
BIM	building information modelling
CIM	construction information modelling
CORS	continuously operating reference station
DFMC	dual frequency and multi constellation
DGNSS	differential GNSS
GLONASS	NAvigation Satellite System (Russian Federation)
GNSS	global navigation satellite system
GPS	Global Positioning System (U.S.A.)
ICD	interface control document
ICG	International Committee on Global Navigation Satellite Systems (UN)
IMU	inertial measurement unit
LEO	low Earth orbit
LiDAR	light detection and ranging or laser imaging detection and ranging
LBS	location-based service
PPP	precise point positioning
QZSS	Quasi-Zenith Satellite System (Japan)
RTCM	Radio Technical Commission for Maritime Services
RTK	real-time kinematic GNSS positioning
SBAS	satellite based augmentation system
SSV	space service volume
TTFF	time to first fix
UAS	unmanned aircraft system

5 Code system

5.1 Positioning

5.1.1 General

The GNSS receiver class codes shall be specified as shown as Table 1. These codes are used not only satellite positioning, but also in satellite radionavigation.

Table 1 — Codes on positioning

Function		Ranging		Augmentation or correction	
C	Code-based positioning	**C1**	Single frequency ranging	**C10**	No augmentation
				C11	DGNSS OSR correction
				C16	SSR correction without fixed phase-range
		C2	Dual or multiple frequency ranging	**C20**	No augmentation
				C25	DFMC SBAS
				C26	SSR correction without fixed phase-range
P	Phase-range positioning	**P0**	No ranging	**P06**	Input: SSR correction Output: OSR correction
		P1	Single frequency ranging	**P11**	OSR correction
				P16	SSR correction
		P2	Dual or multiple frequency ranging	**P21**	OSR correction
				P26	SSR correction

Continuation of Table 1			
	Continuation of C1	**C10a**	C10 with authentication
		C11a	C11 with authentication
		C16a	C16 with authentication
	Continuation of C1	**C20a**	C20 with authentication
		C25a	C25 with authentication
		C26a	C26 with authentication
	Continuation of P0	**P06a**	P06 with authentication
	Continuation of P1	**P11a**	P11 with authentication
		P16a	P16 with authentication
	Continuation of P2	**P21a**	P21 with authentication
		P26a	P26 with authentication

Corrections have two types: OSR and SSR. SSR covers wider area than OSR. Further, these services shall provide integrity information.

OSR is a representation of correction in observation form such as pseudorange. It is represented as a factor in observation space, which is a mathematical vector space.

On the other hand, SSR is another representation of correction as error factors, such as satellite clock and orbit errors, signal bias, ionospheric error, which is a state in a state space, a mathematical vector space.

In this document, the correction that represents an error element is generically termed SSR. For example, the SBAS corrections may be termed SSR in this case. They are distinguished from RTCM SSR which was developed for the dissemination specific SSR information parameters. The SSR correction shall also include integrity information for users.

The OSR corrections are used in the method of RTK and network RTK GNSS positioning. The SSR corrections are used in the method of PPP and PPP-RTK

C16, C16a, C26 and C26a are examples as per ISO 18197:2015, 5.4.1, which explains that certain kind of positioning augmentation data are used for the meter-class augmentation or submeter-class augmentation.

See Annex A as use examples of the receiver class codes for positioning devices and terminals.

5.1.2 C10, C10a

Code C10 shall be applied to a GNSS receiver to:

— enable code-based point positioning;

— use single frequency ranging signal.

Code C10a shall be applied to the C10 receiver to be equipped with the GNSS authentication.

5.1.3 C11, C11a

Code C11 shall be applied to a GNSS receiver to:

— enable code-based positioning;

— use single frequency ranging signal;

— augmented using DGNSS OSR augmentation.

Code C10a shall be applied to the C11 receiver to be equipped with the GNSS authentication.

5.1.4 C16, C16a

Code C16 shall be applied to a GNSS receiver to:

— enable code-based positioning;

— use single frequency ranging signal;

— correct the positioning using SSR correction.

For example, the positioning using this class receiver is specified in ISO 18197:2015, 5.4.1.

Code C16a shall be applied to the C16 receiver to be equipped with the GNSS authentication.

5.1.5 C20, C20a

Code C20 shall be applied to a GNSS receiver to:

— enable point positioning;

— use dual or multiple frequency ranging signals.

Code C20a shall be applied to the C20 receiver to be equipped with the GNSS authentication.