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Space systems — Global Navigation Satellite System (GNSS) receiver class codes

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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 space-based services. Space systems provide a huge merit for the society and economy in each country today; and 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 the application of other areas. Therefore, this document has harmonized the content in the GNSS (global navigation satellite system) relevant area as shown in Figure 1

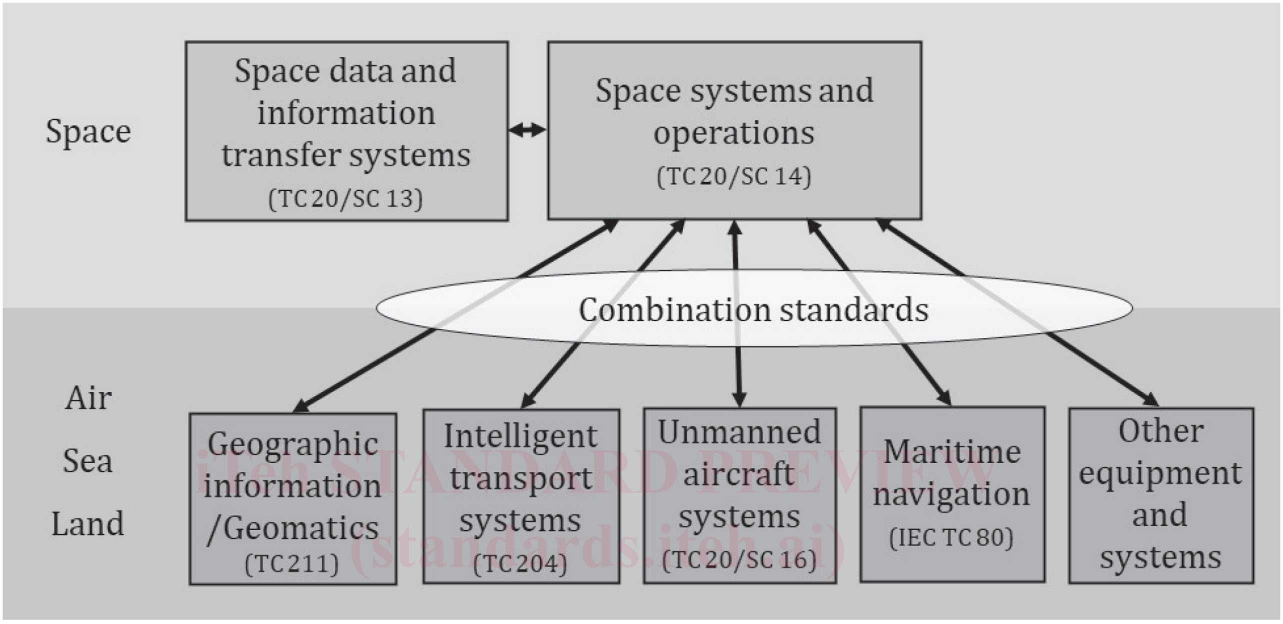

Figure 1 — Standardization of space-based services (GNSS relevant area)

In the initial decades of the 21st century, several countries have provided their constellations of Global Navigation Satellite System (GNSS), and it has been utilized as an international public service. GNSS technology has progressed and become complicated such as multi-frequency, multi-constellation, carrier-phase measurement, precise point positioning, and so on.

As a result, a chorus of users who want to try new GNSS technology is that GNSS receivers are too diverse to choose product matching their own needs.

To solve this problem, "GNSS receiver class codes" has been developed. It was applied into the actual 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.

"GNSS receiver class codes" provides easier choice for users, sales expansion for sellers, the direction of development and business strategies for manufactures, and the framework of policy making for governments and public sectors.

This document is intended to utilize "GNSS receiver class codes" in the international market, in order to promote the GNSS utilization for world stakeholders of space-based positioning, navigation and timing services.

The GNSS environment has been drastically improved, and its usages are increasing in recent years by the development of several countries of GNSS space system infrastructure.

In this background, GNSS receivers become diverse and accept multi-constellation. Only one receiver equips various functions. There are receivers for specified region and timing-dedicated receivers.

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

Through use of this document, it is expected that end-users can understand GNSS signal types which their devices receive from navigation satellites. On the other hand, receiver providers can easily present their products on signals of receiver.

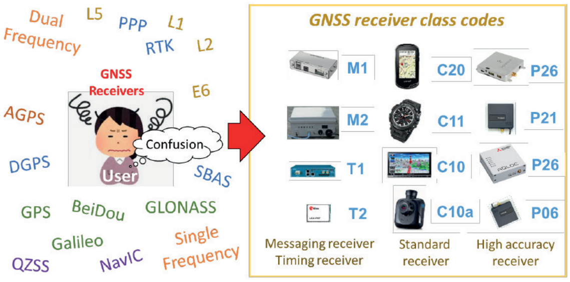

Figure 2 — GNSS receiver class codes for an efficient market

Some GNSS receivers equip 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 GNSS receivers. The class codes represent how are processed signals transmitted from radionavigation satellites.

This document applies all types of GNSS receiver devices.

The class codes in this document are not specific 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

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 18197:2015, *Space systems — Space based services requirements for centimetre class positioning*

3 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 https://www.electropedia.org/

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

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 60050-725:1994, 713-03-44, Modified – delete “such as sounds or pictures”]

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 60050-725:1994, 11-11-22]

3.3
GNSS receiver
receiver to determine the user position, velocity, and/or precise time by processing the signals broadcasted by radionavigation 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 may equip 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 60050-725:1994, 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
state space representation
SSR
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 mathematically orthogonal representation of parameters.

3.13
observation space representation
OSR
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 Modeling
CIM	Construction Information Modeling
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
NavIC	Navigation with Indian Constellation (India)
NMEA	National Marine Electronics Association (U.S.A.)
OSR	Observation Space Representation
PPP	Precise Point Positioning
QZSS	Quasi-Zenith Satellite System (Japan)
RTCA	Radio Technical Commission for Aeronautics
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

The GNSS receiver class codes shall be specified as shown as Table 1.

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(3.12) and SSR(3.13). 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 must be distinguished from RTCM SSR which is an international format standard developed by RTCM for the dissemination of 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. Regarding the frequency bands, Annex B can be referred.

5.1.1 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.

5.1.2 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.

5.1.3 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.

5.1.4 C20, C20a

Code C20 shall be applied to a GNSS receiver to

— enable point positioning,

— use dual or multiple frequency ranging signals.