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Rabat, Morocco
24-26 Feb 2025



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北京航空航天大學 BEIHANG UNIVERSITY

The Latest Development of BeiDou Navigation Satellite System

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24 February 2025

The Latest Development of BeiDou Navigation Satellite System

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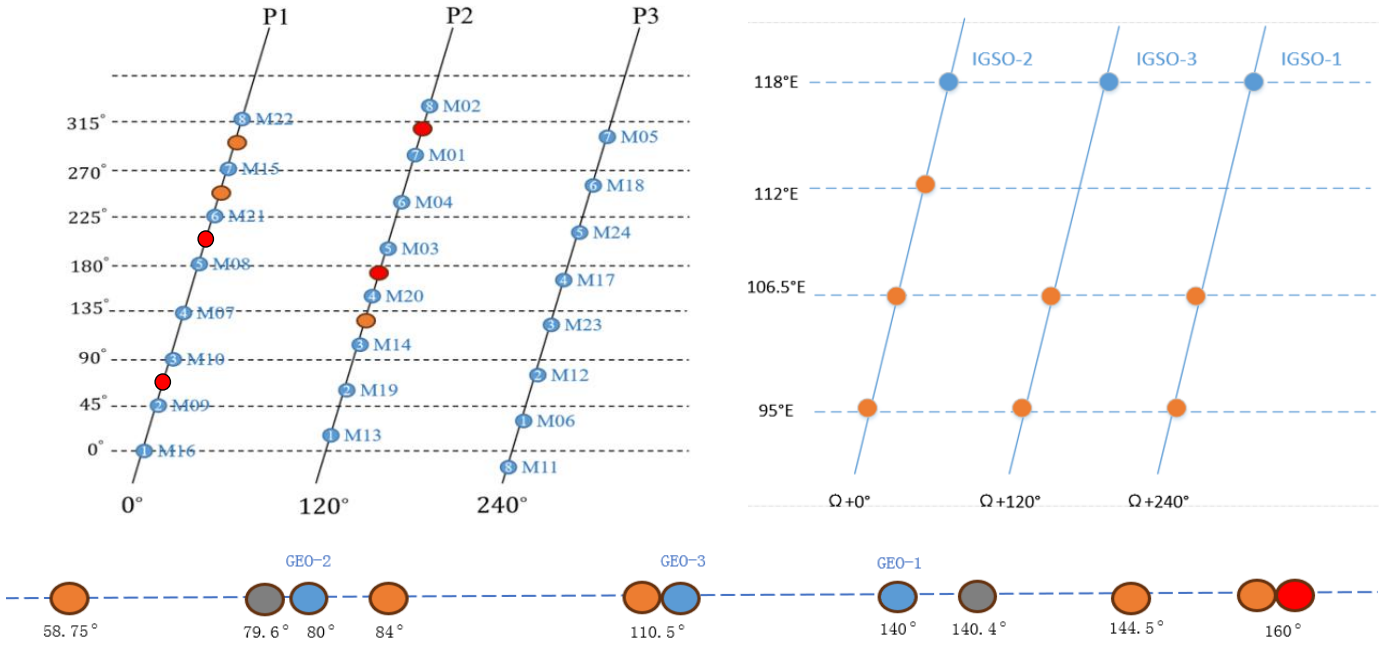
1 BDS Status

2 BDSBAS Status

1.1 BDS Constellation Status

A total of **50** satellites is operational in orbit

- **15** BDS-2 satellites
- **35** BDS-3 satellites (30 networking satellites, 5 satellites under in-orbit testing)



Off & Back-up | BDS-2 Satellites | BDS-3 Satellites | BDS-3 under in-orbit testing



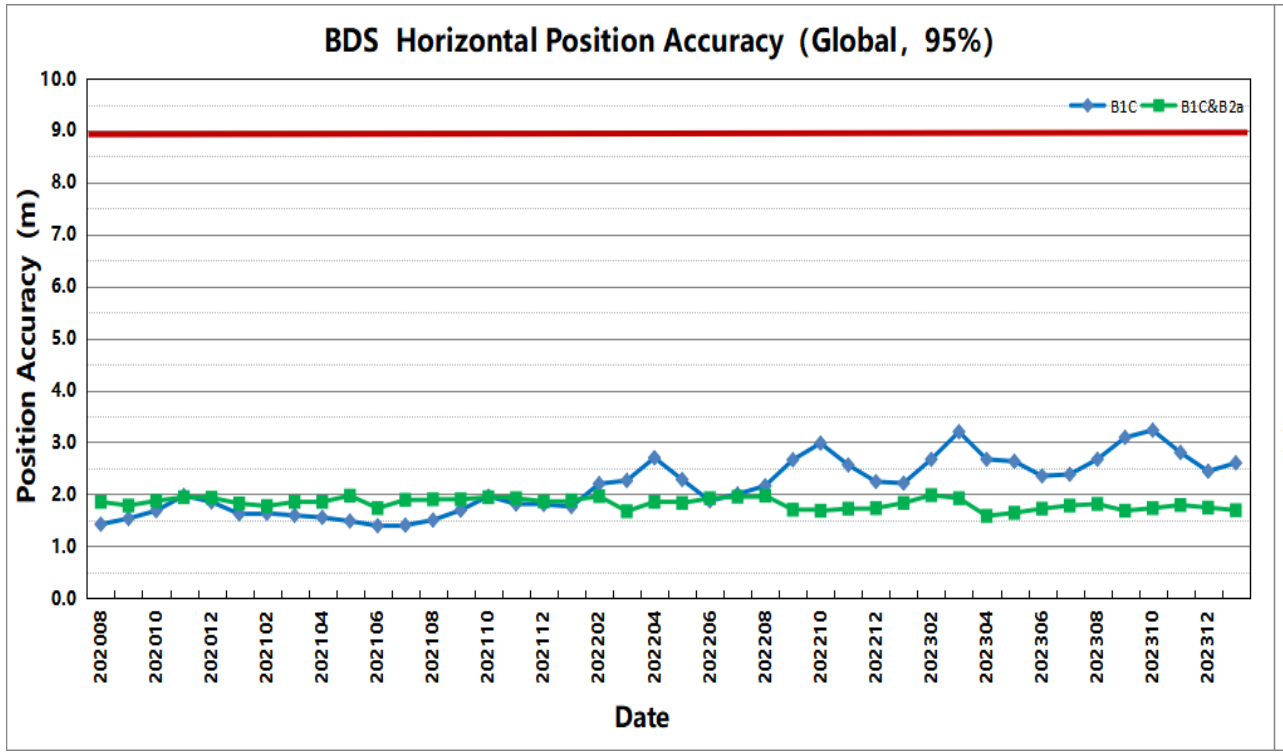
The 57th and 58th satellites for BDS were launched at Xichang on Dec 26, 2023

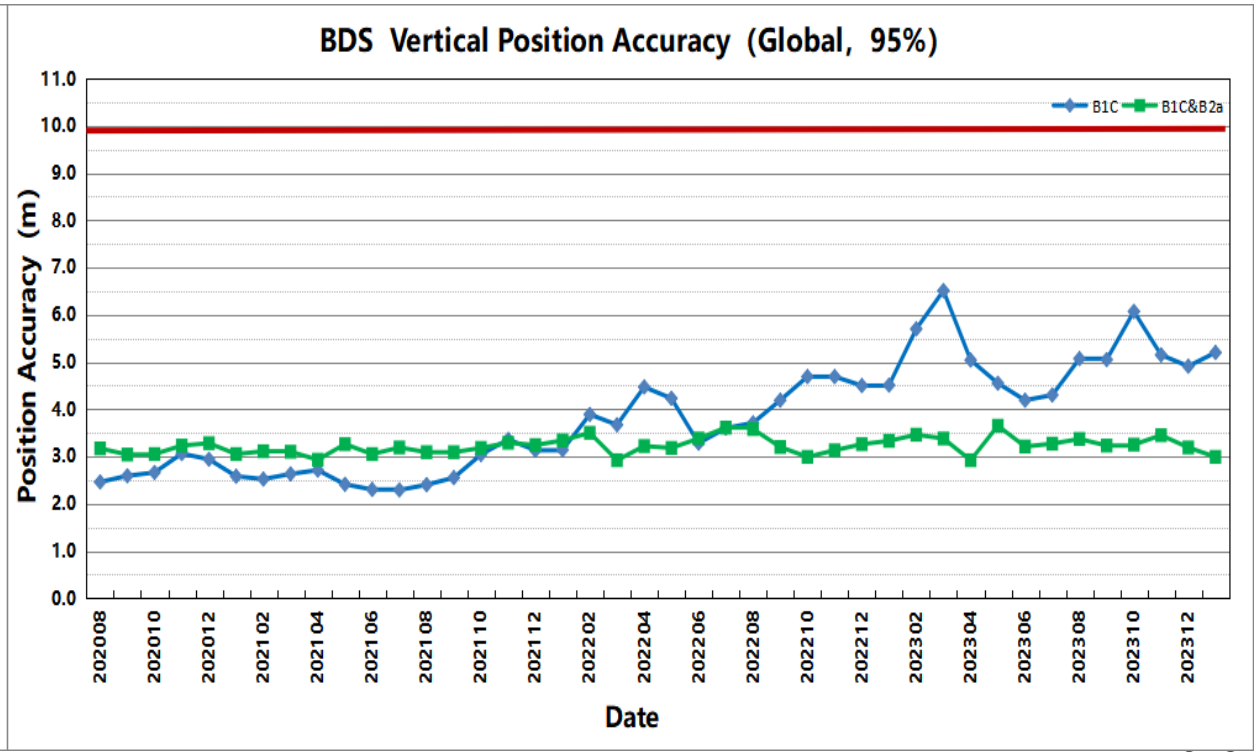


The 59th and 60th satellites for BDS were launched at Xichang on Sep 19, 2024

1.2 BDS Service Performance

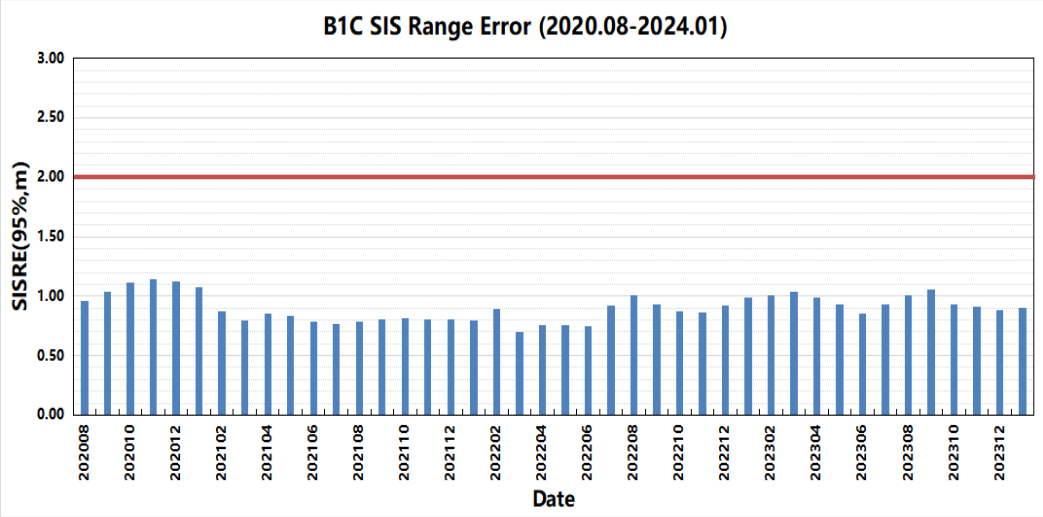
- BDS provides positioning, navigation and timing services for global users on the ground and 1,000 km above sea level
- **Accuracy**
  - **Horizontal**: better than **2 m**
  - **Vertical**: better than **4 m**

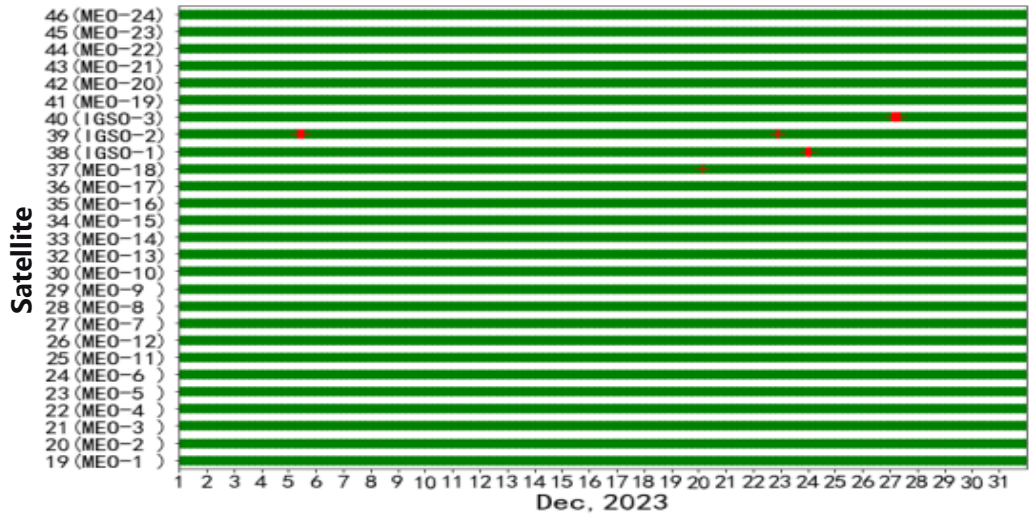


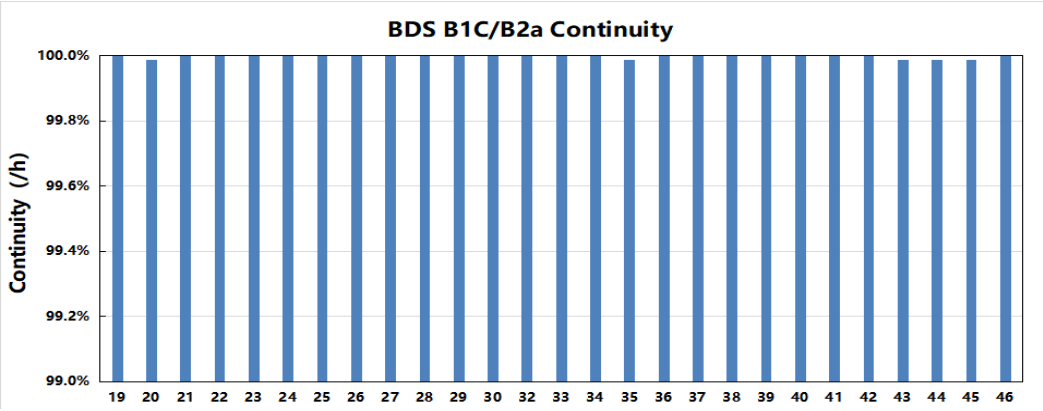


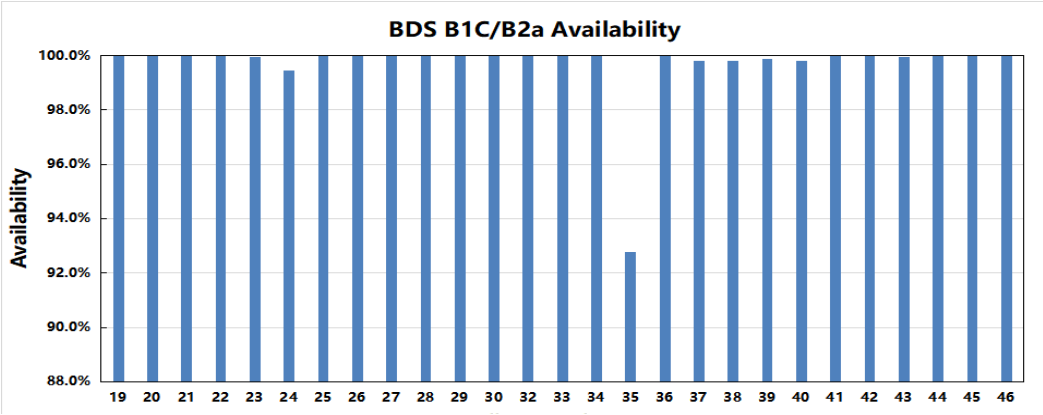
1.2 BDS Service Performance

- **Continuity**: 0.9998/h during 2023
- **Availability**: 0.9968 during 2023









1.3 BDS Global Short Message Communication

➢GSMC[1]

- **Coverage:** Global
- **Space Segment:** 14 MEO satellites support up link; 3 ISGO and 24 MEO support down link
- **Maximum length of a single message**: About 560 bits (40 Chinese characters per message)

	Performance Indicators[1]	Test Result
GSMC	Delay≤60s	16s





- **BDSMC used in the newly-launched Einstein Probe**

The Einstein Probe was launched in Jan 2024, where BDSMC used for wide-field-view sky survey



- **BDSMC used in China-France SVOM Joint Space Observatory**

Space-based multi-band astronomical Variable Objects Monitor launched in 2023, where BDSMC used for signal transmission and joint observation.



- **BDSMC used in China’s Space Station**

BDSMC sub-system launched with Mengtian experiment module into orbit in Oct 2022 to provide telemetry information transmission and emergency communication.



- **BDSMC used in GECAM Space Probe**

BDSMC used in Gravitational wave high-energy Electromagnetic Counterpart All-sky Monitor (GECAM) in 2021 to provide information transmission of space

[1] BeiDou Navigation Satellite System Open Service Performance Standard (Version 3.0), 2021.05

1.4 Regional Short Message Communication

➢ RSMC[1]

- **Coverage**: Asia-Pacific Region
- **Space Segment**: 3 GEO satellites (main) and 2 GEO satellites (Backup)
- **Maximum length of a single message** : 14,000 bits (around 1,000 Chinese characters)
- **Main functions**: search & rescue, location report, short message communication, etc.
- **Service Capability**: Up:12,000,000 times/h, Down: 6,000,000 times/h

	Performance Indicators[1]	Test Results
RSMC	Success Rate≥95% Delay≤2s	Success Rate: 99% Delay: 1s



In Nov. 2022, BDMSS was recognized by the International Maritime Organization (IMO) as the third global maritime distress and safety system (GMDSS)

Accelerating Commencement of BDS GMDSS

➢ Frequency Coordination of BDS GMDSS



Provisional regulations for BDMSS GMDSS service were approved during WRC-23 in December 2023.

➢ EGC Service Manual Review

- In September 2023, the 15th session of the International Hydrographic Organization World-wide Navigational Warning Service approved the review of BDMSS EGC service manual.
- In March 2024, Service Manual approved primary review by DRWG of IHO.
- In September 2024, IHO WWNWS 16th Meeting reviewed the Manual.



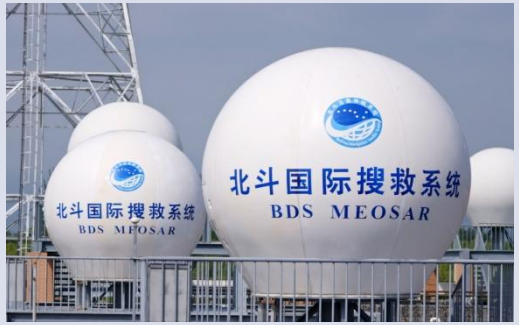
- ➢ **Developing BDS GMDSS Ship Earth Station**
- ➢ **Construction of the backup Master Control Station and Gateway and contingency arrangements with the main stations**
- ➢ **BDS GMDSS Operation Manual Drafted**
- ➢ **Accelerating signing PSA with IMSO**

[1] BeiDou Navigation Satellite System Open Service Performance Standard (Version 3.0), 2021.05

1.5 Search and Rescue

➢MEOSAR

In Nov. 2022, China formally becomes the provider of COSPAS-SARSAT space segment



Performance Characteristics	Performance Indicators[1]
Positioning Accuracy	≤5km
Detection Probability	≥99%
Availability	≥99%

Performance results better than indicators

➢Return Link



In October 2023, at the 69th session of the Open Council of COSPAS-SARSAT, the revised proposals related to the service of BDS RLS were considered and adopted, BDS RLS was incorporated into COSPAS-SARSAT

- Beacons supporting RLS developing
- Tested in cities of the northern, southern, eastern and western parts of China with an average delay of 11.26s
- Tested in Alexandria, Egypt with average delay 11.5s

Better than 2 mins indicator

Early Warning Service Information Broadcasting based on BDS RL

- Availability of broadcast of BDS RL personalized messages verified, and the ability to provide EWS confirmed.
- By equipment transformation, BDS RL EWS information broadcasting based on B2b message was tested, A 436 bits maximum capacity of personalized message and framing broadcast by every 4 frames supported with maximum 1440 bits, 11.33s delay, and 96.82% communication reliability.



Better than indicators

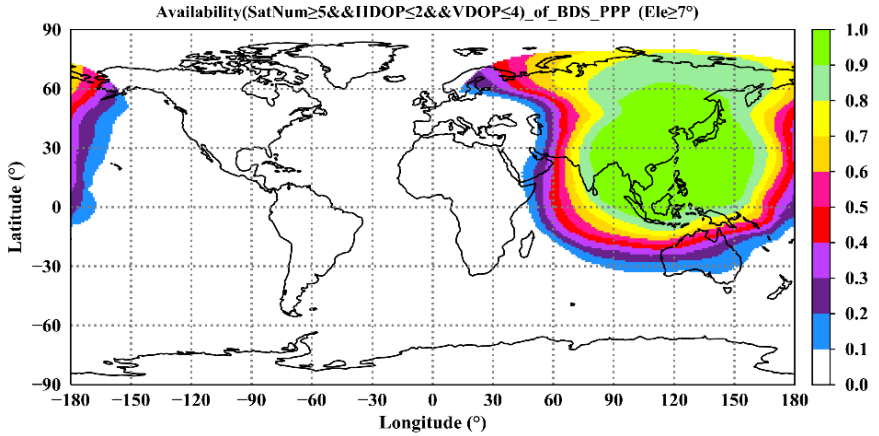
➢Potential Cooperation

- **RLS joint testing to be carried out globally**
- **RLS-based Two-way Communication Service to be developed**
- **Global service to be formally commissioned for global users**
- **Evolution and Innovation to be pushed forward for BDS MEOSAR**

[1] BeiDou Navigation Satellite System Open Service Performance Standard (Version 3.0), 2021.05

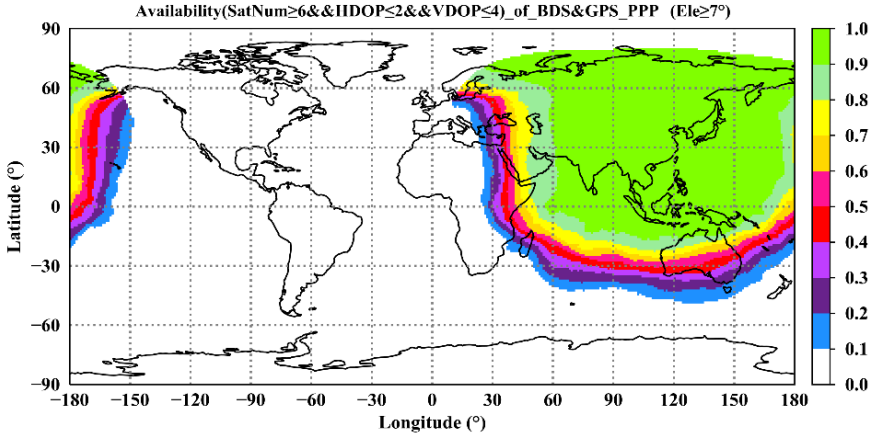
1.6 Precise Point Positioning

➢ Coverage: Asia-Pacific Region



BDS PPP availability

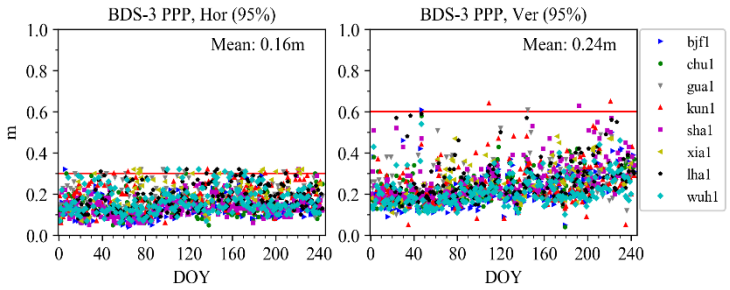
Sat numbers≥5，HDOP≤2 & VDOP ≤ 4

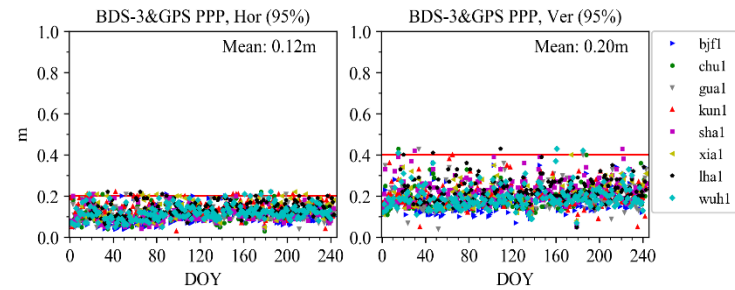


BDS+GPS PPP availability

Sat numbers≥6，HDOP≤2 & VDOP ≤ 4

➢ Positioning accuracy and convergence time





Station	BDS-3 PPP			BDS-3&GPS PPP		
	Hor/m	Ver/m	convergence time/min	Hor/m	Ver/m	convergence time/min
BJF1	0.14	0.20	15.6	0.10	0.19	11.2
CHU1	0.15	0.21	18.7	0.11	0.21	12.8
GUA1	0.20	0.26	22.0	0.13	0.23	13.2
KUN1	0.17	0.25	18.1	0.14	0.23	9.8
LHA1	0.20	0.26	22.8	0.13	0.23	10.9
SHA1	0.13	0.25	12.7	0.09	0.21	9.4
WUH1	0.17	0.22	15.8	0.11	0.19	8.1
XIA1	0.19	0.22	14.5	0.10	0.20	8.8
Mean value	**0.17**	**0.23**	**17.5**	**0.11**	**0.21**	**10.4**

- **BDS**

  Positioning accuracy: H (95%) 0.16m, V (95%) 0.22m

  Convergence time: 19.8 mins better than 30 mins requirement

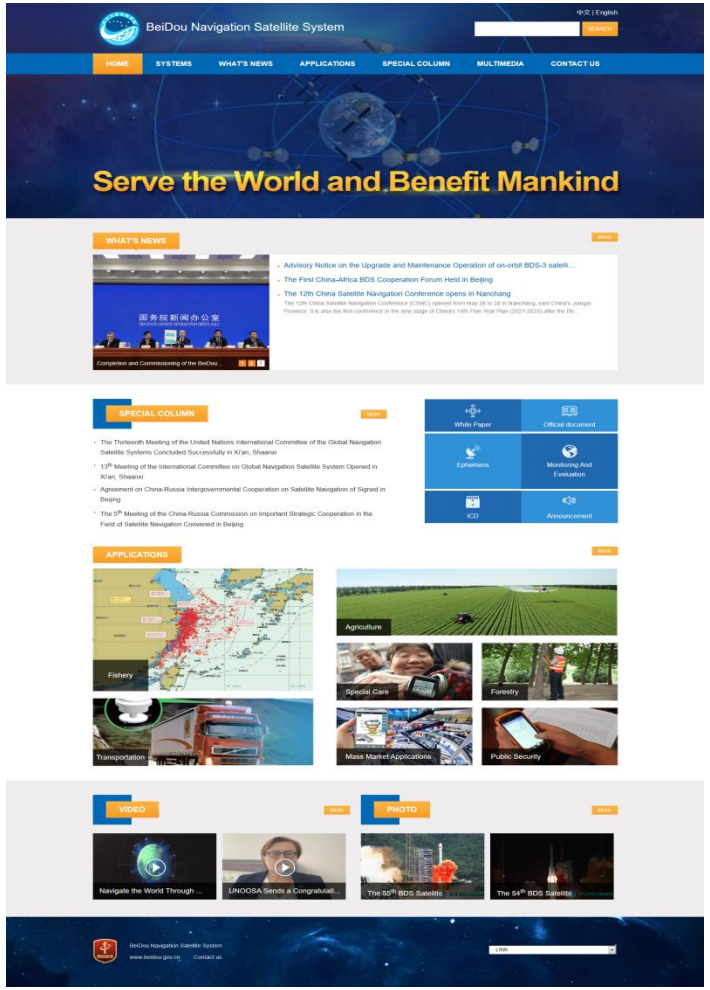
- **BDS+GPS**

  Positioning accuracy: H (95%) 0.09m, V (95%) 0.15m

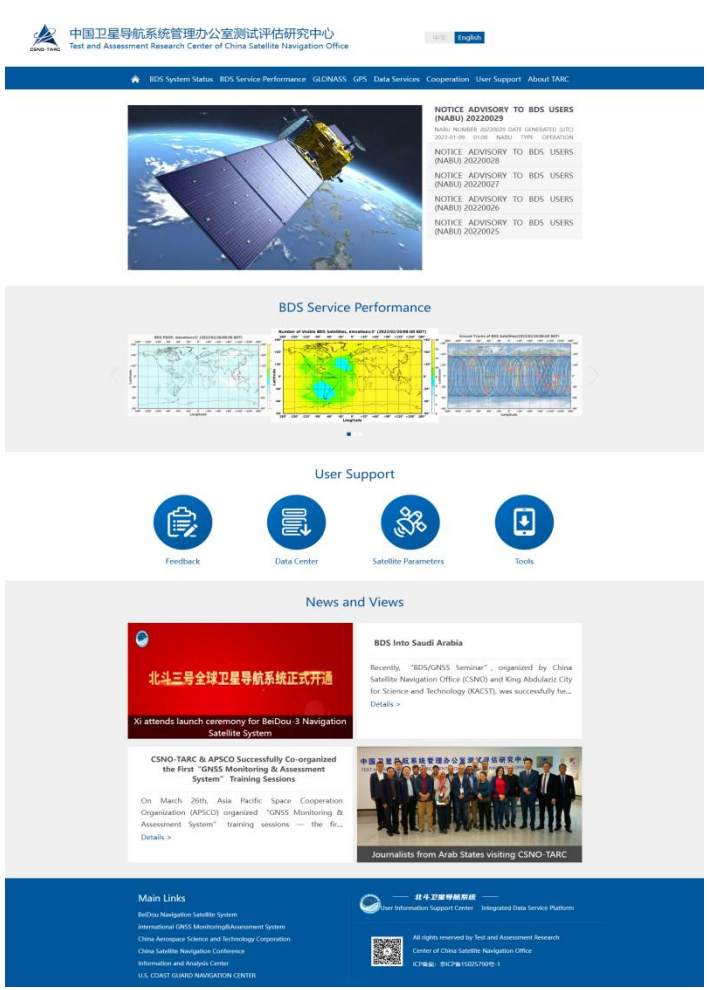
  Convergence time: 15.9 mins better than 20 mins requirement

[1] BeiDou Navigation Satellite System Open Service Performance Standard (Version 3.0)，2021.05

1.7 User Access



URL: www.beidou.gov.cn



URL: www.csno-tarc.cn



APP: navsat

bdservices@beidou.gov.cn beidouicd@beidou.gov.cn bdsfeedback@csno-tarc.cn

The Latest Development of BeiDou Navigation Satellite System

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2 BDSBAS Status

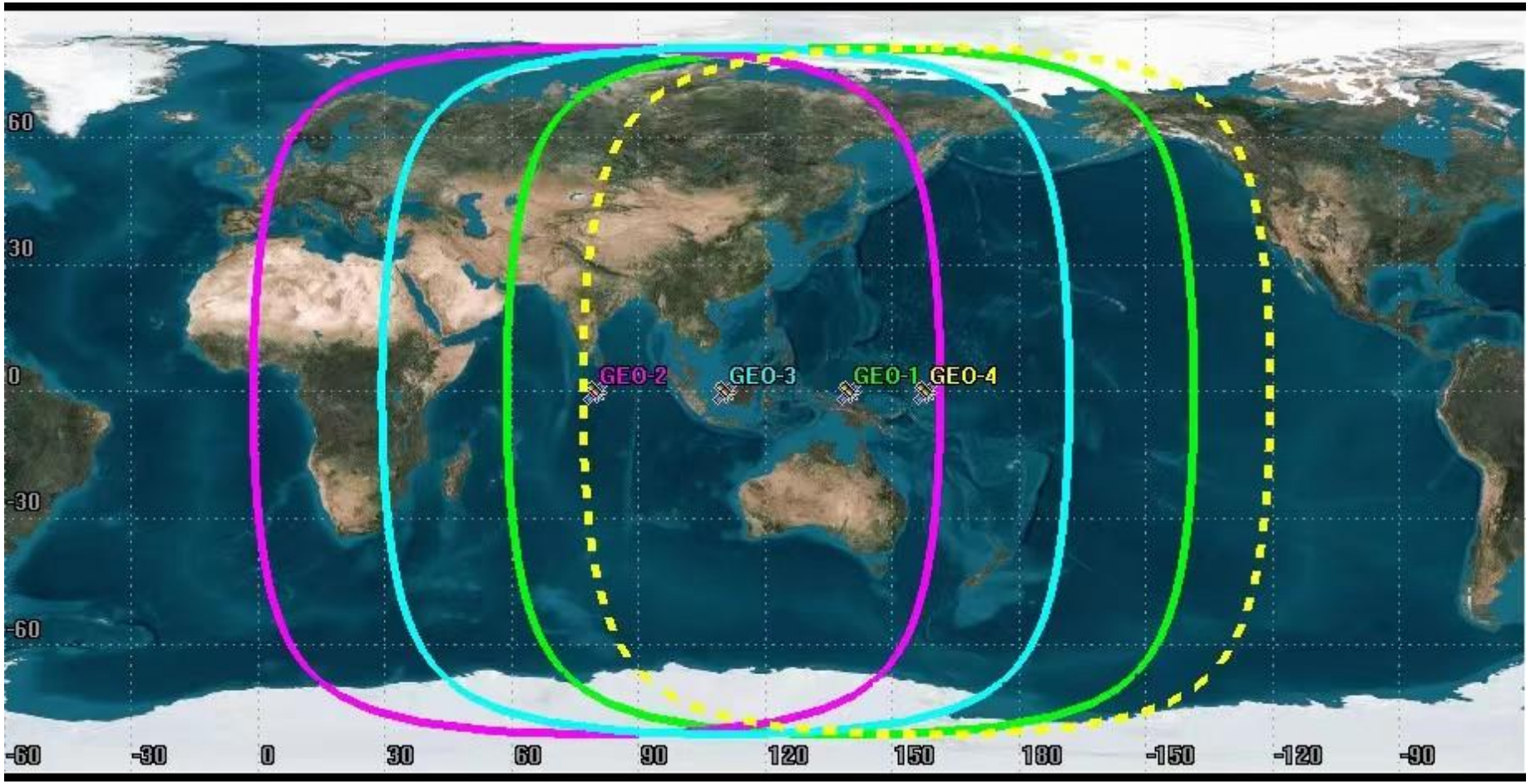
2.1 BDSBAS Introduction

BeiDou Satellite-based Augmentation System (BDSBAS) provides services to users in China and surrounding areas in accordance with the International Civil Aviation Organization (ICAO) standards



2.2 Update of Space Segment

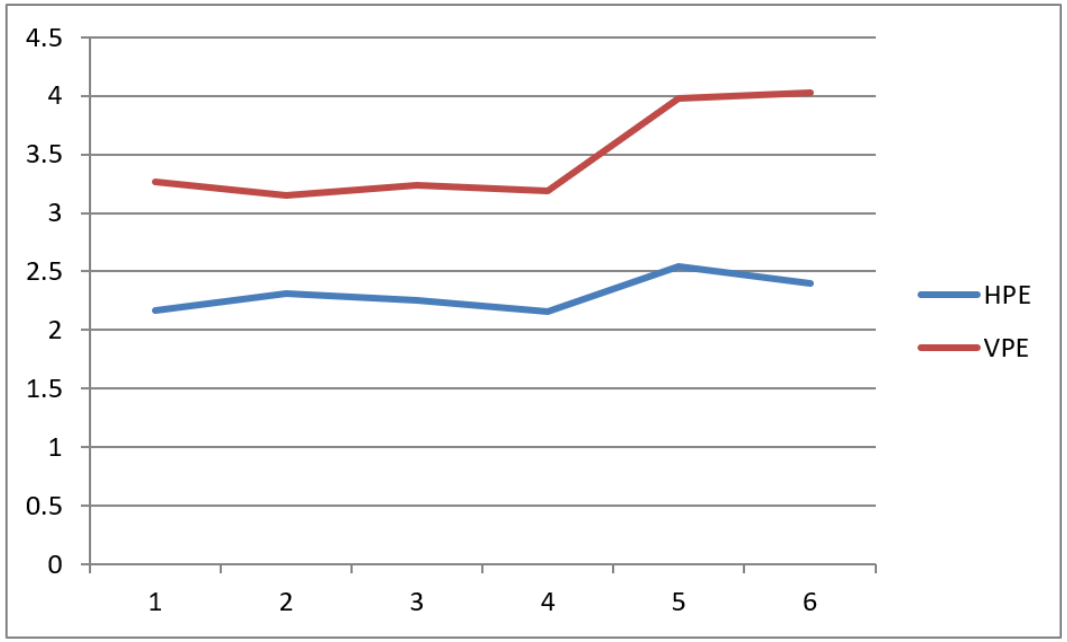
The fourth GEO satellite was successfully launched on May 17, 2023, orbiting at 160°E as an **on-orbit backup** satellite



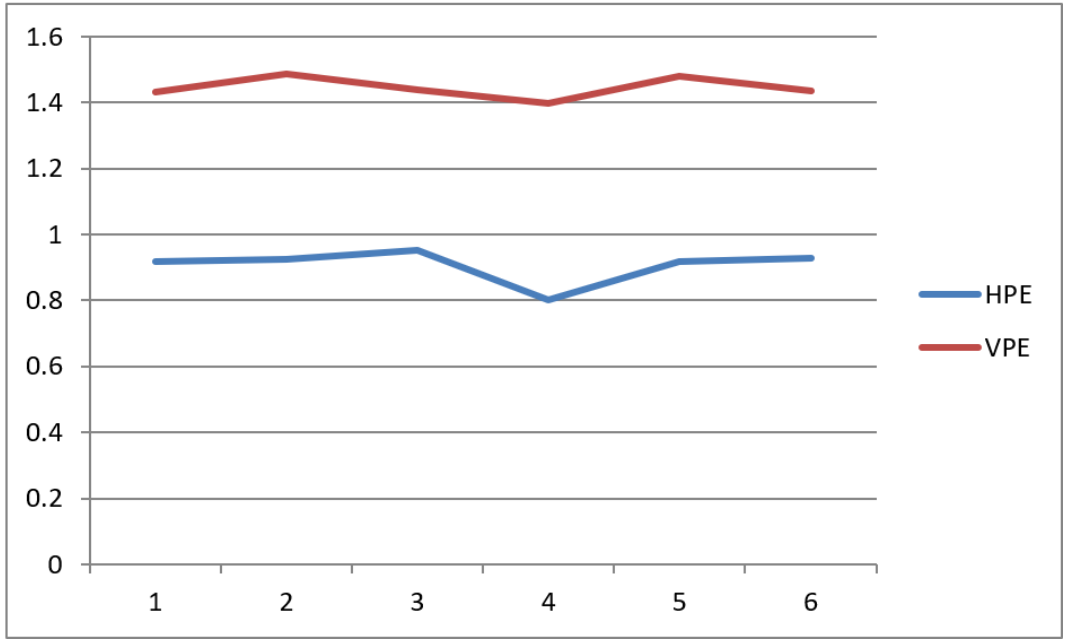
2.3 Service Evaluation

The performance of BDSBAS from January to June, 2024

- **Positioning accuracy**
  - SF service: HPE(95%)=2.3 m, VPE(95%)=3.5 m
  - DFMC service: HPE(95%)=0.9 m, VPE(95%)=1.4 m
- During the evaluation period, no HMI occurred
- **Availability:** both services are better than 99.9%



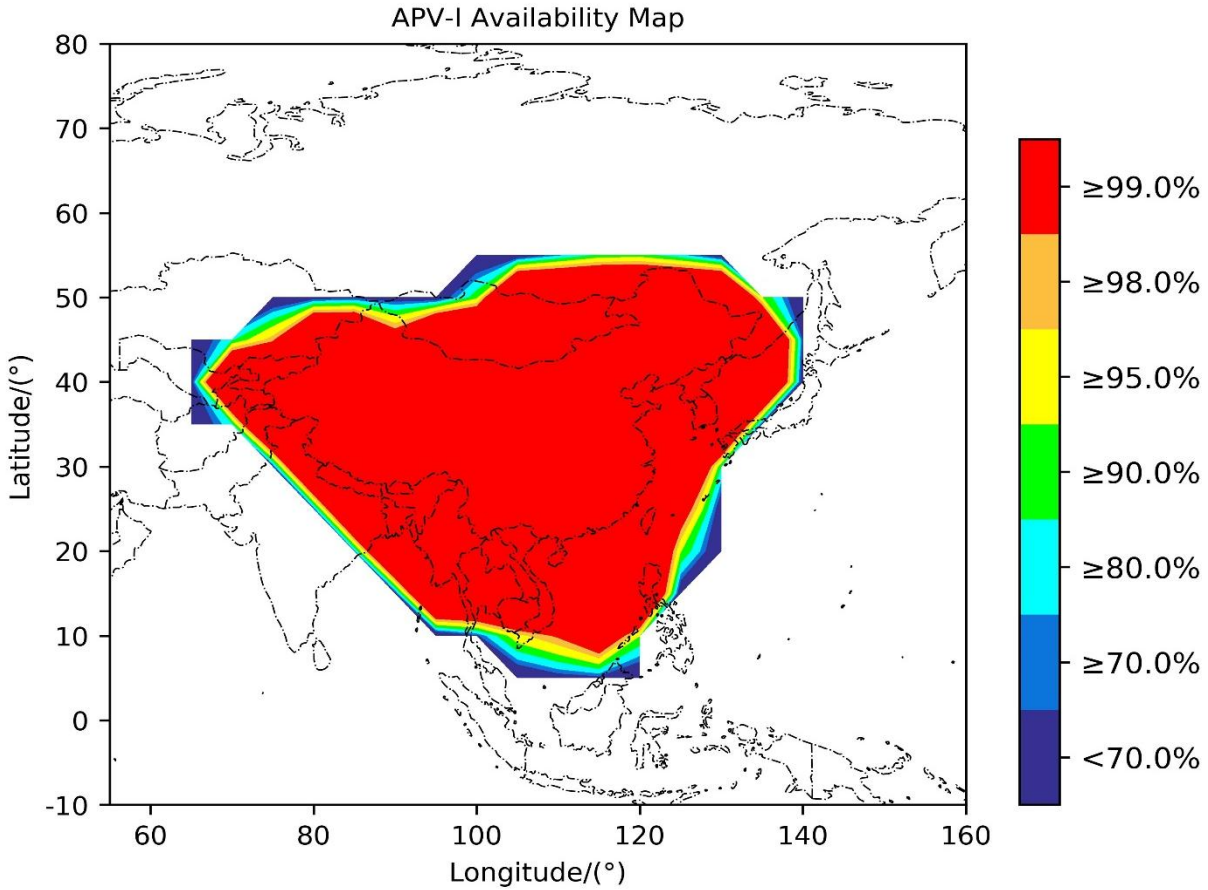
SF Service Positioning Accuracy



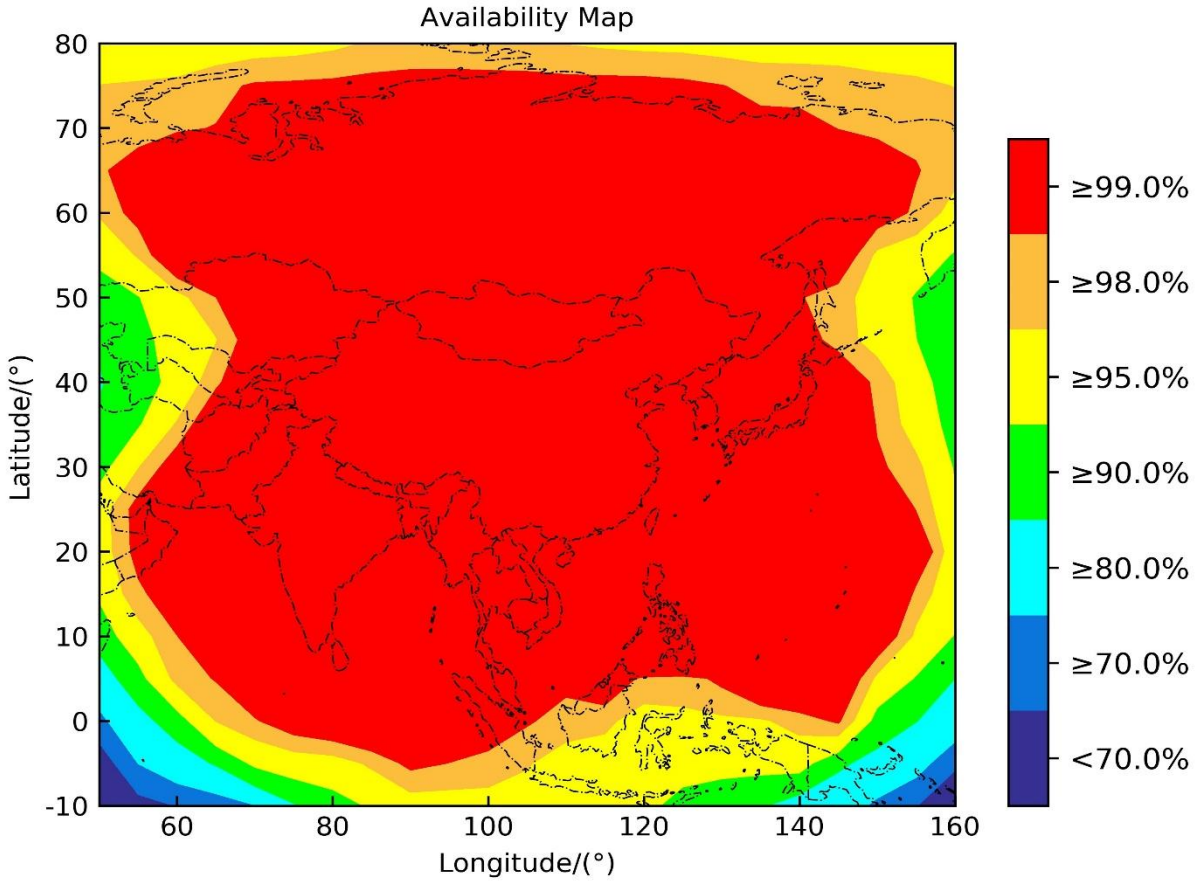
DFMC Service Positioning Accuracy

2.3 Service Evaluation

- **BDSBAS SF service**: augments GPS
- **BDSBAS DFMC service**: augments both BDS and GPS



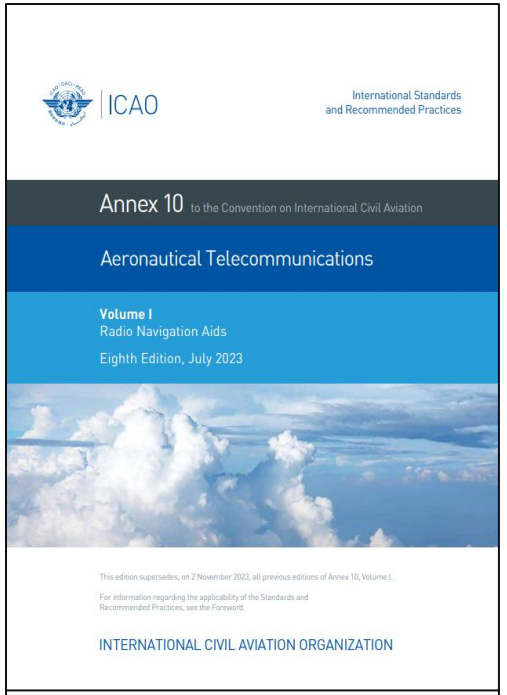
The APV-I availability of the BDSBAS SF service

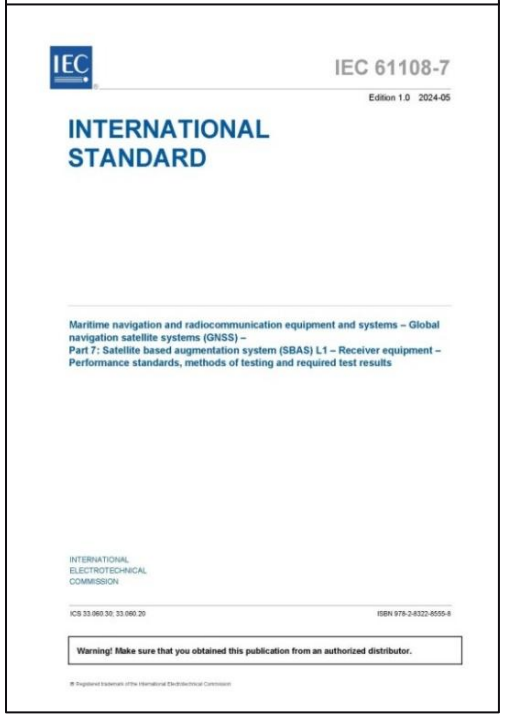


The APV-I availability of the BDSBAS DFMC service

2.4 Standards promotion

- The requirements and elements of BDS and BDSBAS were added in **ICAO Annex 10 Volume I**: Radio Navigation Aids Eighth Edition, which was published in July 2023
- The BDS Standardization Working Group has been working with **EUROCAE and RTCA. A EUROCAE** sub-group, "WG-62 SG-1 Internal Report on BDS and BDSBAS" , was approved by the EUROCAE TAC at its 88th meeting. The Internal Report on BDS and BDSBAS is scheduled to be completed in 2024.
- Participated in the development of **SBAS maritime standard** "Satellite Based Augmentation System (SBAS) L1 – Receiver equipment – Performance standards, methods of testing and required test results (IEC 61108-7) " , which was released in May, 2024.





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Thanks for your attention

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Session 3.1

Advanced RAIM

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