



BeiDou Navigation Satellite System Development

CHEN Gucang

China Satellite Navigation Office

October 25, 2021



01

System Status

02

Application Promotion

03

International Cooperation

04

Future Plans

01

System Status

1. Constellation Deployment



Since the last Workshop, 9 BDS-3 satellites (including 6 MEO, 2 GEO, and 1 IGSO) have been launched, marking the full constellation of BDS.

Satellite	Launch Time	Orbit
47th&48th	2019.09.23	MEO
49th	2019.11.05	IGSO
50&51th	2019.11.23	MEO
52&53th	2019.12.16	MEO
54th	2020.03.09	GEO
55th	2020.06.23	GEO

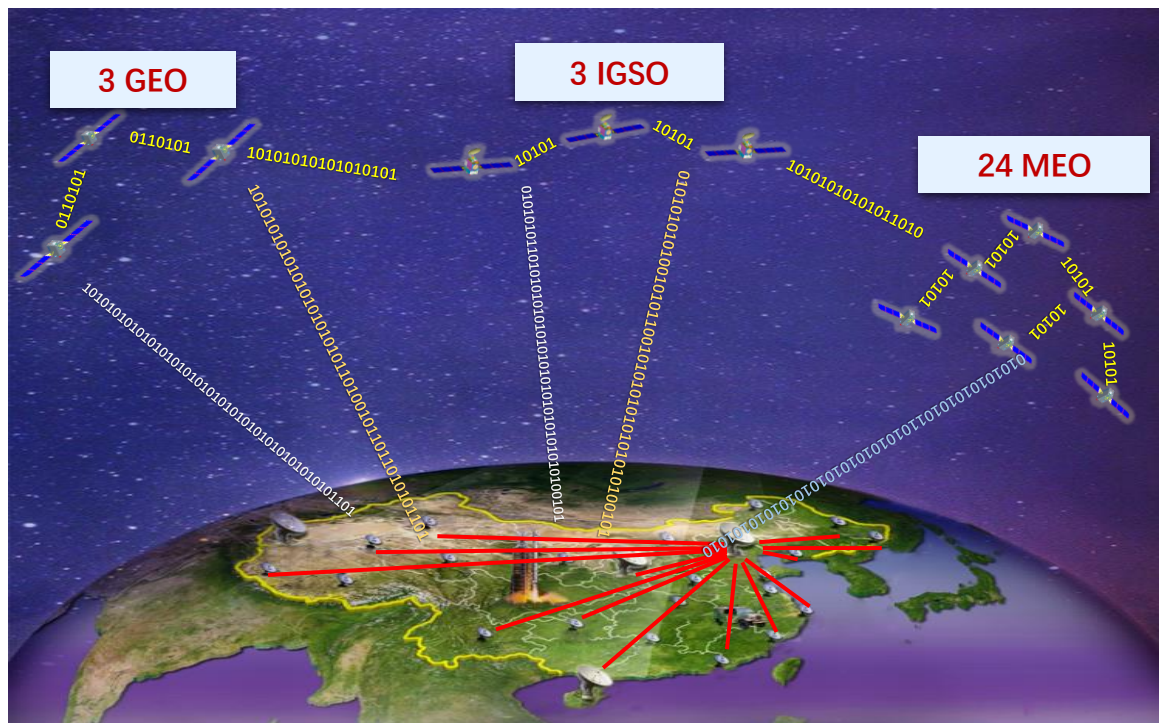
2. Completion and Commissioning

On July 31st, 2020, Chinese President XI Jinping announced the completion and commissioning of the BeiDou Navigation Satellite System (BDS-3).



01 System Status

3. System Components



BDS is mainly comprised of three segments: a space segment, a ground segment and a user segment.

Up to now, BDS-3 constellation consists of 3 GEO satellites, 3 IGSO satellites, and 24 MEO satellites.

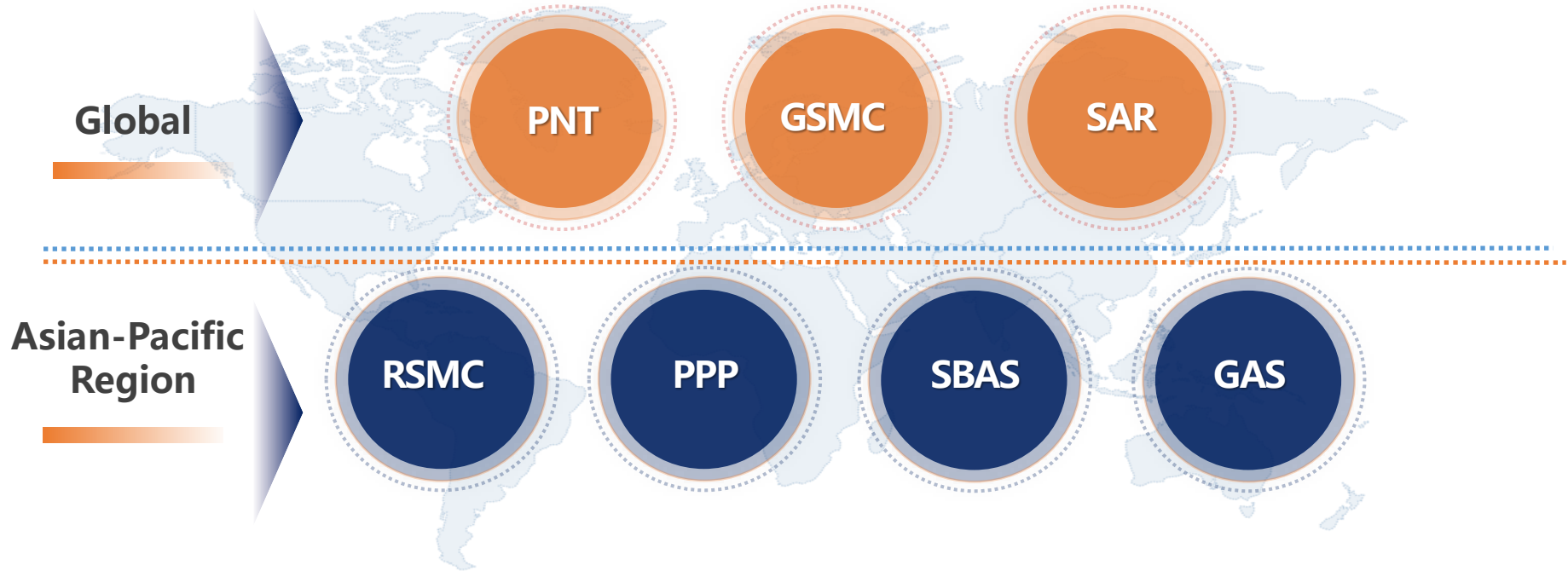
The BDS ground segment consists of various ground stations, including master control stations, time synchronization/uplink stations, monitoring stations, etc.

The BDS user segment consists of various kinds of the BDS terminals.

01

System Status

4. Various Services with Powerful Functions



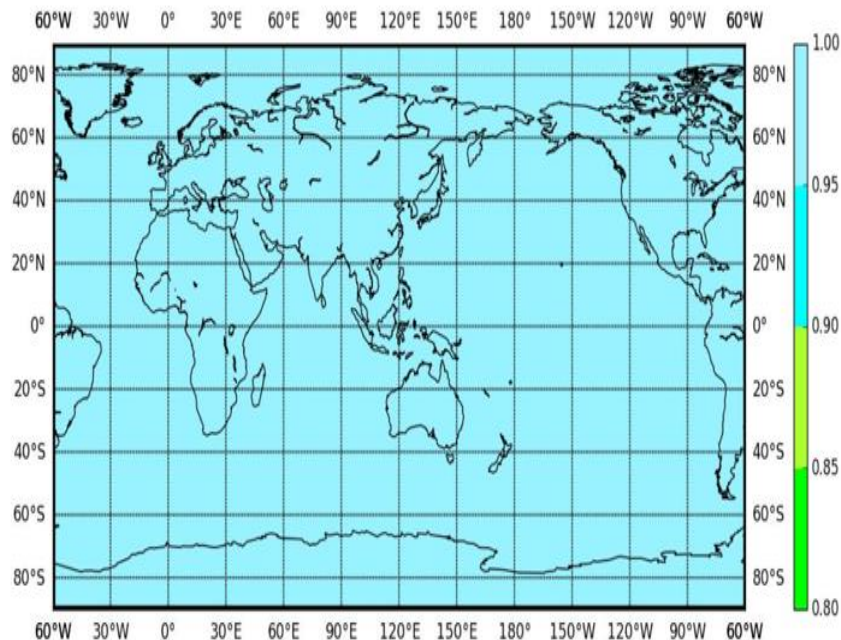
01 System Status

4. Positioning, Navigation and Timing (PNT)

BDS Service Performance Indicator

Performance Characteristics	Performance Specification
Global Positioning Accuracy (95%)	Horizontal $\leq 2.5\text{m}$ Vertical $\leq 5\text{m}$
Global Velocity Measurement Accuracy (95%)	$\leq 0.2\text{m/s}$
Global Timing Accuracy (95%)	$\leq 20\text{ns}$
Space Signal Continuity	99.996%
Space Signal Availability	$\geq 99\%$

BDS Availability (5° Elevation Mask, PDOP ≤ 6)



01 System Status

5. Information Dissemination

- The latest released documents of Open Service Performance Standard, Signal In Space Interface Control Document are shown as followings.
- More information is available at: en.beidou.gov.cn



Document	Date
BeiDou Navigation Satellite System Open Service Performance Standard (Version 3.0)	2021.05
BeiDou Navigation Satellite System Signal In Space Interface Control Document Open Service Signal B2b (Version 1.0)	2020.08
BeiDou Navigation Satellite System Signal In Space Interface Control Document Precise Point Positioning Service Signal PPP-B2b (Version 1.0)	2020.08
BeiDou Navigation Satellite System Signal In Space Interface Control Document Satellite Based Augmentation System Service Signal BDSBAS-B1C (Version 1.0)	2020.08
BeiDou Navigation Satellite System Signal In Space Interface Control Document Search and Rescue Service (Version 1.0)	2020.08
BeiDou Navigation Satellite System Ground-based Augmentation Service Interface Control Segment	2020.08
Development of the BeiDou Navigation Satellite System (Version 4.0)	2019.12
The Application Service Architecture of BeiDou Navigation Satellite System	2019.12

02

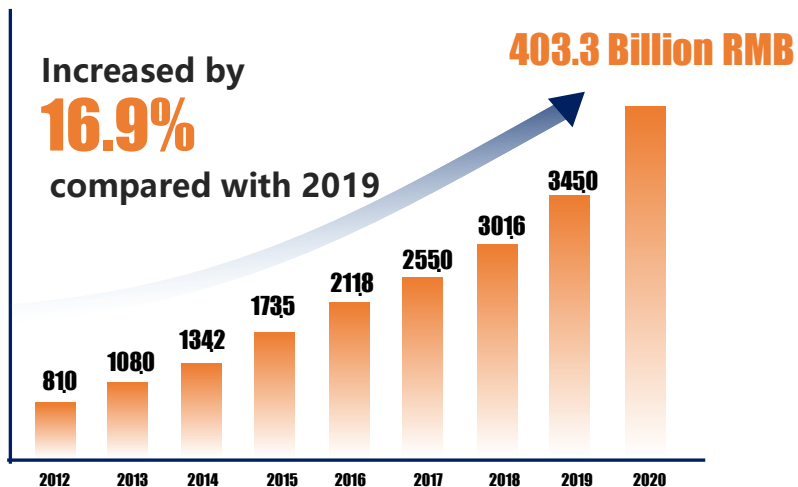
Application Promotion

02 Application Promotion

1. Domestic output value of satellite navigation and location-based service industries reached 403.3 billion RMB.

2020

Domestic output value of satellite navigation and location-based service industries:



2. Establishment of full industrial chain and making breakthroughs in basic products innovation

Making breakthroughs in the key technologies of basic products

Performances and techniques greatly improved, and large-scale applications enter into market

Sales volume domestic BDS-supported chips and modules has exceeded 100 million

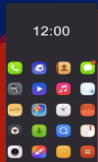


3. Entry into mass market, sharing economy and people's livelihood

79% smart phones sold in China in the Q1 and Q2 of 2021 supported BDS positioning function

Meter-level positioning is available based on BDS ground-based augmentation service signal

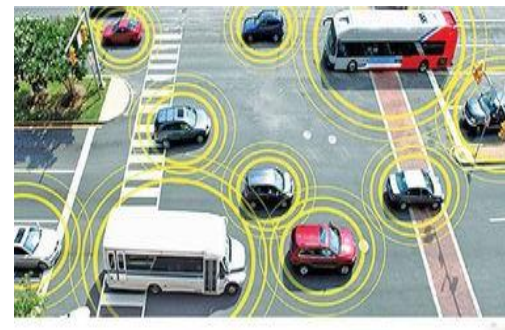
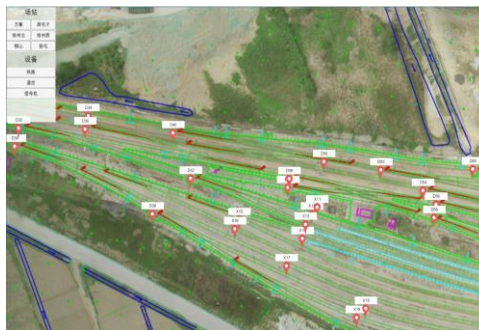
Smart phone supporting BDS short message service and **information interconnection** to be launched



02 Application Promotion

4. BDS improves the level of traffic informatization

- A large dynamic monitoring and management system for operating vehicles has been built
- 7 million operating vehicles
- Precise bus information inquiry system
- BDS high precision positioning + shared bike
- BDS Lock + smart container

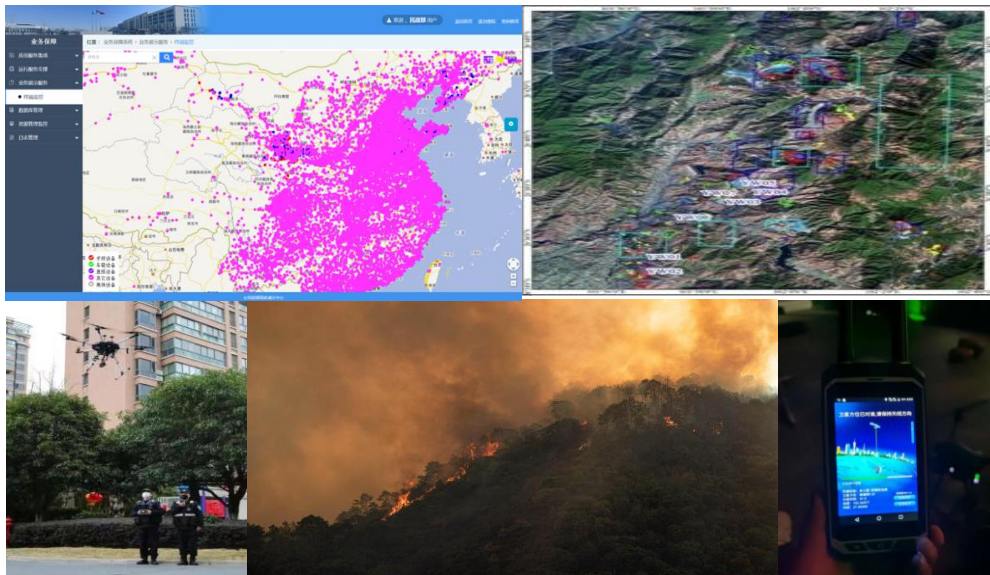


Decreasing incidence of severe traffic accident and accelerating the realization of smart transportation

02 Application Promotion

6. BDS protects the safety of people's lives and property

- 3-level of disaster relief management platform is built
- Over 45,000 BDS-based terminals and equipment are deployed
- BDS-based high-precision geological disaster monitoring and alert system has been built

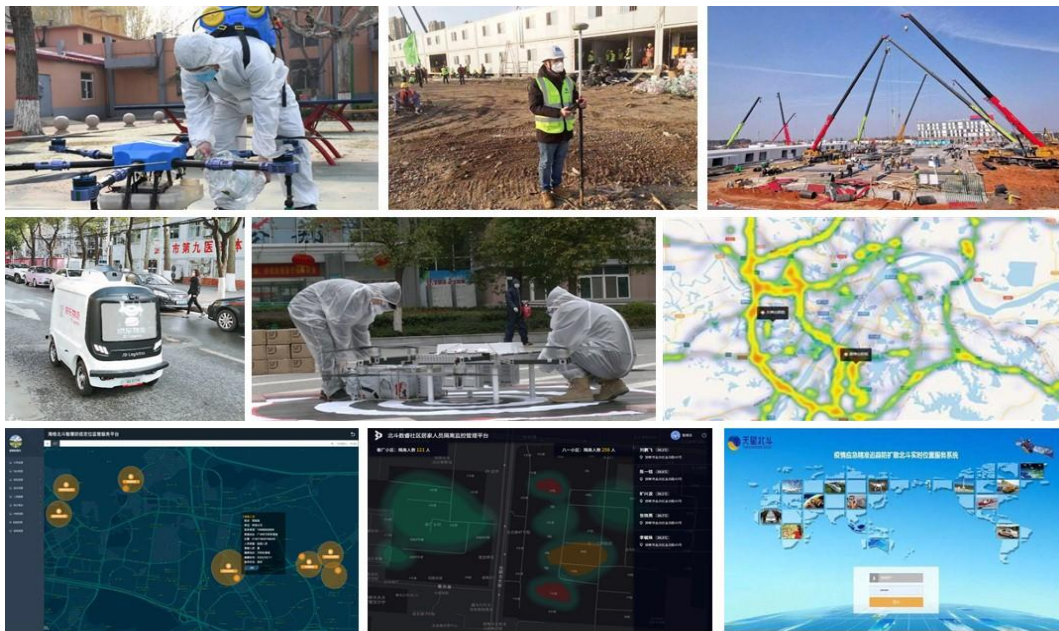


The capabilities of disaster and emergency relief, quick response, and coordinated command has been enhanced. Geological disasters have been successfully forecast for many times

02 Application Promotion

7. BDS promotes the intelligent health services and epidemic prevention

- Travel record monitoring
- Epidemic prevention
- Tele Medicine
- Smart old-age insurance
- Personal health management
- Material distribution
- Precise disinfection through UAV



Real time data and decision support have been provided

02 Application Promotion

8. BDS helps the construction of smart city

- Intelligent operation and maintenance of BDS charging pile

- Smart operation and maintenance and centralized meter

reading based on IoT

- BDS Intelligent tourism information service system

- The big data service platform of scenic spots



Improving urban power infrastructure and making tourism more smart, informationalized, and modernized

02 Application Promotion

9. BDS enables precise digital construction

- Emergency communication for field construction
- Precise construction and machinery control
- BDS+BIM visual management on construction
- Monitoring, dispatch, and management of workers, equipment, and vehicles
- Security monitoring of construction environment



Quality and efficiency has been improved
Labor and material costs has been reduced
Security has been enhanced

02 Application Promotion

10. BDS helps realize standard time applications

- Platform deposit certificate business
- Illegal broadcast video forensics
- Application of product traceability
- Time synchronization systems
- Smart transportation control system



Meeting the needs of different accuracy in different standard time application scenarios

02 Application Promotion

11. More diversified application mode

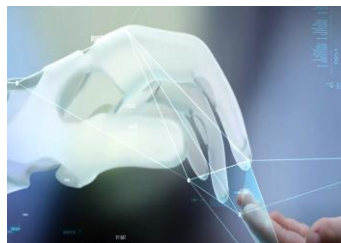
BDS
&
Technologies

BDS
&
Terminals

BDS
&
Platforms

BDS
&
Data

BDS
&
Services



BDS+5G→More Mature Fusion of Communication & Navigation

12. BDS safeguards China-Europe Railway Express



BDS satellites can be used to positioning the trajectory of trains, record and save operation information in bad signal reception areas, and then guarantee the integrity of transportation.

02 Application Promotion

13. BDS safeguards the security of the dam across the world's highest quake lake



Confronted with the threat of potential natural disaster in Sarez Lake in Tajikistan, China and Tajikistan utilized BDS to undertake the deformation monitoring and disaster warning in surrounding area, providing important scientific and technological reference for the safety of the dam.

02 Application Promotion

14. BDS is promoting the applications in Africa



By establishing the EarthEyes System, a satellite positioning system for vehicle, BDS carries out the monitoring of various kinds of vehicles and equipment and is widely applied in different scenarios. With the CORS system built in Tunisia, Mali, Nigeria, etc., BDS supply a real-time, wide spread, continuous, stable and precise positioning GNSS correction data and timing information for African users.

15. BDS provides good services for global users



BDS-based products have been exported to and used in more than **half** countries and regions in the world. BDS has been widely used in **ASEAN, Southern Asia, Eastern Europe, Western Asia, Africa in land ownership confirmation, precision agriculture, intelligent port management, etc.**, promoting local economic and social development.

03

International Cooperation

03 International Cooperation

1. Compatibility and Openness to Provide Better Service (China - Russia)

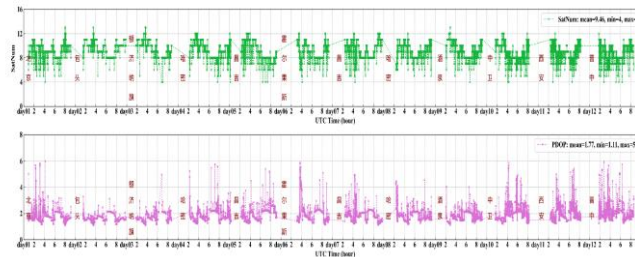


Figure 7 Number of BDS visible satellites and PDOP at B1C/B2a frequency point in Test

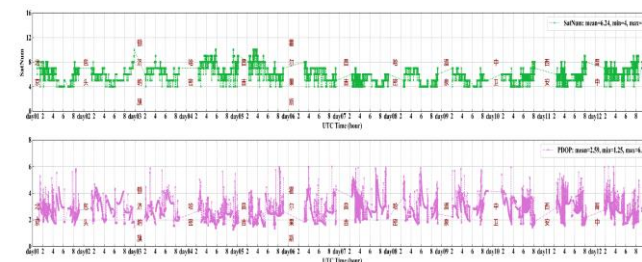




Figure 8 Number of GLONASS visible satellites and PDOP at L1 frequency point in Test

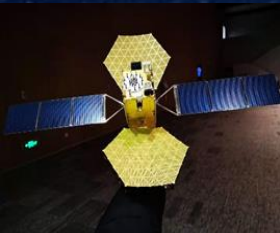
Cooperation in joint test, station construction, and precision agriculture under the China-Russia Satellite Navigation Key Strategic Cooperation Project Committee

03 International Cooperation

2. Compatibility and Openness to Provide Better Service (China – U.S.)

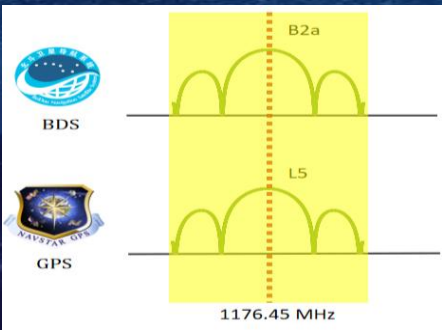



PRN130
PRN143
PRN144



L1 C/A PRN Code Number	C/A			System (Satellite)	Orbital Slot	Effective Through	Assignment Type
	G2 Delay (chips)	Initial G2 Setting (Octal)	First 10 Chips (Octal)				
130	355	0341	1436	BDSBAS (GEO-1)	140E	Aug 2030	Final
143	307	1312	0465	BDSBAS (GEO-3)	110.5E	Aug 2030	Final
144	127	1060	0717	BDSBAS (GEO-2)	80E	Aug 2030	Final

L5 PRN Code Number	XB Code Advance (Chips)		Initial XB Code State (Octal)		System (Satellite)	Orbital Slot	Effective Through	Assignment Type
	I5	Q5	I5	Q5				
130	1224	1092	17754	12737	BDSBAS (GEO-1)	140E	Aug 2030	Final
143	3745	8126	05474	15167	BDSBAS (GEO-3)	110.5E	Aug 2030	Final
144	4723	7017	02275	16761	BDSBAS (GEO-2)	80E	Aug 2030	Final



1176.45 MHz

Fostered the cooperation in compatibility and interoperability, SBAS, and civil use industries

03 International Cooperation

3. Compatibility and Openness to Provide Better Service (China-Argentina)

中国卫星导航系统管理办公室与阿根廷国家空间活动委员会合作谅解备忘录在线签署仪式 Ceremonia de firma virtual del MOU entre CONAE y CSNO



Virtual Signing Ceremony of MoU between CSNO and CONAE

CSNO and CONAE has built a kind of normal cooperation mechanism in satellite and navigation, and will carry out cooperation in joint applications, test and assessment, education and training, etc., to accelerate economic and social development in Argentina.

4. Joint Discussion, Construction and Sharing with The Belt and Road countries



**3rd China-Arab
States BDS
Cooperation
Forum**
Nov. 2, 2021



**2nd China-
Central Asia BDS
Cooperation
Forum**
Oct. 13, 2021



**1st China-
Africa BDS
Cooperation
Forum**
Nov. 5, 2021

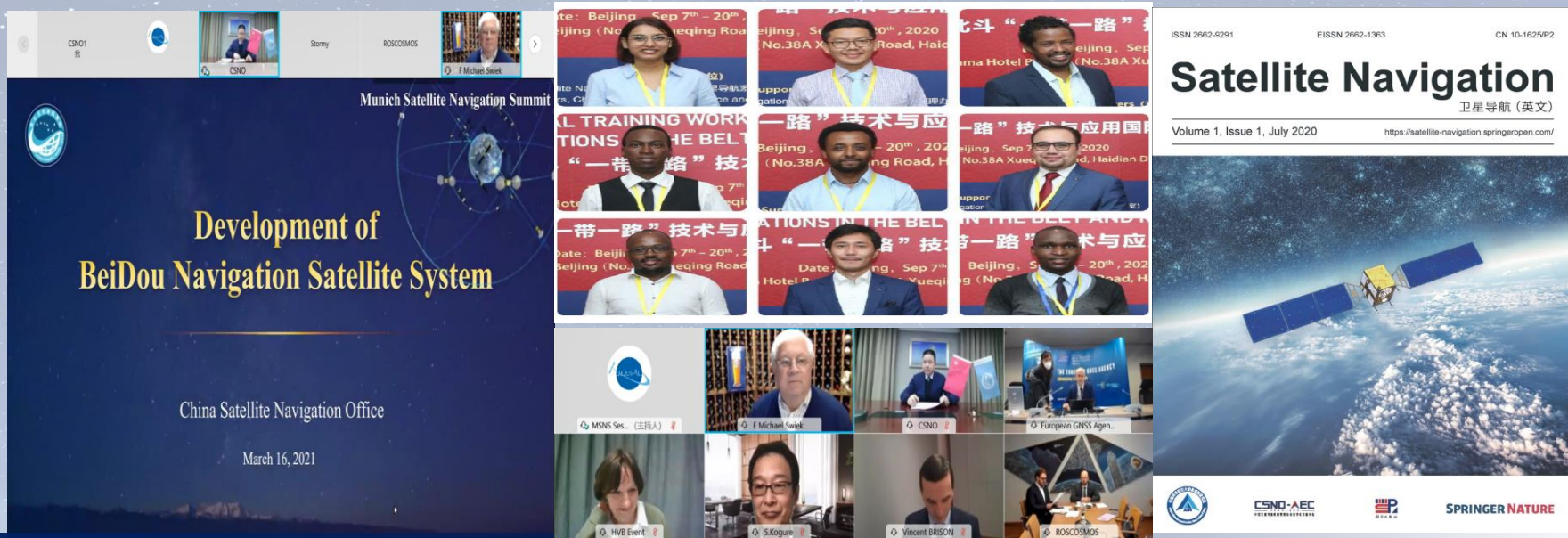


**EXPO 2020 Dubai
BeiDou Showcase**
Oct. 2, 2021

**EXPO
2020
DUBAI
UAE**

03 International Cooperation

5. Chinese Wisdom and Contribution through Multilateral Exchanges



Communicated with other GNSS providers technically, and issued updates on BDS in multilateral academic platforms such as Munich Satellite Navigation Summit, Scientific and Technical Subcommittee, UNOOSA, etc.

03 International Cooperation

6. Ratification by International Standards



International
Electrotechnical
Commission

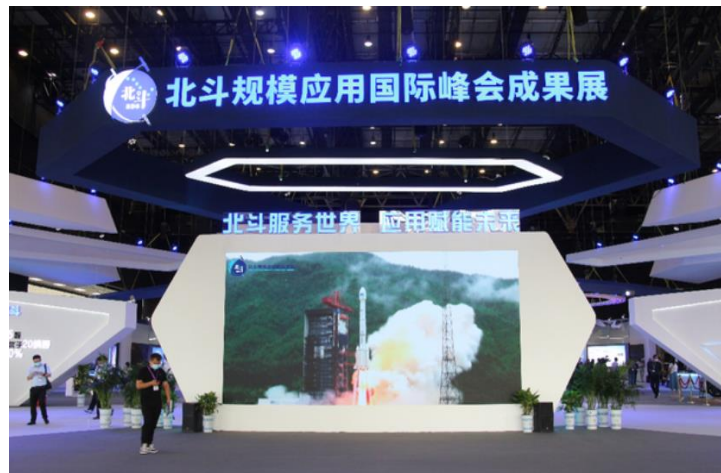
COSPAS-SARSAT.INT
INTERNATIONAL SATELLITE SYSTEM FOR SEARCH AND RESCUE
406TH DISTRESS ALERTING SERVICE



RTCM

03 International Cooperation

8. BDS serves the world, and application energizes the future



On September 16, 2021, the First International Summit on BDS Applications was hosted in Changsha, Hunan Province. Chinese president XI Jinping sent the congratulation letter.

04

Future Plans

Future Plans

1. A Comprehensive PNT System will be Established with BDS as the Core
2. Adoption of Standardized Solutions to Meet Common Needs

- Positioning precision at decimeter level
- Global integrity services

Satellite
Navigation

- Navigation and communication empowers each other
- Communication accessible areas are navigable

Communi
cation

- Acquire PNT information autonomously

Micro
autonomous
PNT

Deeply
Integration



- High Accuracy
- High Availability
- High Continuity
- Low cost



**Thanks for your continuous attention
and support to the BDS development.**

<http://en.beidou.gov.cn>