



Update on BeiDou Navigation Satellite System

China Satellite Navigation Office

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Kathmandu, Nepal

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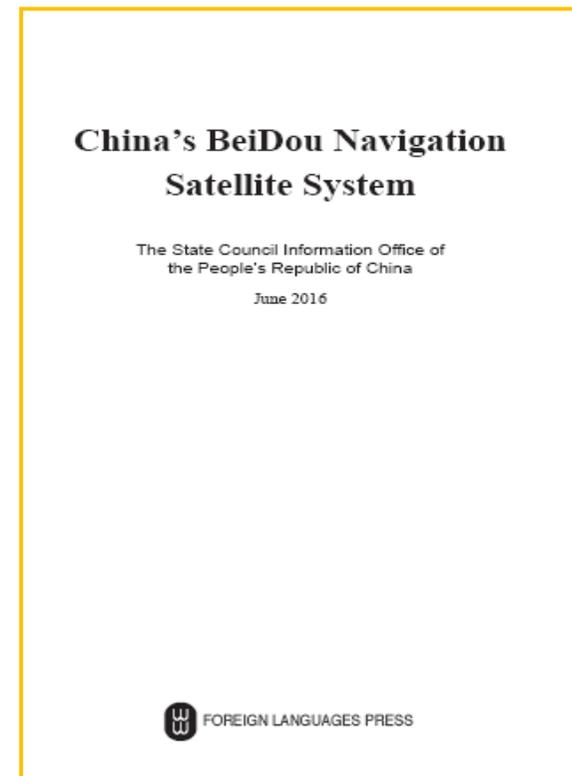


Policy of Development

The whitepaper on BDS has been released in June 2016, to interpret its development concepts and propositions.

1. Providing Open Services Free of Charge

- **B1I and B2I open service signals are being broadcast by the operating BDS-2 to provide open services to the Asia-Pacific region free of charge.**
- **The services cover an area extending 55°N-55°S and 55°E-180°E, with positioning accuracy less than 10 meters, velocity measurement accuracy less than 0.2 meter per second, and timing accuracy less than 50 nanoseconds.**



Policy of Development

2. Ensuring Safe and Reliable BDS Operations

- Improving the management mechanism on operation.
- Establishing a GNSS monitoring and assessment network.
- Taking a redundant and backup approach.

3. Disseminating BDS Information in a Timely Manner

- Publishing BDS documents related to open services and signals to provide inputs for global BDS product development efforts.
- Establishing a multi-channel information dissemination mechanism.



Policy of Development

4. Improving of BDS Performance

- Providing global services.
- Strengthening service capabilities.
- Maintaining spatio-temporal reference.

5. Protecting the Utilization of Radio-Navigation Satellite Frequency Spectrum

- Protecting the radio-navigation satellite frequency spectrum.
- A monitoring network for IDM will be established and the corresponding database will be also constructed.
- China prohibits the production, sale and use of illegal interference devices, investigates and punishes in accordance with the law any hostile interference actions which affect the system operations and services.

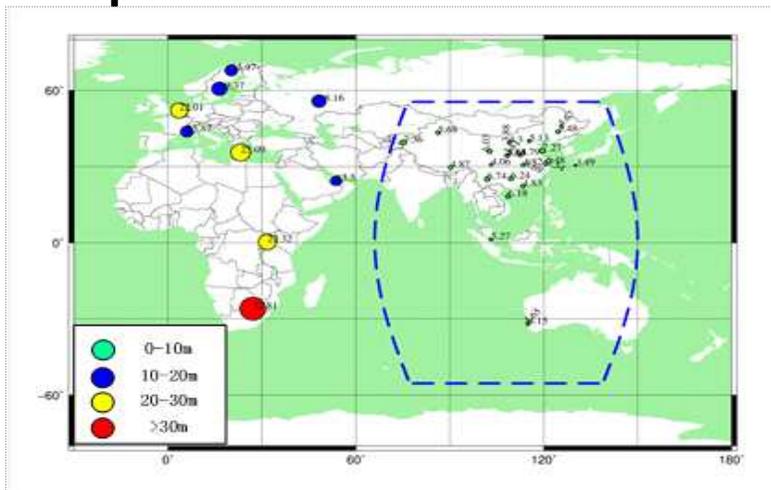




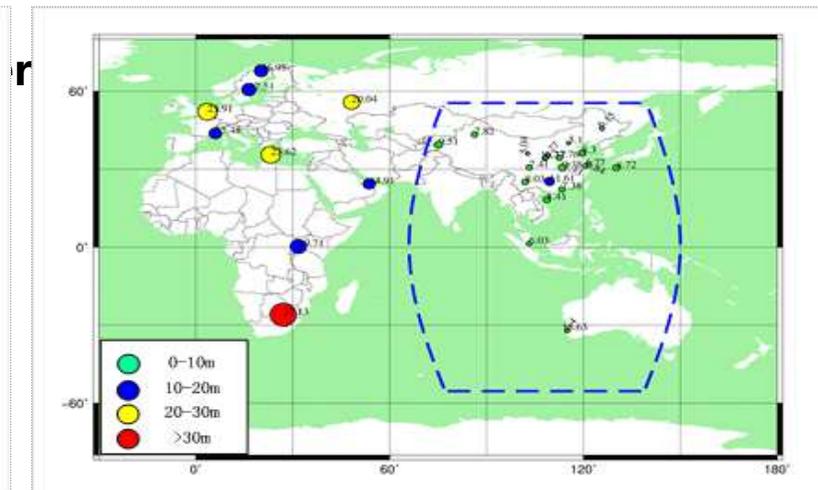
》 (I) System Construction

1. Improvement of the BDS Performance

- Since its formal regional service provision on December 27, 2012, BDS has maintained continuous and stable operation. The system service performance can satisfy the nominal requirements.
- Monitoring and assessment results of signals covering the Asian-Pacific region indicate that the BDS performance meets the specification.



B1I 平面定位精度



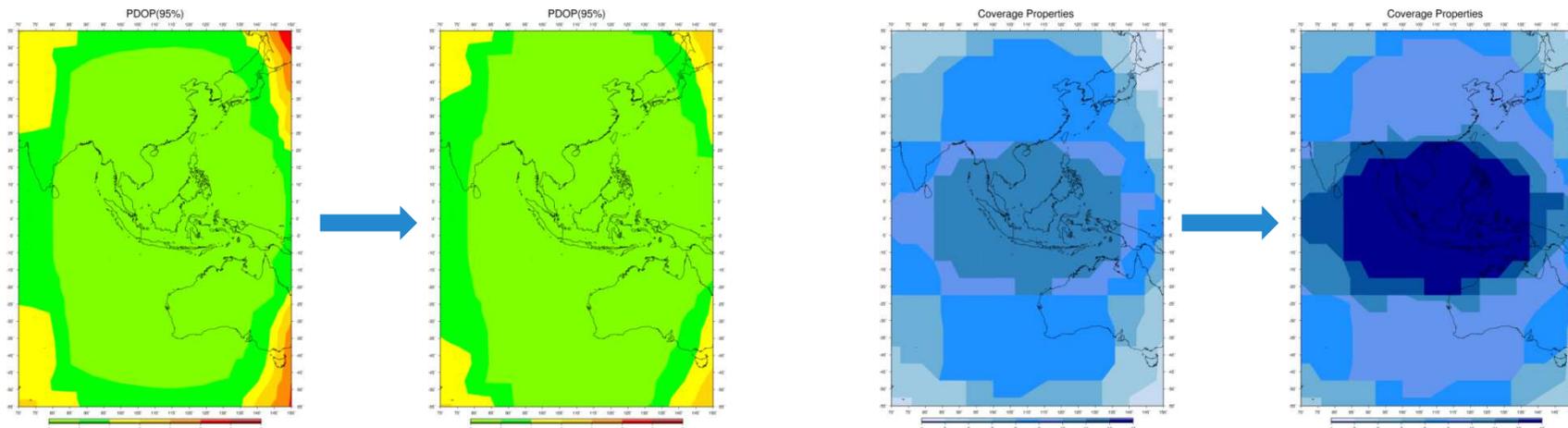
B1I 高程定位精度



(I) System Construction

1. Improvement of the BDS Performance

- After one IGSO and one GEO satellites were successfully launched, the average PDOP (95%) decreased obviously.



» (I) System Construction

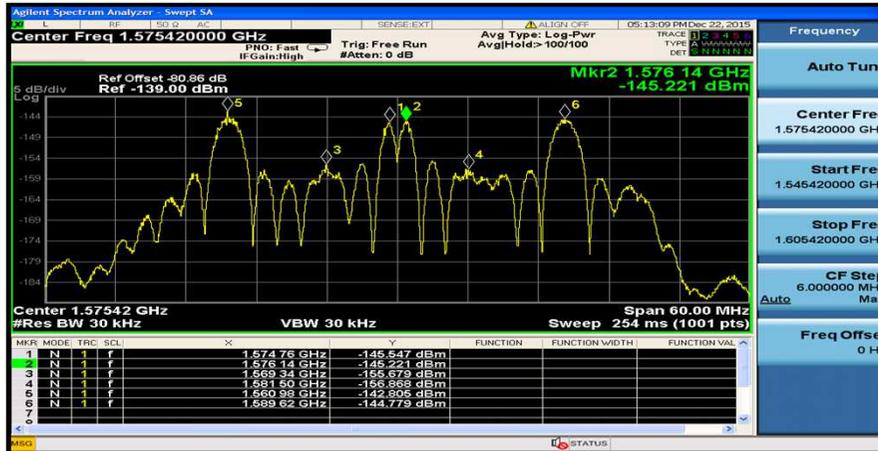
2. Demonstration of BDS Global System

- Since 2015, five new-generation BDS satellites have been successfully launched, including 3 MEO and 2 IGSO satellites.
- New signal structure has been designed and tested.
- The interlinks among the satellites have been realized, by which the accuracy of satellite orbit has been improved about 50% in 24 hour prediction.
- The accuracy of the satellite clock is also improved 60% in 24 hour prediction.
- The new hydrogen clock has been equipped on-board with stability about $6E-14/d$, rather than the rubidium clock with stability of $3E-13/d$.
- The service capability is improved accordingly.

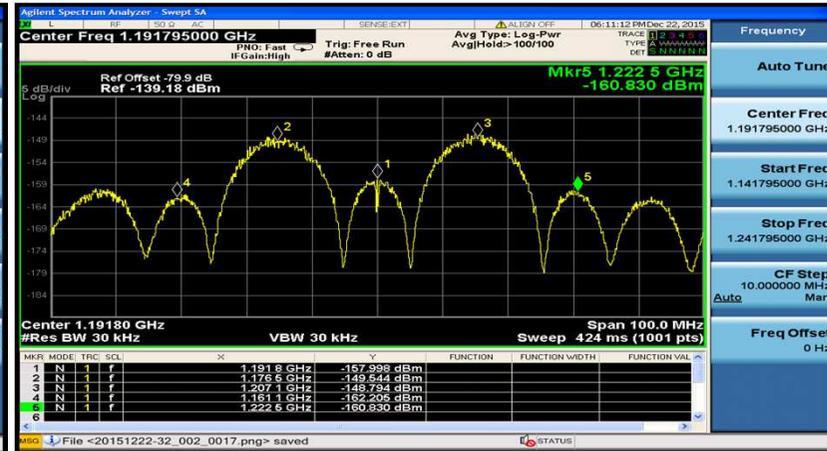


(I) System Construction

- Spectrum of B1 and B2

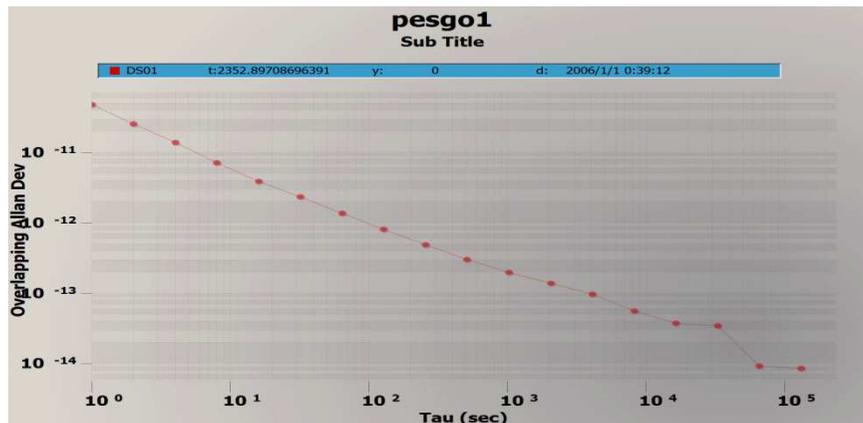


Spectrum of B1

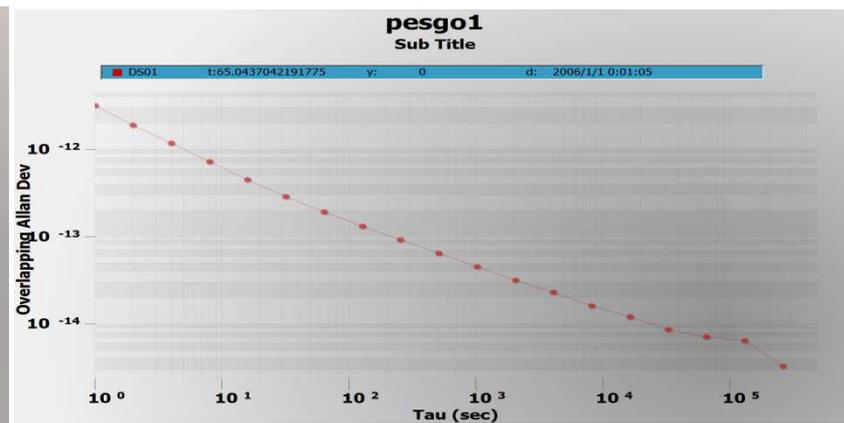


Spectrum of B2

- Stability of satellite clock



I1-S Stability



I2-S Stability

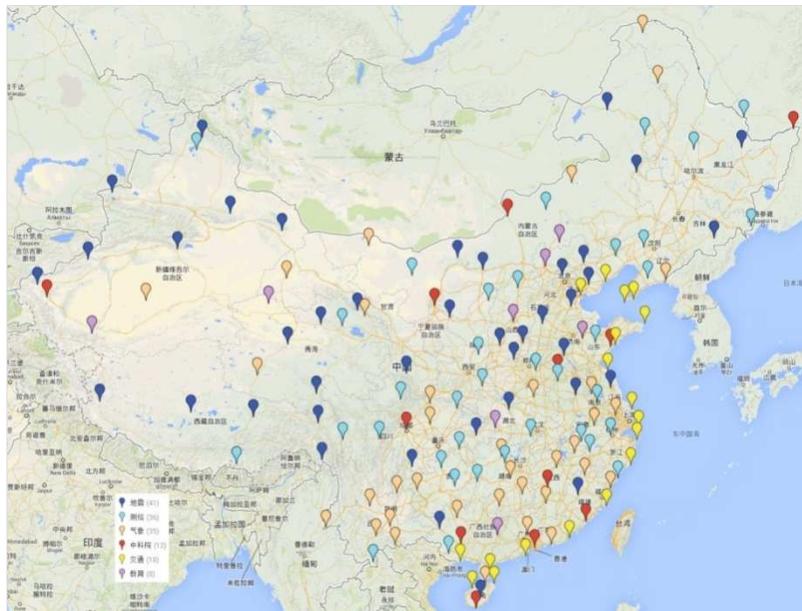


(I) System Construction

4. Construction of Augmentation System

NDBDS

- The basic system construction has been completed, while the positioning accuracy is under test, including meter and decimeter level for wide-area real-time services, centimeter level for the Beijing region, millimeter level for post-processing services.



Overall layout of National framework network reference stations



Completed 31 National framework network reference stations

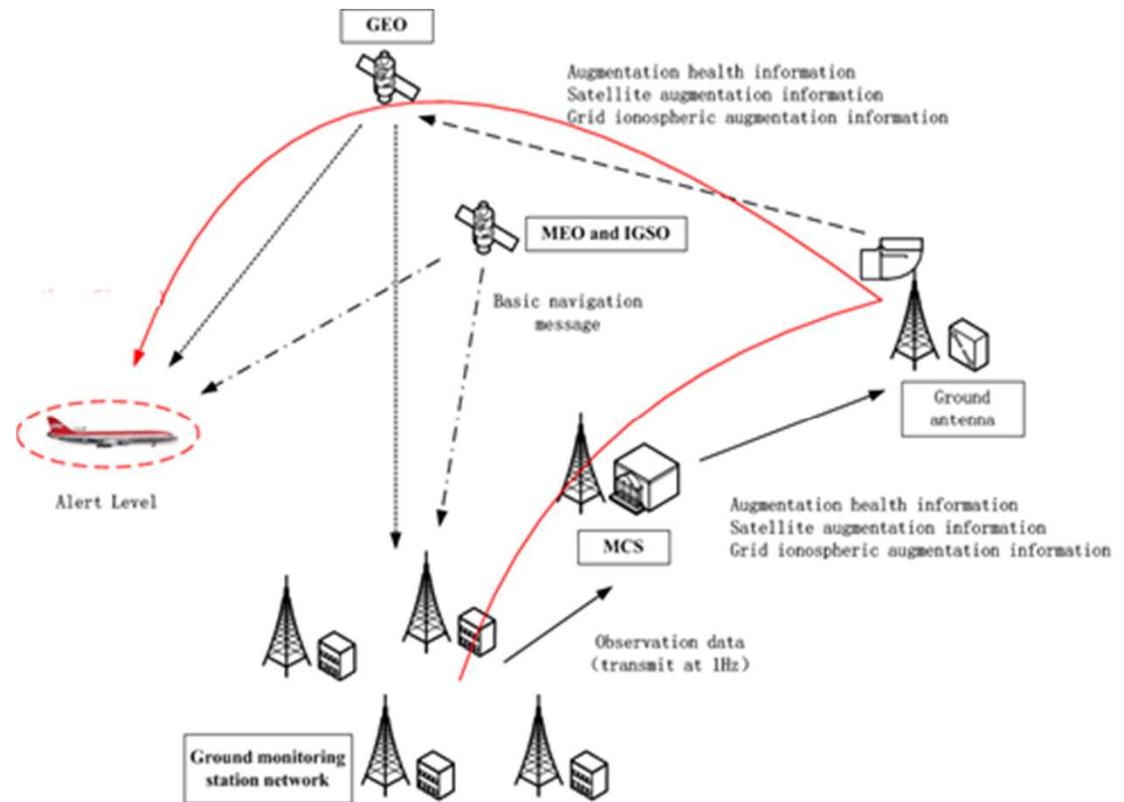


(I) System Construction

4. Construction of Augmentation System

BDSBAS

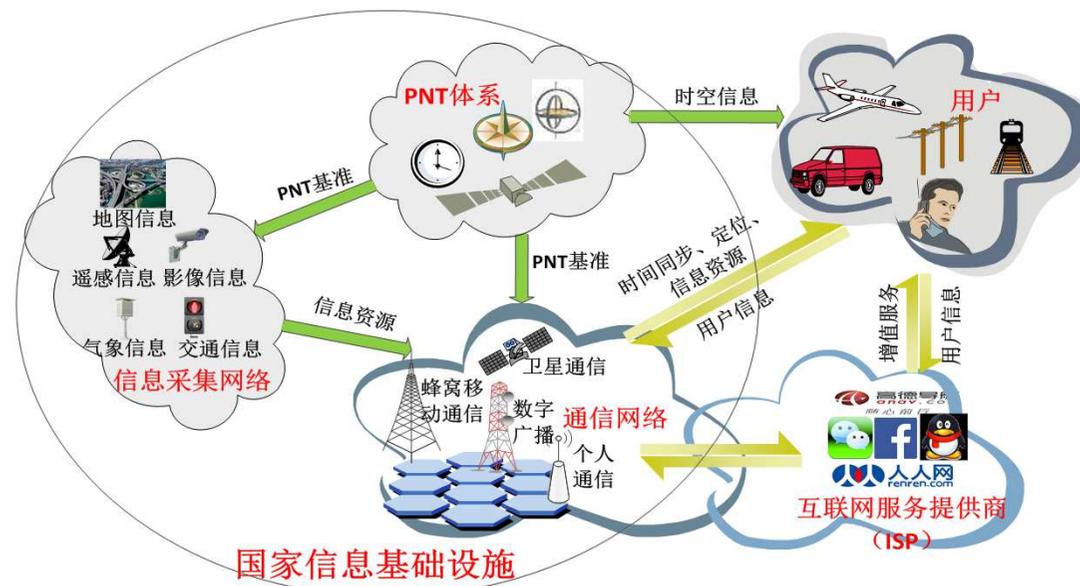
- BDS will comply with the international civil aviation standards, carry out the design, validation and construction of BeiDou Satellite-Based Augmentation System (BDSBAS), which will provide CAT-I services to civil aviation users in China and surrounding areas.
- At present, SBAS IWG has adopted BDS as one of the augmented objects of future satellite-based augmentation systems.



》 (I) System Construction

5. National Integrated PNT Systems Constructing

A national comprehensive PNT system is under study, and related technology is under research, so as to narrow the gap of satellite navigation services in some blind areas, such as in indoor, underwater, and deep spaces, to meet the needs of economic and social development.



《 》 (II) Application Promotion

1. Fundamental Products

- BDS fundamental products have been upgraded in terms of self-controlled intellectual properties, quality and quantity.
- BDS chips have entered a new era of 40-nanometer, and achieved a jumped upgrade from basic products to high-end industry.



④ (II) Application Promotion

BDS/GNSS navigation products

- The cost-effectiveness of first generation of BDS/GNSS navigation chips, modules, antennas and other core products are comparable with international mainstream products. Integrated RF chips, the second generation chips, that get lower power consumption, better performance and smaller size have been sold in massive amount, and they are widely intergraded with IP core and mobile communications, to serve the mass consumer.
- By April 2016, the sales amount of BDS/GNSS navigation chips and modules has exceeded 24 million pieces. The sales amount of IP core that are used in mobile phone has reached about 18 million pieces.

Smart Phone



Automobile navigation



Wearable · Smart Devices



④ (II) Application Promotion

High-precision products

- BDS high-precision products are compatible with GPS/GLONASS/Galileo/SBAS, using RTX technology, modular and miniaturized, with low power consumption and low cost.
- By April 2016, the sales amount of BDS/GNSS high-precision OEM card has exceeded 120,000 pieces and accounted for 1/3 of domestic market in China. The sales amount of BDS/GNSS high-precision antenna has exceeded 500,000 units and accounted for 90% of domestic market in China.



BDS/GPS/GLONASS high precision board card



BDS/GPS/GLONASS high precision receiver



BDS/GPS/GLONASS high precision integrated receiver



BDS/GNSS high precision RTK receiver



》 (II) Application Promotion

2. Industrial / Regional Applications

Transportation Industry

- A total of 3.8 million sets of BDS compatible terminals have been promoted and installed in the coach, tourism charter, dangerous goods vehicles and other key fields.



《 》 (II) Application Promotion

2. Industrial / Regional Applications

- Industrial demonstrations, such as maritime transportation, meteorology, fisheries, public safety, disaster relief and civil affairs , as well as regional demonstrations are being carried out .



》 (II) Application Promotion

3. Mass Market Applications

- With the development of some technologies, such as chip miniaturization, low power, low cost, and RF baseband integration etc., as well as extensive integration of satellite navigation IP core and mobile communications, BeiDou will be fully applied to the mass market and serve the public.



(II) Application Promotion

4. Development of Industrialization

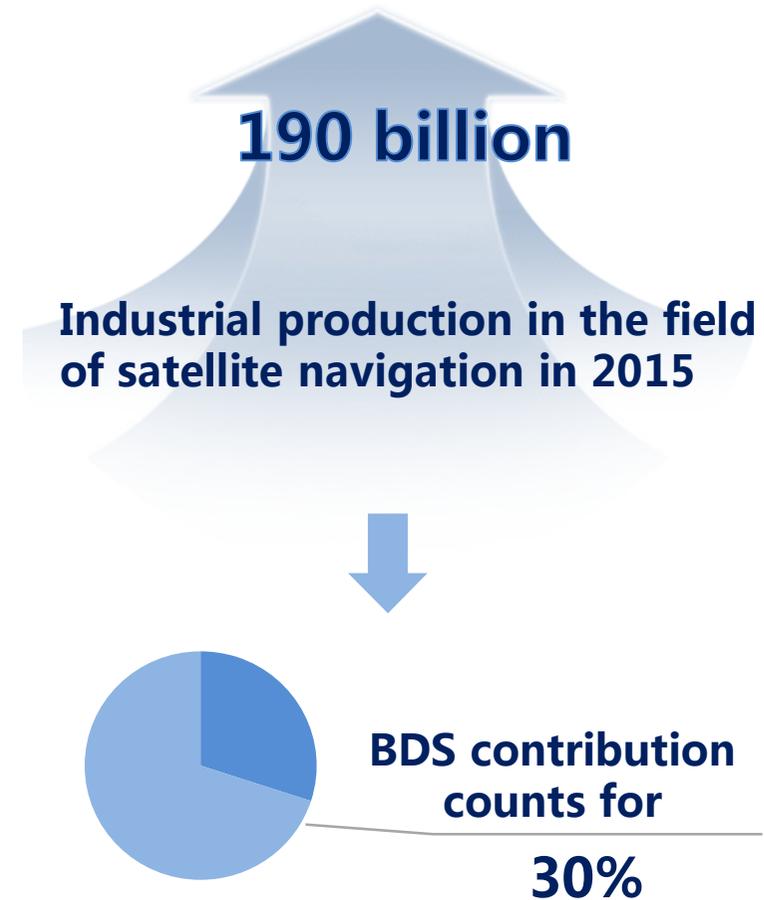
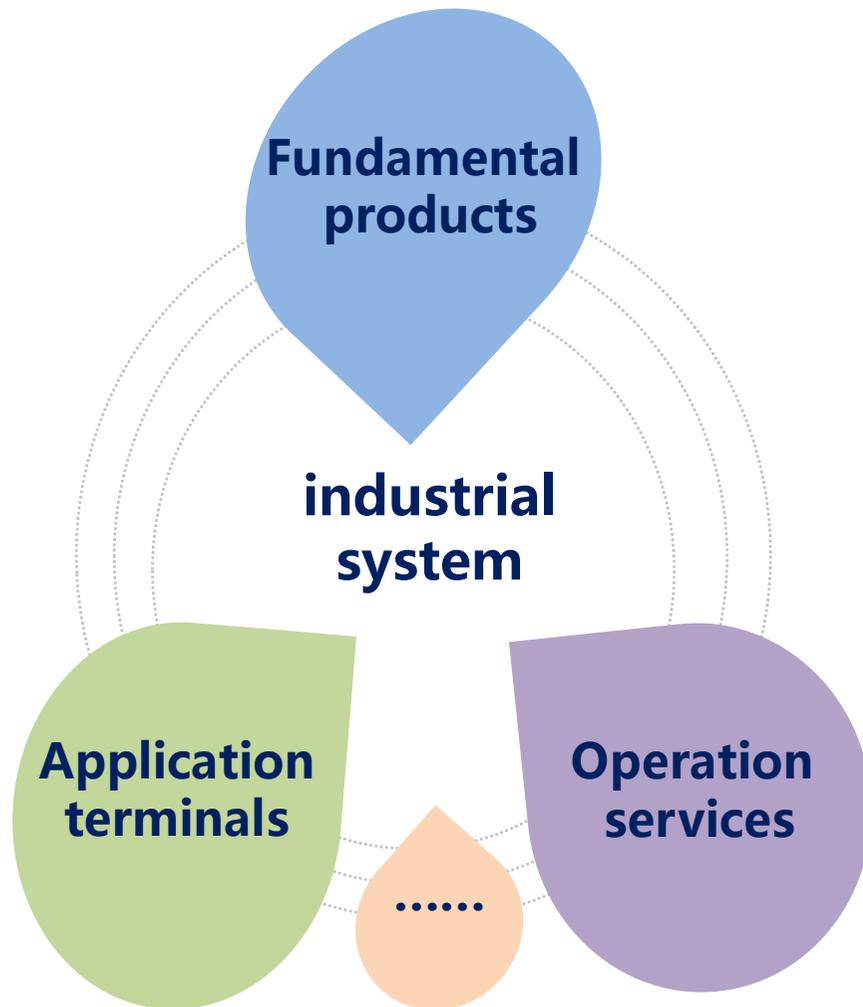
National medium and long term development program on satellite navigation industry and Medium and long term development program on national civil space infrastructure have been released, which makes the general planning and deployment in the long term development of satellite navigation industry at the national level.

BeiDou Navigation Satellite Standard System (version 1.0) and 17 BeiDou standards have been released, which will promote the construction of BeiDou navigation satellite standard system.



》 (II) Application Promotion

4. Development of Industrialization



(III) International Cooperation

1 . Bilateral Cooperation

Keep coordinating with other navigation satellite systems in the sector of compatibility and interoperability, to jointly provide high quality services for users.

China -Russia

- The Chinese-Russian Committee in the field of Satellite Navigation has been founded within the China-Russia Prime Ministers' Regular Meeting framework. The memorandum of understanding on satellite navigation cooperation has been signed. Working groups have been set up. The Joint Statement on GLONASS/BDS Compatibility and Interoperability and Navigation Technology Application cooperation has been released, and seven cooperation projects have been brought out.



(III) International Cooperation

China-U.S. Cooperation

- The cooperation mechanism between BDS and GPS has been set up.
- The Joint Statement between these two systems was released.
- Cooperation has been carried out in the field of compatibility and interoperability, augmentation system and civil aviation application, civil service, monitoring and evaluation.

China -EU Cooperation

- The frequency coordination towards navigation frequency channel between BDS and Galileo has been completed.
- The cooperation mechanism between these two systems are under discussion, especially in the field of compatibility and interoperability.



》 (III) International Cooperation

2. Multilateral Cooperation

- Participated in the meetings of the ICG, ITU and other GNSS activities organized by the United Nations.
- Hosted the 30th SBAS IWG meeting, and to take part SBAS related coordination



(III) International Cooperation

- **Host the China Satellite Navigation Conference, one of the largest GNSS conferences in the world**
- **Attend other international academic conferences in the field of satellite navigation**
- **Carry out the education and training on global satellite navigation, especially in the developing countries.**



» (III) International Cooperation

3 . International Standardization

- Propel the recognition of BDS in international organizations such as IMO, ICAO and 3GPP.
- BDS has been ratified by IMO and become the global satellite navigation system supported by the international mobile telecommunications.
- The RINEX 3.03 standard which supports BDS was published in Jan 2016.







Recent Plan

Provide fundamental services for global users by 2018, and full services by 2020.

In the field of ground based augmentation, provide the trial services, including meter/decimeter-level positioning services to major regions nationwide, centimeter level to density regions, and millimeter-level post-processing services. Complete the construction of dense reference stations for the nationwide frame network by 2018.

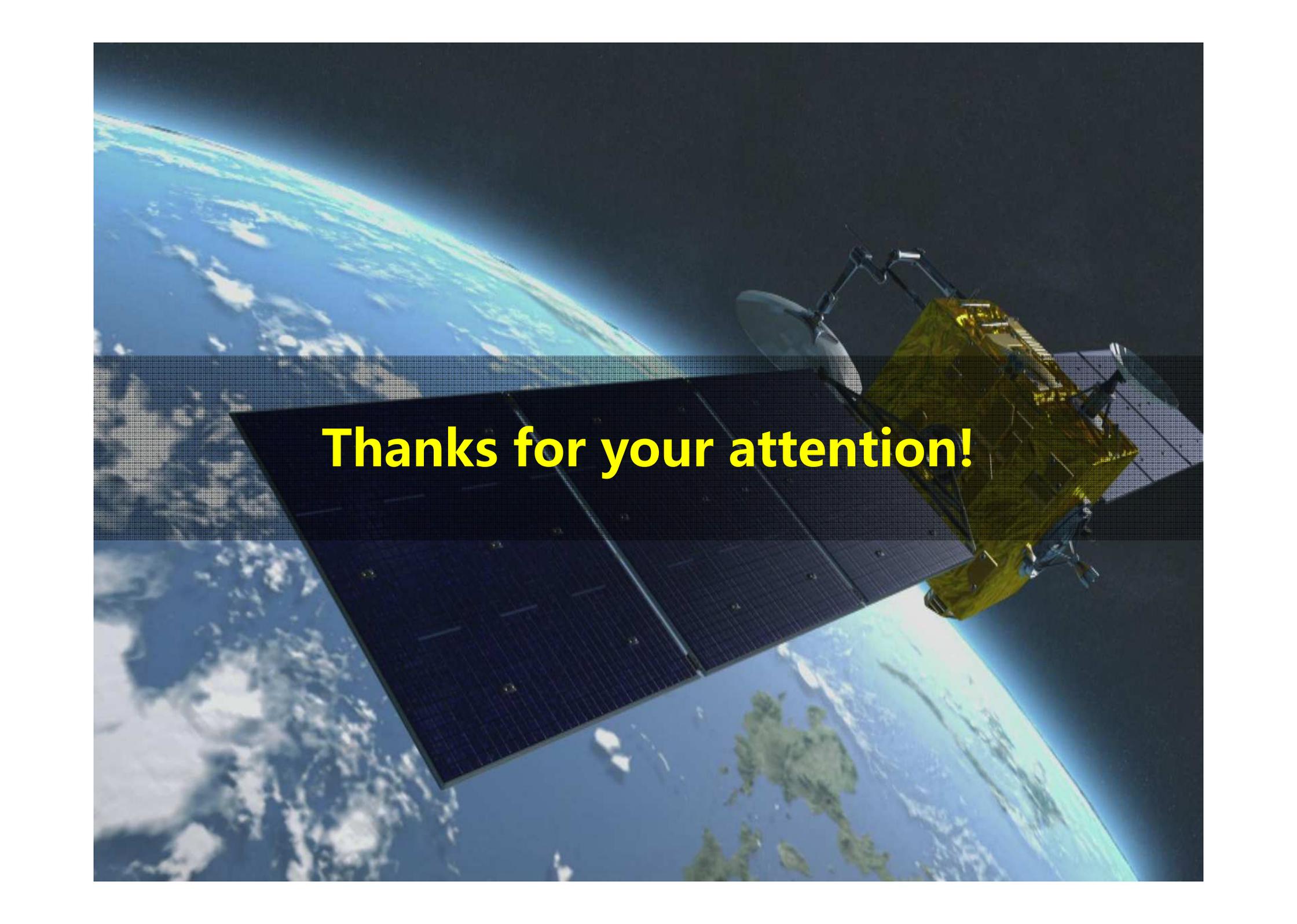




SUMMARY

- **BDS has been providing stable services to the Asia-Pacific region, successfully launched next-generation BeiDou satellites to verify new technologies, deploy the BeiDou augmentation system from all-round scale, and steadily push forward the BDS construction.**
- **The BDS applications market has been preliminarily fostered, expanding from the typical industries to mass market, and the application industry is under fast development.**
- **BDS promotes cooperation among GNSS deeply , and keeps strengthening international exchanges.**



A satellite is shown in orbit above Earth. The satellite has a large, dark solar panel array extending from its main body. The main body is covered in gold-colored thermal insulation. A large, white parabolic dish antenna is mounted on the satellite. The Earth's surface is visible below, showing blue oceans, white clouds, and green landmasses. The text "Thanks for your attention!" is overlaid in the center of the image in a bold, yellow font.

Thanks for your attention!