



# Operation and Development of BeiDou Navigation Satellite System

**China Satellite Navigation Office**



**01** **Development Plan**

**02** **Latest Progress**

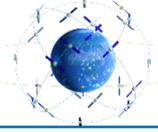
**03** **Near-term Plans**



# 01 Development Plan

**( I ) Basic Principles and  
Development Objectives**

**( II ) Fundamental Policies**



# ( I ) Basic Principles and Development Objectives

Openness Independence

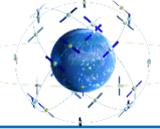
## Basic Principles

Compatibility Gradualness

- To provide continuous, stable and reliable positioning, navigation and timing services to global users
- To meet the requirements derived from national security, economic and social development sectors, to accelerate IT applications and the transformation of economic development methods, and to improve both economic and social benefits
- To serve the world and benefit the mankind through joint efforts with other navigation satellite systems across the globe

**Committed**





## ( II ) Fundamental Policies

**In June 2016, Chinese government officially published the White Paper on BeiDou System explaining the development concepts and policies:**

- **Provide open services free of charge for users**
- **Maintain and perfect the system constantly, improve service performance continuously, and offer services with higher quality**
- **Release open service performance specifications on schedule, bring the function of government and market to full play, promote innovation, popularization and internationalization of BeiDou/GNSS applications, and lay foundation for the national strategic emerging industries**
- **Adhere to the concept of development and win-win cooperation, realize compatibility and interoperability between BeiDou and other GNSS, give the system efficiency into full play and increase users' benefits**



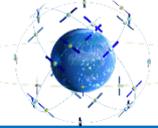


## 02 Latest Progress

**( I ) System Construction**

**( II ) Application Promotion**

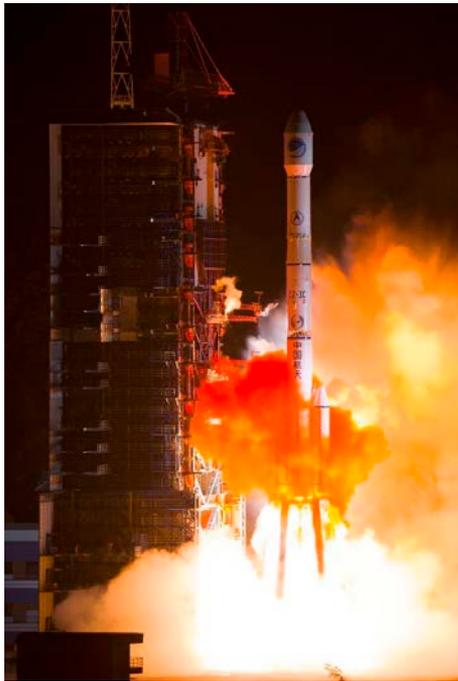
**( III ) International Cooperation**

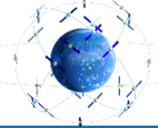


# ( I ) System Construction

## 1. Steady improvement of the BeiDou-2 System performance

To ensure steady operation of BeiDou-2 system, 2 more on-orbit backup satellites have been launched in 2016 based on the steady operation of 13 on-orbit satellites which improves the stability and availability of BeiDou-2 system constellation. The positioning precision has been optimized from 10 meters to 8 meters.



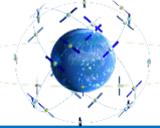


# ( I ) System Construction

## 1. Steady improvement of the BeiDou-2 System performance

**Conduct service-improvement work and complete the annual tasks of upgrading and reconstruction of ground system. To achieve user-oriented service, upgraded control files on application interface are released in time in accordance with the constellation change.**





# ( I ) System Construction

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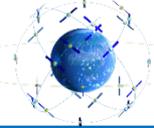
## 2. Constructions of BeiDou-3 system are Steadily Pushed Forward

**Completed the tests and verifications of five BeiDou-3 satellites in 2015 and 2016, make breakthroughs on the core technologies of the system in a comprehensive approach and basically solidify the status of the satellite.**

**BeiDou-3 satellite will be equipped with B1C interoperable signal with optimized performance, the B2I signal will be gradually upgraded to B2a signal with the construction of global satellite systems, and provide Satellite-Based Augmentation System (SBAS) and Search and Rescue(SAR) services based on further enhancement of basic navigation services and international standards.**

**Meanwhile, BeiDou-3 will adopt the higher-performance rubidium atomic clock with stability of E-14 and hydrogen atomic clock with stability of E-15. By utilizing new technologies, performance of BeiDou-3 satellite will be tremendously improved with better signal-in-space (SIS) accuracy superior to 0.5m.**





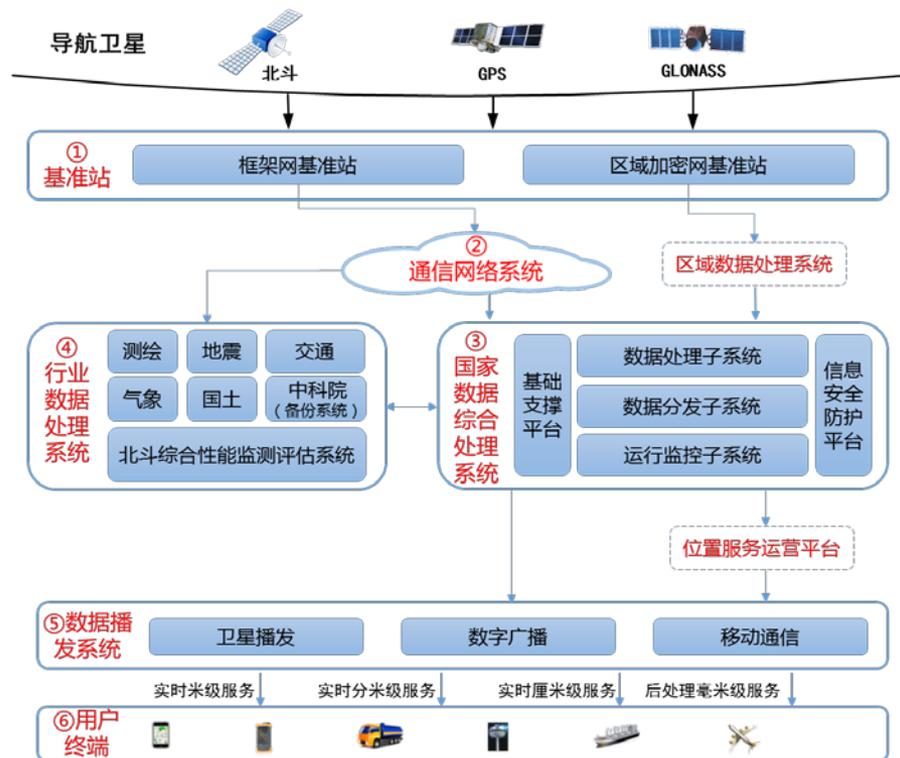
# ( I ) System Construction

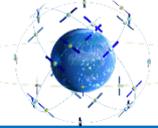
## 3. Application of Ground-based Augmentation System

Complete the Phase I construction tasks of ground-based augmentation system :

- 150 framework reference stations
- 1200 reference stations of higher-density network
- national data processing center
- 6 industrial data processing center
- user terminal etc.

form the capability of basic services, and will release the standards of service performance and control files of application interface, and make a commitment to the meter-level and sub-meter level high-accuracy positioning services.

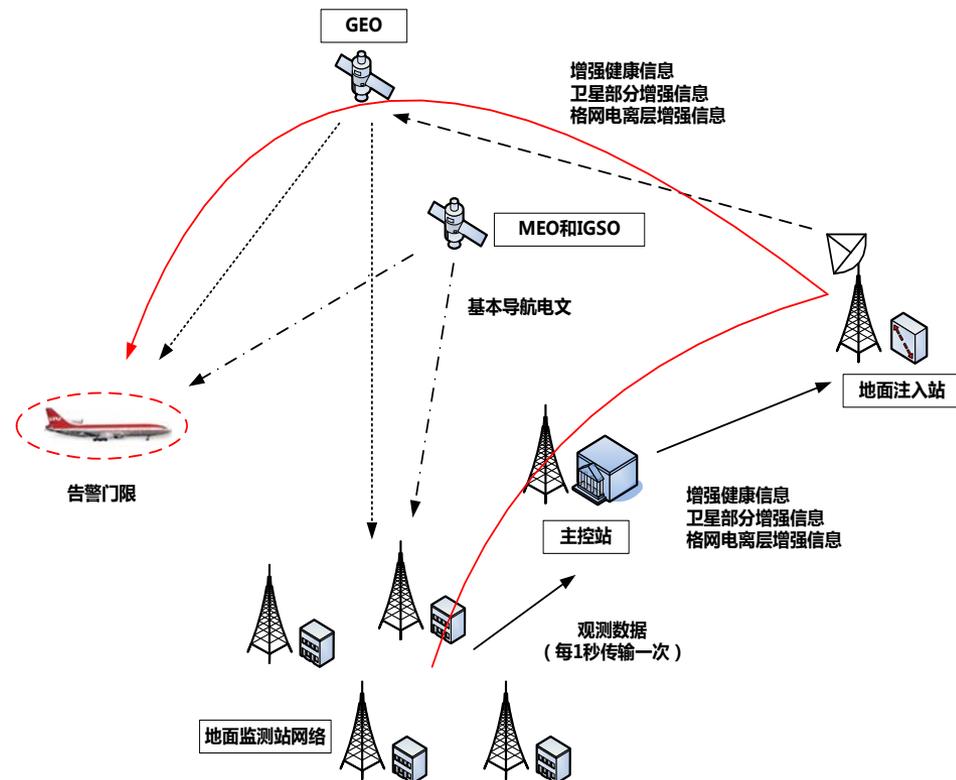


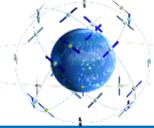


# ( I ) System Construction

## 4. Construction of Satellite-based Augmentation System is Comprehensively Pushed Forward

Carry out the design, test and construction of BeiDou Satellite-based Augmentation System(BDSBAS) based on the standards of ICAO. Currently, implementation plan of the system has been demonstrated which solidifies the technical status of the system in the standards of next-generation Dual Frequency Multiple Constellation(DFMC) SBAS and further consolidates the status of BDSBAS as the satellite-based augmentation service provider.



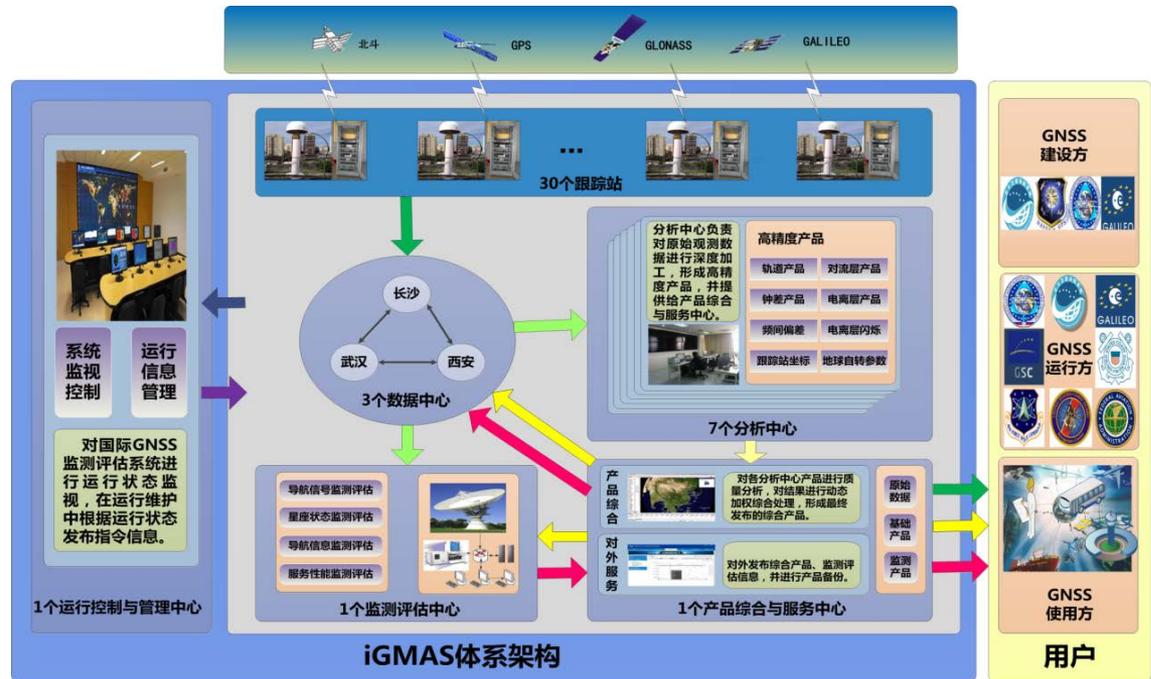


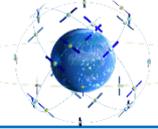
# ( I ) System Construction

## 5. Continuous development of international GNSS Monitoring & Assessment System

8 domestic monitoring stations、15 foreign monitoring stations have been built, with the monitoring and assessment abilities of GPS, GLONASS, Beidou, Galileo systems. The system has been substantial advanced in APSCO, IGMA-IGS joint experimental project, Sino-Russian monitoring and assessment cooperation, and play an important role in

steady operation of BeiDou-2 system, as well as the construction of BeiDou-3 global system.

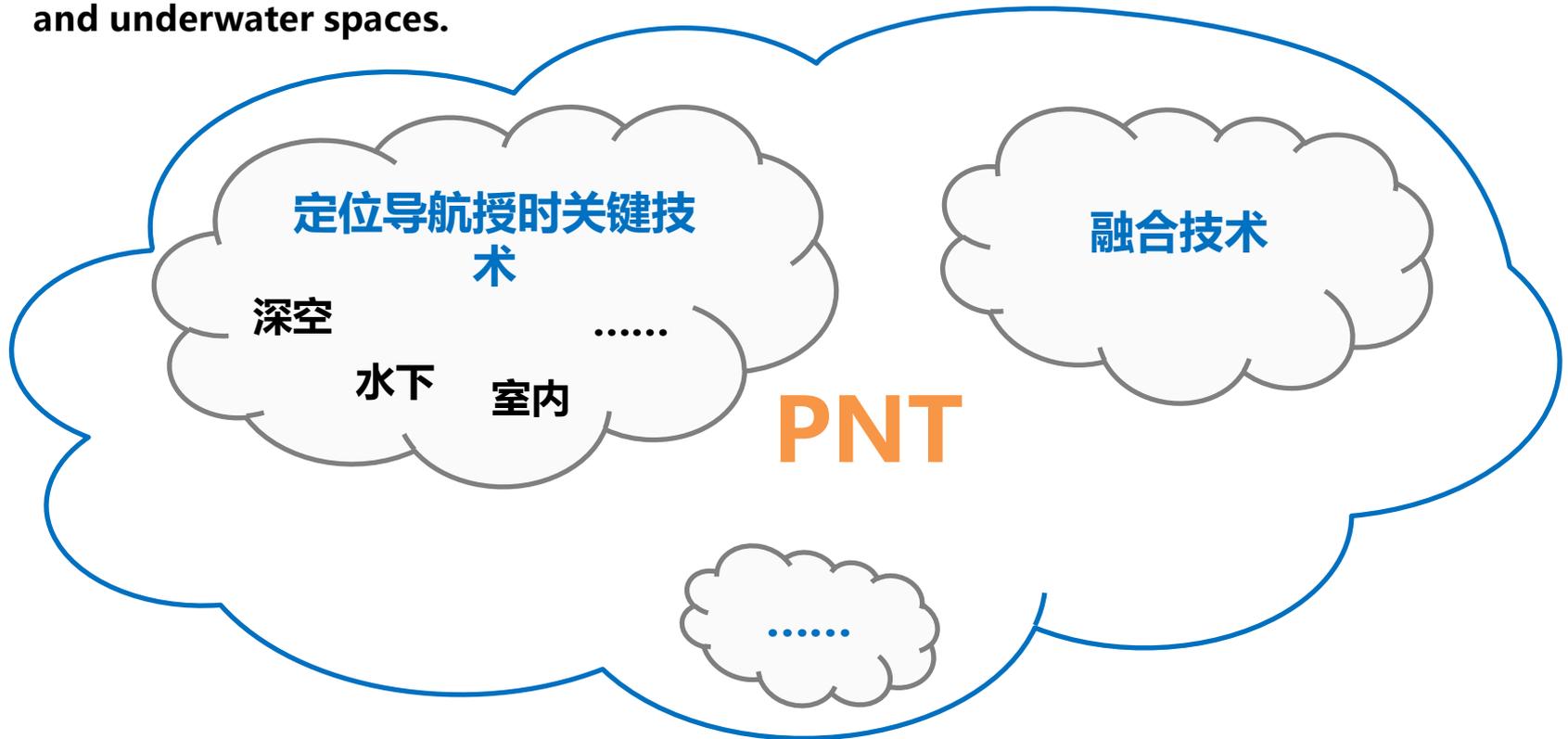


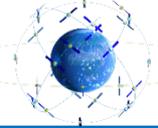


# ( I ) System Construction

## 6. National Integrated PNT System Constructing in Multiple Points

Further demonstration of national integrated PNT(Positioning, Navigation and Timing) system is being conducted to develop key technologies and integrated technologies on positioning navigation timing services in deep spaces, indoor spaces and underwater spaces.





# ( I ) System Construction

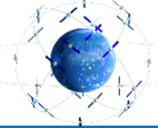
## 6. National Integrated PNT System Constructing in Multiple Points

**XPNAV-1 has been successfully launched and several on-orbit experiments such as the Crab Pulsar observations have been carried out. The data obtained from the Pulsar observations has been published on the BeiDou network ([www.BeiDou.gov.cn/xpnavdata.rar](http://www.BeiDou.gov.cn/xpnavdata.rar)) for public research and academic exchange as well as enhancing the development of Pulsar navigation technology.**



The screenshot shows the official website of the BeiDou Satellite Navigation System. The header features the logo and the text "北斗卫星导航系统" (BeiDou Satellite Navigation System) with the URL "WWW.BEIDOU.GOV.CN". The main content area displays a news article titled "脉冲星试验01星在轨试验数据发布" (Pulsar Experiment 01 Satellite In-orbit Experiment Data Release), dated 2017-05-09. The article text states that the XPNAV-1 satellite was successfully launched on November 10, 2016, and is currently in good health, conducting pulsar observation experiments. It provides a link to the data release: [www.beidou.gov.cn/xpnavdata.rar](http://www.beidou.gov.cn/xpnavdata.rar) and a contact email: [xpnav1@beidou.gov.cn](mailto:xpnav1@beidou.gov.cn). The left sidebar contains navigation links: 首页 (Home), 系统介绍 (System Introduction), 新闻中心 (News Center), 北斗产业化 (BeiDou Industrialization), 政策标准知识产权 (Policy, Standards, and Intellectual Property Rights), and 交流合作 (Exchange and Cooperation).

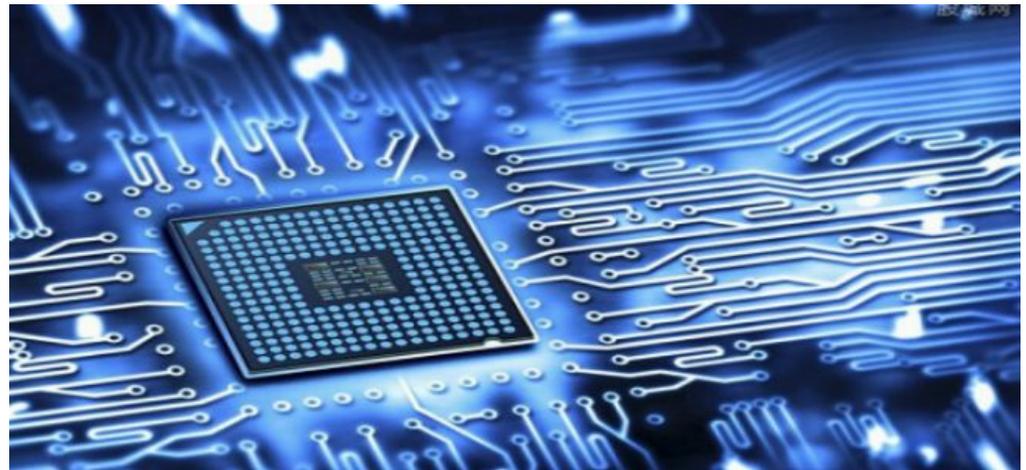


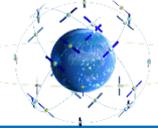


# ( II ) Application Promotion

## 1. Fundamental products provide tailor-made services

The fundamental products of BeiDou have achieved independence and controllability, and the related technologies have reached or nearly approached international level. By the joint ecological cooperation of industrial giants and digging in the industrial and user needs, BeiDou system has presented the advantages on products and services. With the release of the first Chinese in-house developed “meter-level fast positioning BeiDou chip” , application of BeiDou system starts to embrace the era of meter-level positioning.



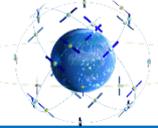


## ( II ) Application Promotion

### 1. Fundamental products provide tailor-made services

By April 2017, the sales volume of BeiDou navigation chips and modules has exceeded 30 million pieces, and that of high-precision surveying boards and navigation antenna take 30% and 90% of market shares respectively. The products have accessed to the markets of over 70 countries and regions, over 30 of which are along the Belt and Road.

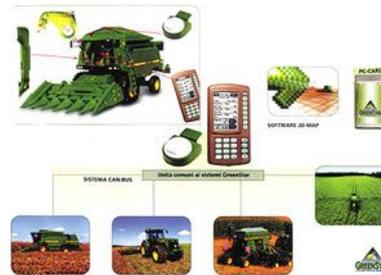


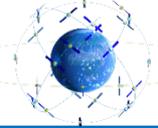


# ( II ) Application Promotion

## 2. Industrial/Regional Demonstration Applications are Integrated in An All-round Manner

Jointly pushed forward by Cyberspace Administration of China, National Development and Reform Commission, China's Ministry of Science and Technology and China's Ministry of Industry and Information Technology, BeiDou applications have made achievements and progressively enhanced in a spectrum of industries and fields such as agriculture, forestry, fishery, police equipment and disaster prevention and relief since 2016.



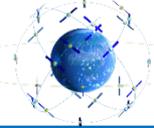


# ( II ) Application Promotion

## 2. Industrial/Regional Demonstration Applications are Integrated in An All-round Manner

At the beginning of this year, BeiDou applications in power distribution industry have drawn attention from all stakeholders. By transmitting parameter information via BeiDou short message communication function in the automated operation of power distribution, the coverage defect of ground-based public communication network in remote areas has been solved , which sets up a new model of electricity information acquisition in remote domestic areas that lacks public communication signals.



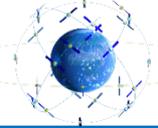


# ( II ) Application Promotion

## 2. Industrial/Reginal Demonstration Applications are Integrated in An All-round Manner

Driven by the first industrial demonstration project— “Demonstration Project of Monitoring and Management on Key Transportation Process” , over 4 million commercial vehicles across have installed the BeiDou-compatible terminal which helps forming the largest dynamic monitoring system for commercial vehicles worldwide including a set of dynamic monitoring system concerning test, investigation, data access, management and assessment. The monitoring system increases the efficiency of commercial vehicle monitoring and improves safety of road transportation.

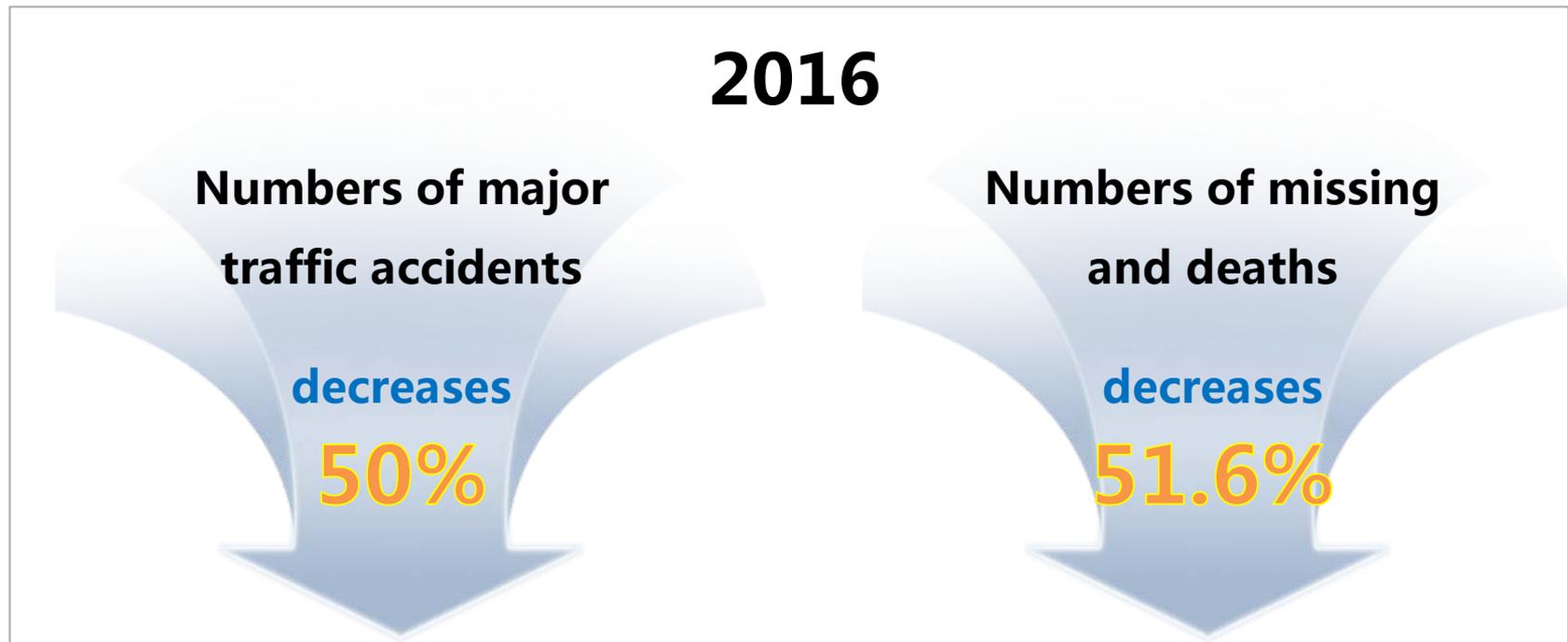


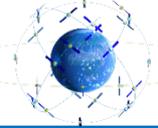


## ( II ) Application Promotion

### 2. Industrial/Reginal Demonstration Applications are Integrated in An All-round Manner

According to the statistics released by China's Ministry of Transport, numbers of major traffic accidents as well as missing and deaths witness 50% and 51.6% year-on-year decreases respectively in 2016.





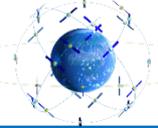
## ( II ) Application Promotion

### 3. BeiDou High-accuracy Service Revolutionizes the Forms of Industrial Applications

- bluegogo—the shared bicycle has achieved precision positioning through BeiDou technologies
- Mobike has been fully compatible with three-model satellite positioning of BeiDou, GPS and GLONASS
- ofo has built strategic-partner relations with BeiDou navigation with the purpose of fine management of bicycles based on BeiDou Smart Lock in order to push forward the establishment of new standards of positioning technologies in bicycle-share industry.

With the support of BeiDou high-precision positioning technologies, the defects on positioning, bicycle finding, irregular parking and bicycle management can be solved. BeiDou makes human-bicycle interconnectivity more integrated and smarter.



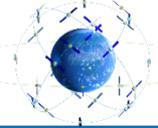


## ( II ) Application Promotion

### 3. BeiDou High-accuracy Service Revolutionizes the Forms of Industrial Applications

Qianxun Spatial Intelligence is the company that developed FindNow, the first acceleration auxiliary positioning system compatible with Assist-BeiDou(A-BeiDou) worldwide. Based on the BeiDou ground-based augmentation system, FindNow can achieve **centimeter-level** positioning accuracy and **3 seconds** of acquisition time. Now the acceleration positioning service has been adopted by over **40 million** users in over **200 countries** and regions and the number of daily use reaches up to **0.1 billion**.



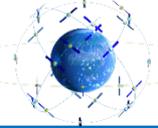


## ( II ) Application Promotion

### 3. BeiDou High-accuracy Service Revolutionizes the Forms of Industrial Applications

BeiDou has achieved cross-border integration in several livelihood fields where all types of high-precision data service products have been widely applied in over 10 typical scenarios such as driving assist, precision agriculture, examination and training of driving license, slope monitoring and smart property management among others. Currently, the integration-featured new model—namely model of “**BeiDou+ Internet+ other industries**” is building an emerging industrial ecological chain with the time and space information of BeiDou as the core, boosting the rapid development of BeiDou-related industries and pushing forward the innovation of production patterns, life styles as well as business models. BeiDou applications are available more than we can imagine.





## ( II ) Application Promotion

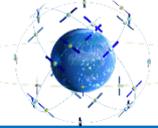
### 3. BeiDou High-accuracy Service Revolutionizes the Forms of Industrial Applications

Promoted by the initiative of mass creative business and innovation, and to serve countries along the "Belt and Road" , BeiDou industry will embrace the period of golden opportunities. By 2020, the volume of satellite navigation industry in China will surpass RMB 400 billion in which the BeiDou system will take RMB 240 billion to RMB 320 billion of market shares.

**By 2020**

- the volume of satellite navigation industry in China will surpass RMB 400 billion
- the BeiDou system will take RMB 240 billion to RMB 320 billion of market shares





## ( II ) Application Promotion

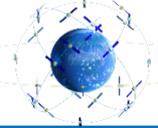
### 4 . Thrived Development of Industrialization

Chinese government attaches great importance to the development of BeiDou system, and is dedicated to the strategic in-depth integration between BeiDou system and the strategies such as “Informatization Development” . BeiDou industry is embracing the period of intensive policy release. Since 2016, national departments and ministries such as Ministry of Transport publish several BeiDou-related policies consecutively to support BeiDou application and industrial development with the state power; the governments in Beijing and other provinces and cities publish related regional policies based on the regional needs to boost local

economic development.

The future path of integrated industrial application and globalization of BeiDou system has been ever brighter.



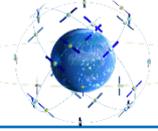


## ( II ) Application Promotion

### 4 . Thrived Development of Industrialization

The research and drafting work of *Regulations on Satellite Navigation of People's Republic of China* has been started. A drafting group involved key users and professionals and representatives from the central ministries, national departments, and enterprises concerning civil aviation, power grid, electric power and public security to name a few. Through the wide-range review and demonstration and nationwide academic workshops, the first draft of the regulations has been finished and will be released for public review.

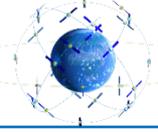




# ( III ) International Cooperation

Continuously propel the globalized development of BeiDou system, push forward the development of global satellite navigation and make a better BeiDou system providing better services for the world and people.





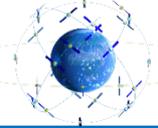
# ( III ) International Cooperation

## 1 . Carry Out Bilateral Cooperation



Keep coordinating with other navigation satellite system providers in the sector of compatibility and interoperability, and provide users together with high quality services.





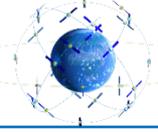
# ( III ) International Cooperation



## China-Russia Cooperation

- The third meeting of The Chinese-Russian Committee on Important Projects of Strategic Cooperation in the field of Satellite Navigation has been convened in November 2016 which has officially launched 7 cooperation projects including the Service Platform of Chinese-Russian Satellite Navigation Monitoring and Assessment , Joint Demonstrations on BeiDou and GLONASS-based Cross-border Transporters and Joint Design Center of Chinese-Russian Navigation Chips.
- The countries are pushing forward new cooperation on satellite-based augmentation system and education and training in the field of satellite navigation.





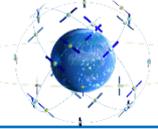
# ( III ) International Cooperation



## China-U.S. Cooperation

- 2 meetings of sub-work group jointly organized by China and U.S. have been convened to conduct the work on compatibility and interoperability coordination of newly-increased global signals of BeiDou.
- Promote the cooperation on augmentation system applications in civil aviation, civil use and related monitoring and evaluation.





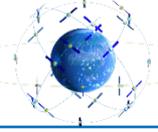
# ( III ) International Cooperation



## China -EU Cooperation

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



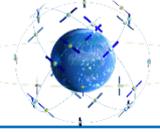


# ( III ) International Cooperation

## 2. Participate in International Satellite Navigation Organization activities

Participate in the meetings of the ICG-11, ITU and SBAS IWG-30 organized by the United Nations, and Munich Satellite Navigation Summit, Moscow SatNav Forum and ION' s Pacific PNT Conference, to carry out technical exchanges and cooperation.





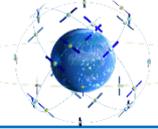
# ( III ) International Cooperation

## 2. Participate in International Satellite Navigation Organization activities

Encourage academic exchanges; till now the China Satellite Navigation Conference has been held for 8 times. It has become a most influential international academic exchange platform in China and worldwide. The 8th China Satellite Navigation Conference has been held in Shanghai this year and about 3000 persons have attended.

- The annual conference is dedicated to innovation which has make lots of contributions to the construction and application of satellite navigation system, PNT system and industrial development
- The annual conference boasts distinct theme, adheres to the global scientific development trends and leads the edge of integrated development of applications on satellite navigation, mobile communication, internet, IoT and AI
- The annual conference boasts plentiful contents including academic exchanges, exhibitions and science generalization which attract peers from all various sectors



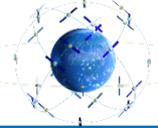


# ( III ) International Cooperation

## 3 . Promote Application Cooperation

- At the beginning of this year, the visit group of UNOOSA came to China to inspect the construction of BeiDou system and they spoke highly of the achievement obtained by BeiDou system.



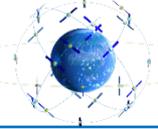


# ( III ) International Cooperation

## 3 . Promote Application Cooperation

Recently, we launched the first China-Arab States BeiDou Cooperation Forum where over 80 representatives from 21 countries of Arab League carry out report exchange with Chinese part and have a visit on the achievement exhibition of BeiDou applications in order to promote China-Arab States cooperation on satellite navigation.





# ( III ) International Cooperation

## 4 . Integrate into the International Standardization

Since BeiDou system obtained recognition by International Maritime Organization last year, BeiDou has made material progress in the standards of International Maritime Organization(IMO). In March this year, Multi-system shipborne receiver standard which is compatible with GPS, Beidou, GLONASS was approved; meanwhile, BeiDou system has been included in the PNT guidelines of maritime applications.

On the standards of international mobile communication, BeiDou system has become one of the global satellite navigation system approved by the international mobile communication standards. Now 26 international standards concerning BeiDou system have been formulated and the penetration of BeiDou in China' s mobile communication field has achieved 25% with support of related standards of mobile communication.



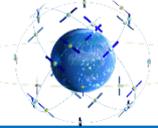


## 03 Near-term Plans

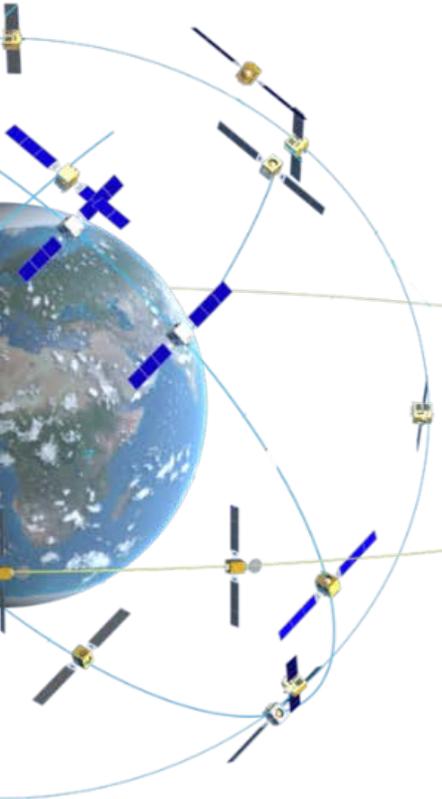
**( I ) System Construction**

**( II ) Application Promotion**

**( III ) International Cooperation**



# ( I ) System Construction

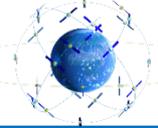


**1** Keep improving the continuous stability and service accuracy of the BeiDou System, and will launch 2 BeiDou-2 backup satellites in 2018, ensuring its regional service performance maintain stable and grow better.

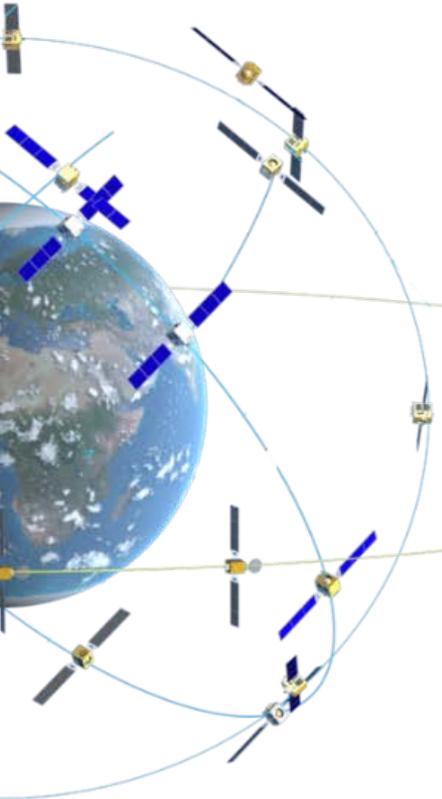
**2** Push forward the research, development and construction of BeiDou-3 system.

- In 2017, it is planned to launch 6 to 8 BeiDou-3 MEO satellites
  - In 2018, about 10 BeiDou-3 MEO satellites and 1 BeiDou-3 GEO satellite will be launched
  - From 2019 to 2020, 6 BeiDou-3 MEO satellites, 3 BeiDou-3 IGSO satellites and 2 BeiDou-3 GEO satellites will be launched
  - In August 2017 , plan to publish the beta version of ICD documents on B1C and B2a signals
  - Further verify the accuracy and availability of interface documents based on the on-orbit satellite tests, and plan to publish the official version of ICD documents on B1C and B2a signals at the beginning of 2018
- BeiDou system will guarantee continuous and stable operation, steady improvement on the service performance with meeting promised standards as a prerequisite, and gradually obtain the worldwide service capability.





# ( I ) System Construction



**3** In 2018, complete the construction of Phase II BeiDou ground-based augmentation system with meter/decimeter-level positioning accuracy available to major regions nationwide, centimeter level to density regions, and millimeter level correction data for post-processing services.

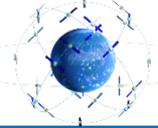
**4** **●**In 2018, the first BDSBAS GEO satellite will be under the phase of system integration and test

**●**In 2019, the construction of related ground-based monitoring network will be improved

**●**In 2020 , launching of 2 GEO satellite will be finished and initial service capability of satellite-based augmentation system covering China and the neighboring areas will take shape

**5** Promote and complete the construction of the national comprehensive PNT system with the united benchmark, no-gap coverage, security and effectiveness by 2030. Remarkably advance the national time and space services, meet the requirements derived from national economic and security sectors, and provide high-quality services to global users.



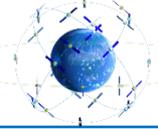


## ( II ) Application Promotion



- 1** Carry out all-round R&D and industrialization of new generation BDS/GNSS fundamental products, improve the core strength on service performance, power consume, compact design and cost, so as to promote the mass market applications of hundred-million units.
- 2** Bring GNSS in the integration procedure between industrialization and IT applications, combine GNSS with the national strategies like the Belt and Road, Beijing-Tianjin-Hebei Integration, Yangtze River Economic Belt, etc. and push forward applications.
- 3** Accelerate the drafting and formulation of Regulations on Satellite Navigation of People' s Republic of China, fill in the gap of related domestic laws and improve healthy development of satellite navigation industry.
- 4** Construct ecologic system BeiDou application and service; promote the innovation of the BeiDou application based on the convergence of the network, the collection of data, the harmonization of terminals and fund raising.





## ( III ) International Cooperation

**1** Promote cooperation and exchanges with satellite navigation system suppliers from U.S., Russia and the Europe etc., strengthen bilateral cooperation on compatibility, interoperability, monitoring and evaluation, SBAS and applications, to name a few.

**2** Continue international coordination on the global organization platforms such as ICG, ITU, ICAO and IMO to push forward the globalization of BeiDou system and fulfill the responsibilities of a global power.

**3** Use the Silk Road Economic Belt and 21st-Century Maritime Silk Road as a fulcrum, promote the internationalization of BeiDou System, and serve the areas along it.



A satellite with a large solar panel and a gold-colored body is shown in orbit above the Earth. The Earth's surface is visible with blue oceans, white clouds, and green landmasses. A semi-transparent dark grey rectangular box is overlaid on the center of the image, containing yellow text.

**Thanks for your attention and support TO  
the BeiDou System.  
Thank you!**

**CSNO**