

Development of BeiDou Navigation Satellite System



China Satellite Navigation Office
May 18 2015 Krasnoyarsk, Russian Federation

Contents

1

System Overview

2

System Application

3

International Cooperation

4

Recent Plan

5

Summary

Contents

1

System Overview

2

System Application

3

International Cooperation

4

Recent Plan

5

Summary

Development Objectives



The BeiDou System is committed:

- 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.



Basic Principles



Openness

The BeiDou System will offer open services free of charge for global users.

Independency

Develop and operate BeiDou system independently.

Basic Principles

Compatibility

The BeiDou System is devoted to pursue compatibility and interoperability with other navigation satellite systems, and enable users to obtain better services.

Gradualness

The establishment of BeiDou System follows a stepwise manner in the light of Chinese actual technical and economic conditions.



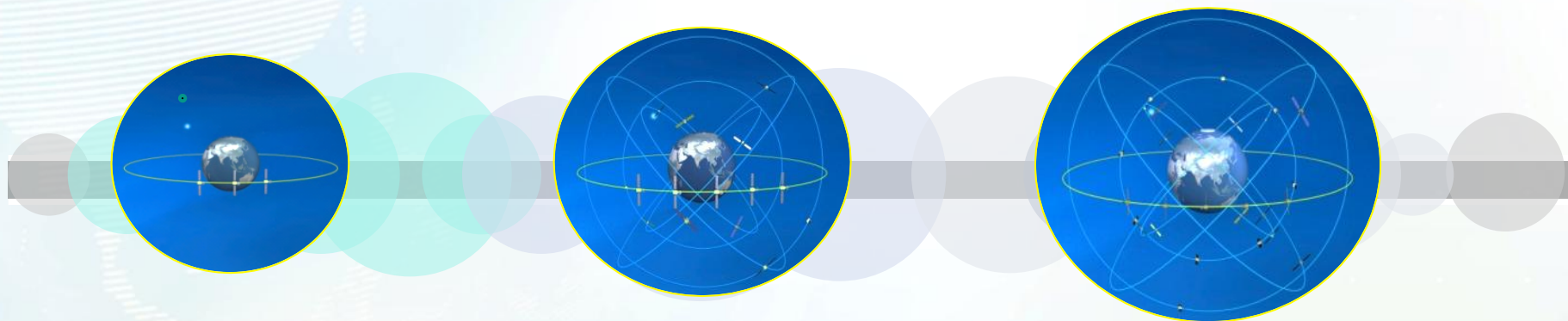
Development Steps



The BeiDou System has been developing in line with the “three-step” roadmap and the thinking of “from regional to global, and from active to passive”, and forms a development path as region-highlighted, world-oriented, with its own features.

The 1st step:
1994~2000, provide regional active services

The 3rd step:
2013~2020, provide global passive services



The 2nd step:
2004~2012, provide regional passive services



System Architecture



Basic System



Four types of services:
open, authorized, wide area differential and short message services.





Augmentation Systems

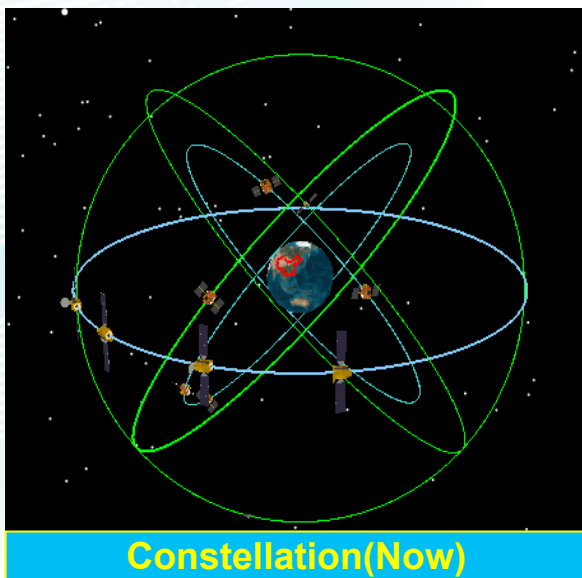
- Ground & Satellite based
- Positioning and navigation services
 - meter/decimeter – level (wide area)
 - centimeter – level (real time, China and its neighboring areas)
 - 175 reference stations (backbone network), 1000+ stations (regional density network)
- CAT-I services for civil aviation users
 - Dual-frequency multi-system augmentation signals
 - Preliminary Scheme Argumentation & Integrity



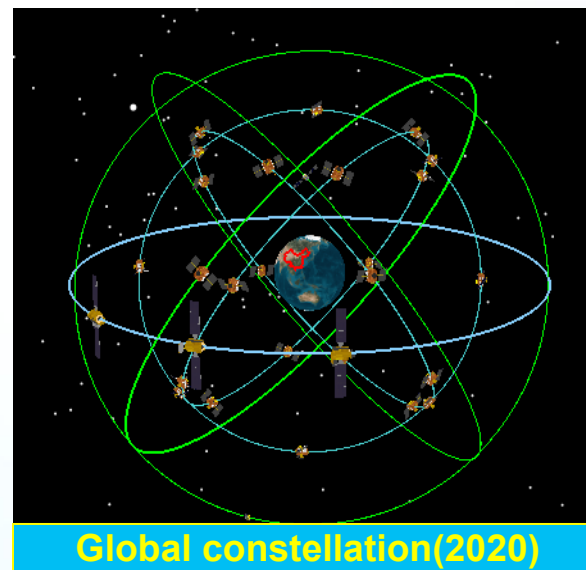
Current Status



- Since formal regional services provision on December 27 2012, the BeiDou System has maintained continuous and stable operation, and the service performance has met with the specification requirements.



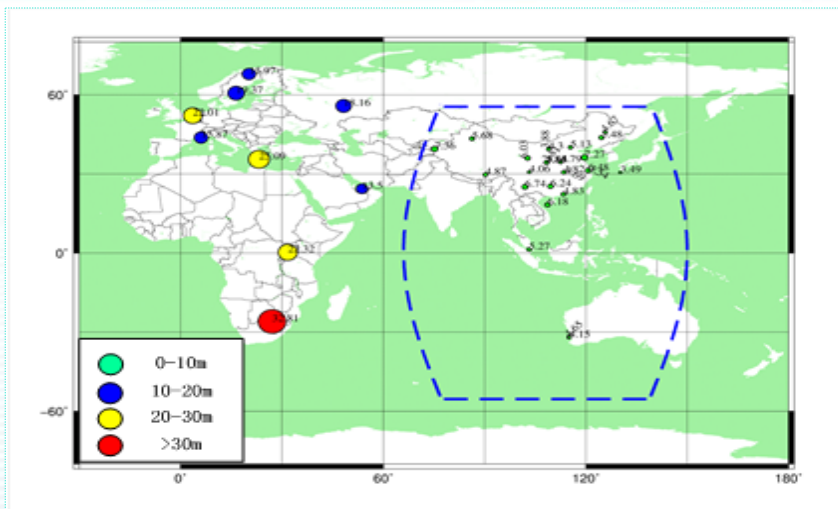
14 operational satellites in orbit
(5GEO+5IGSO+4MEO)



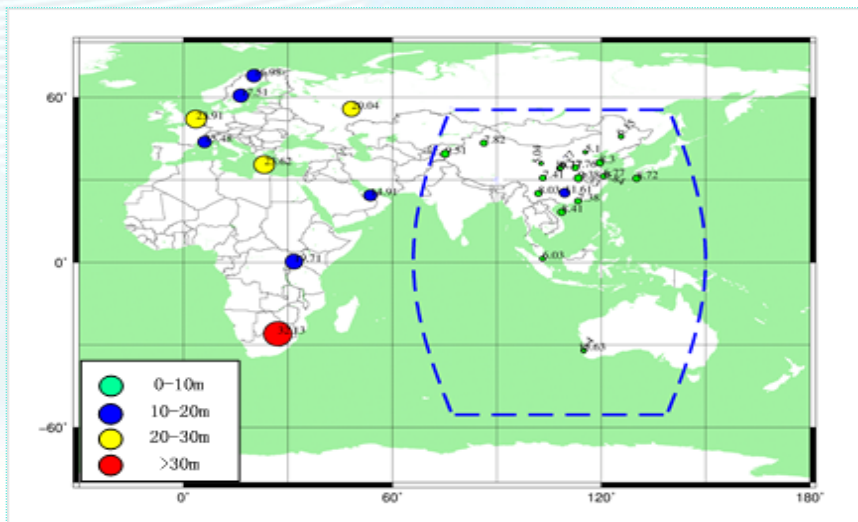
35 satellites
(5GEO+30 Non-GEO)



Current Status



B1I Horizontal Positioning Accuracy



B1I Elevation Positioning Accuracy

BDS System Performance

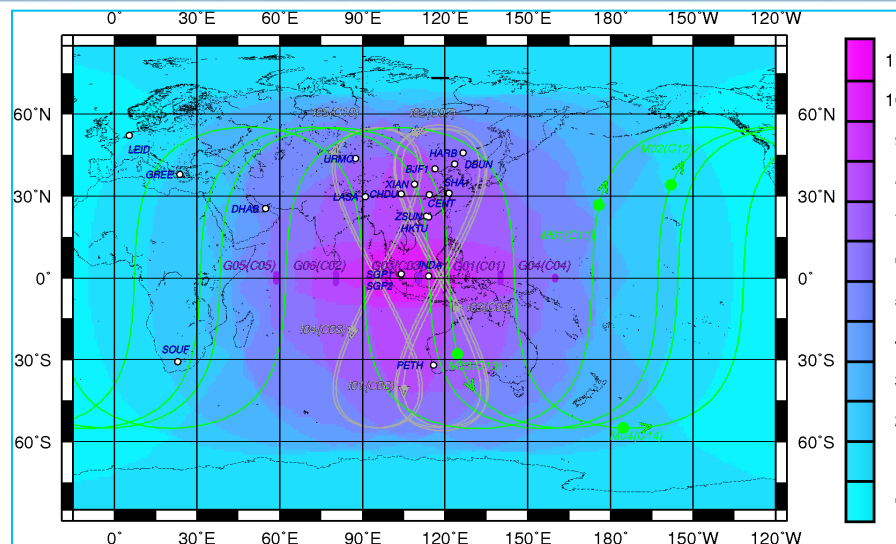
- Most parts of the Asia-Pacific region:
55° N-55° S , 55° E-180° E
- Open Service Performance Specification:
Position Accuracy: better than 10 m,
Velocity Accuracy: better than 0.2 m/
s.
Time Accuracy: better than 20 ns.



Current Status



- With 14 fresh BeiDou satellites in orbit, there is the largest number of available GNSS satellites in the BeiDou coverage area.
- A hybrid, asymmetric constellation consisting of GEOs, IGSOs and MEOs
- IGSOs and GEOs could provide better elevation angle. Service performance is more outstanding in the city canyon, multi-level traffic interchange, and tree-sheltered environment



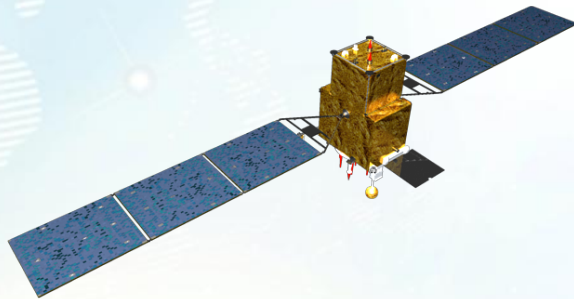
Distribution of visible in-orbit BeiDou satellites



Current Status



- The 1st new-generation satellite successfully launched on March 30, 2015.
- New signals and inter-satellite link, and other technologies is undergoing in-orbit test as scheduled.
- Right now, the new-generation satellite has preliminarily verified the new technology structure and performance specifications, which meet the designed requirements .



The first next-generation BeiDou satellite



Fundamental 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.



Contents

1

System Overview

2

System Application

3

International Cooperation

4

Recent Plan

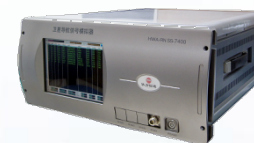
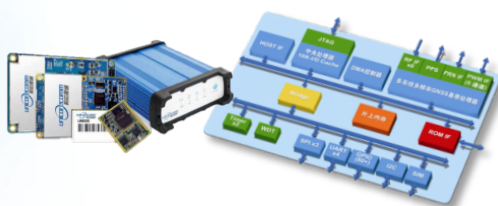
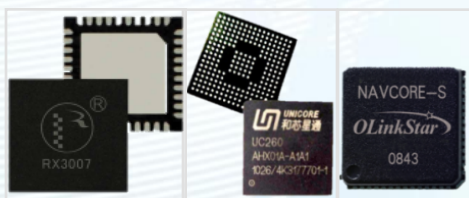
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Summary

Fundamental Products



- Promote the R&D and industrialization of fundamental navigation products with independent IPR in an all-round way, with the core as BDS/GNSS compatible chips.



- the sales volume of BDS/GNSS navigation chip/module has surpassed 6 million pieces
- the sales volume of high-precision surveying boards has surpassed 85, 000 sets, which amounts to 1/3 of the domestic market share
- the sales volume of navigation antenna is approximately 3 million sets
- the sales volume of high-precision antenna is approximately 280, 000 pieces, which amounts to 90% of the domestic market share



Fundamental Products



The research and development of next-generation BDS/GNSS chips which integrate baseband with RF has made great breakthroughs, and will meet global users' demands in the mass market, such as smart phones, PAD, wearable equipment, etc.



Smart phones



PAD



Wearable equipment



Industrial/Regional Applications



In view of the significant orientation and fields which have impact on the national welfare, the people's livelihood, and national security, carry out demonstrative applications in selected industries and regions with relevantly large application scales and outstanding marketing prospects.



Totally **750,000 sets** of BeiDou terminals have been promoted and applied.



Mass Market Applications

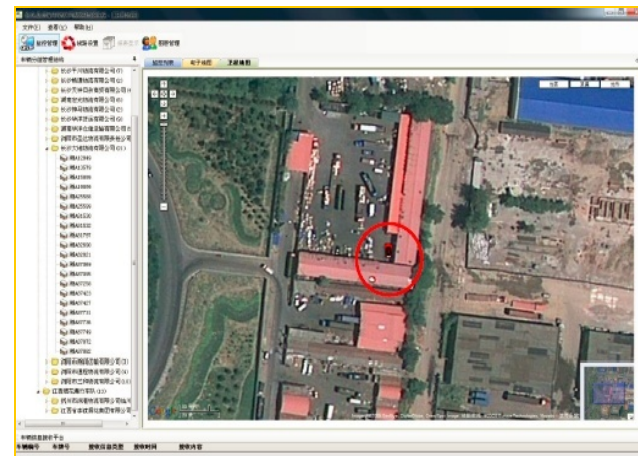


Applications Cases



★ Road Transportation Management

- Cargo, personnel and dangerous goods transportation management
- Over 80 thousand BeiDou vehicle terminals installed in 9 provinces and cities
- More than 2 thousand BeiDou/GPS handheld terminals equipped for regional law enforcement

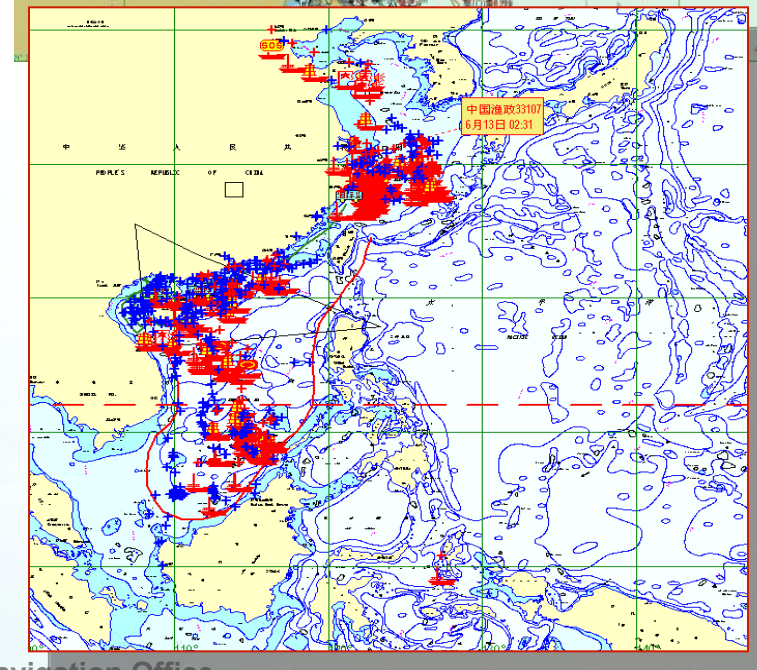
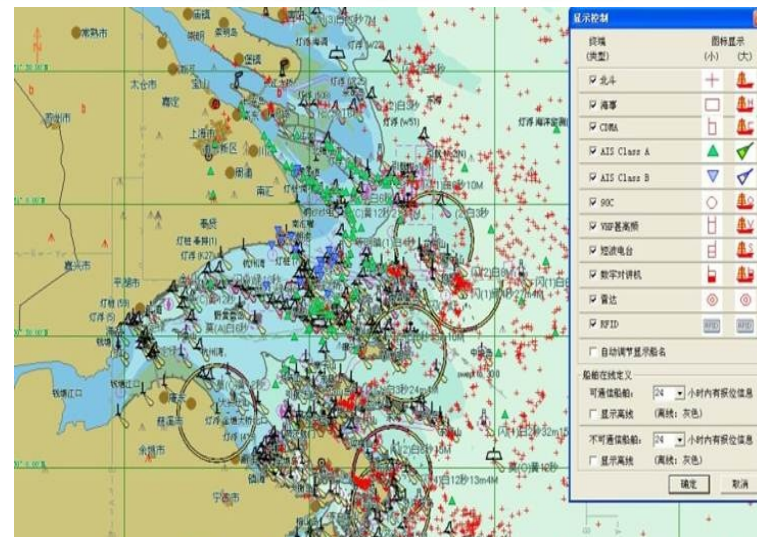


Applications Cases



★ Marine Fishery

- Vessel position monitoring
- Emergency alarm and rescue
- Port entry and departure management





★ Maritime Ship Management

- Integrating BeiDou/GNSS, GIS, satellite communications, mobile communications, etc
- Tracking & monitoring personnel and cargo logistics
- Information exchanges services among ships, between ships and the monitoring authority

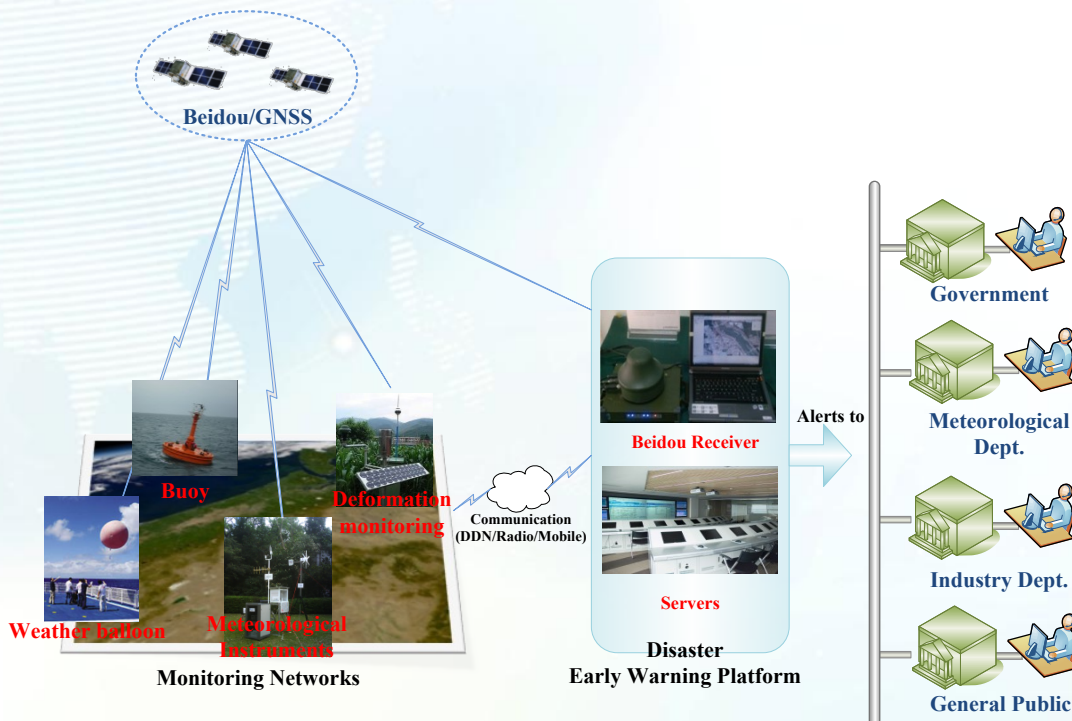


Applications Cases



★ Disaster Early Warning

- Air-land-sea integrated disaster surveillance network
- Collect and transmit real-time information through BeiDou Short message services, mobile/satellite communication

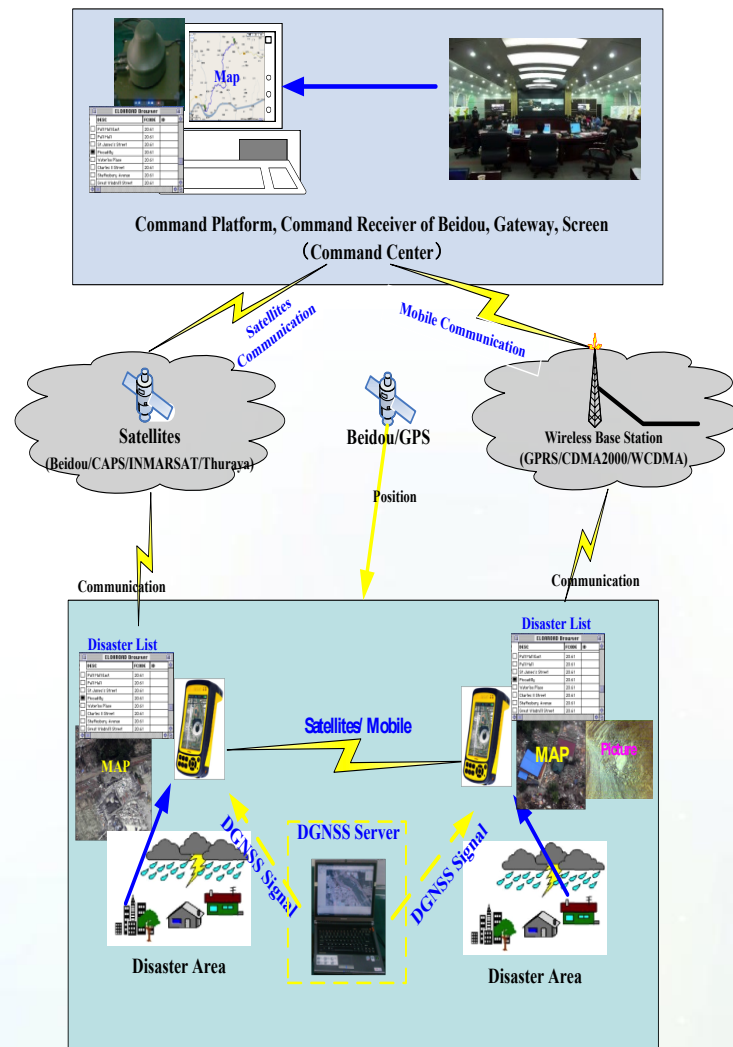


Applications Cases



★ Emergency Rescue & Command

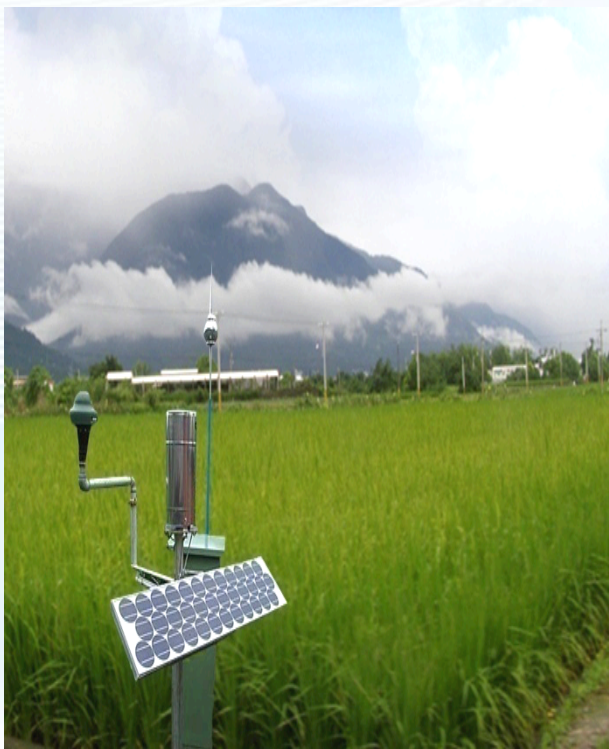
- Integrate BeiDou/GNSS, GIS, RS, communication technology
- Provide positioning and navigation services to rescue staff and vehicles
- Plan the path for supplies
- Report information to the commanding center



Applications Cases



★ Agriculture



Applications Cases



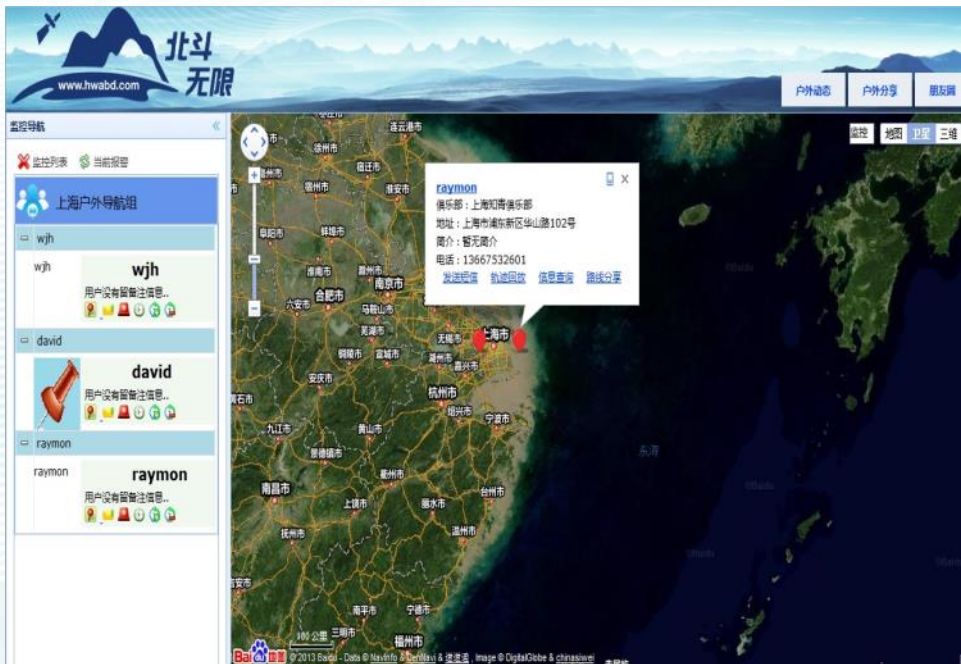
★ City Bus Management



Applications Cases



★ Outdoor Tourism



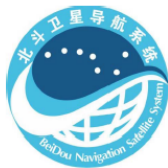


★ Related technical documents

- ★ BeiDou Open Service Performance Standard (version 1.0)
- ★ BeiDou Signal-In-Space Interface Control Document (version 2.0)

★ Two civil signals of BeiDou- B1I & B2I

BeiDou Navigation Satellite System
Open Service
Performance Standard
(Version 1.0)



China Satellite Navigation Office
December 2013

BeiDou Navigation Satellite System
Signal In Space
Interface Control Document
Open Service Signal (Version 2.0)



China Satellite Navigation Office
December 2013

(Both Chinese and English versions of above documents are available at www.beidou.gov.cn; <http://en.beidou.gov.cn/>)



Contents

1

System Overview

2

System Application

3

International Cooperation

4

Recent Plan

5

Summary

Bilateral Cooperation



Sino-Russia



Sino-U.S.



Sino-EU

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



Bilateral Cooperation



China -Russia

- The Project Committee on China-Russia GNSS cooperation
- The first bilateral round table meeting on GNSS cooperation
- The MOU on China-Russia cooperation in the field of satellite navigation
- GLONASS ground stations in China and BeiDou ground stations in Russia
- The joint statement on compatibility and interoperability .of BeiDou and GLONASS



Bilateral Cooperation



China-U.S.

The first bilateral meeting of China- U.S. civil GNSS cooperation has been held, the cooperation mechanism between BeiDou and GPS has been set up, and the Joint Statement between these two systems have been signed.



Bilateral Cooperation



China -EU

The frequency coordination towards navigation frequency channel between BeiDou and Galileo has been completed, and the cooperation mechanism between these systems are under discussion.



Multilateral Cooperation



Actively undertake international responsibility, promote the compatibility and co-existence among navigation satellite systems.

- **Actively participate in the 9th Meeting of the ICG, IWG, ITU and other GNSS activities organized by the United Nations**
- **Deeply join in the coordination of important subjects, such as the compatibility and interoperability among basic systems and Satellite-Bases Augmentation Systems, service performance parameter, GNSS monitoring and assessment, etc.**

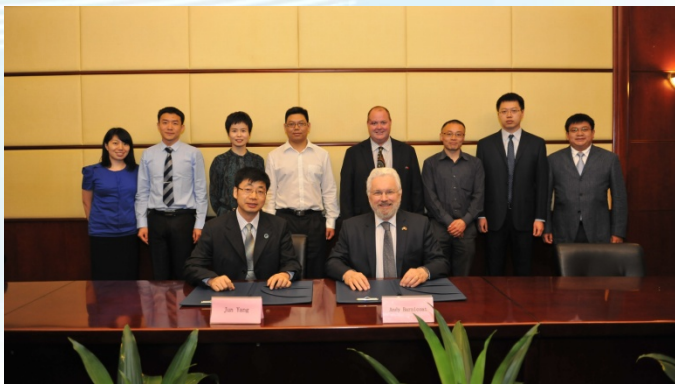


Applications Cooperation



Advocate integrated applications of multiple systems, push forward the BeiDou services to spread abroad and benefit neighboring countries, and include applying BeiDou System into the national strategic planning of jointly building the Silk Road Economic Belt and 21st-Century Maritime Silk Road, namely "One Belt and One Road".

- Carry out cooperation with Korea, Australia, Indonesia, Pakistan, Thailand , Singapore, the United Arab States, Nigeria, etc.
- Continue to hold BeiDou ASEAN Tour and BeiDou Asia-Pacific Tour, and promote system applications.



Satellite navigation cooperation meeting between China-Australia



Visit Egypt for on-site survey in 2015



BeiDou ASEAN Tour Thailand



International Standardization



Actively propel the recognition of the BeiDou System in international organizations, such as IMO, ICAO and 3GPP.

The Ship-borne BeiDou-based Receivers Performance Standard has been approved by IMO, making the BeiDou System the third navigation satellite system worldwide recognized by IMO.



International Standardization



Promote the establishment of BeiDou Working Group affiliated to the 104th professional committee of RTCM. 16 technical standards which support positioning function of the BeiDou System have been approved by the 3rd and 4th Generation Partnership Projects.



*National Marine
Electronics Association*



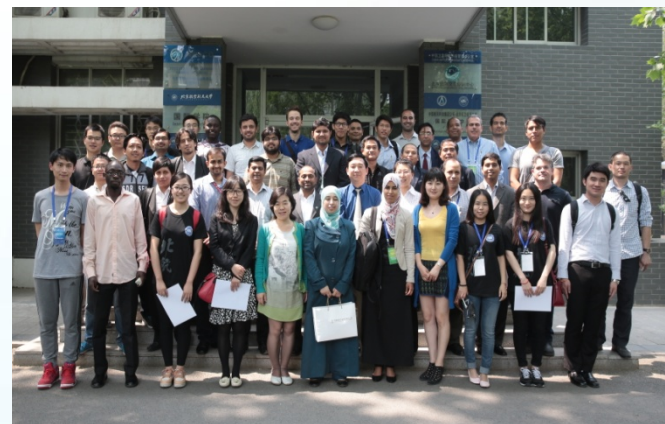
Technical Exchanges



- Encourage academic exchanges, host the China Satellite Navigation Conference, and keep attending other international academic conferences in the field of satellite navigation.

In the aspect of International Exchange and Training, CSNO has organized three sessions of

- Master Program majored in satellite navigation, while 44 trainees from 8 countries in the Asia-Pacific and African areas have been recruited. Three sessions of Summer School on Frontier Technology in the field of satellite navigation have successfully organized, and more than 200 trainees have completed their studies.



Contents

1

System Overview

2

System Application

3

International Cooperation

4

Recent Plan

5

Summary

System Construction



1. Keep improving the continuous stability and service accuracy of the BeiDou System, ensure its regional service performance maintain stable and grow better.
2. Launch another 3-4 next-generation BeiDou satellites in 2015, and steadily accelerate the deployment of next-generation global constellation, to lay foundations for serving the areas along the Silk Road Economic Belt and 21st-Century Maritime Silk Road by 2018.
3. Complete the construction of 150 reference stations for the frame network of BeiDou ground based augmentation system, and 300 reference stations for regional density network before the end of 2015, and broadcast the correction data, 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. The regional density network will be established within the whole country before the end of 2018.



Application Promotion



1. Carry out all-round R&D and industrialization of new generation BDS/GNSS fundamental products, to promote mass market applications amount to ten-million units.
2. Bring GNSS to full play in the integration procedure between industrialization and IT applications, push forward all-scale industrial and regional demonstrative applications.
3. Comprehensively implement industrial policies and action plans on products quality monitoring, standardization and IPR protection. Improve the industry chain of satellite navigation.



International Cooperation



1. Publicize the white paper of the BeiDou System and explain its development concepts, policies and opinions.
2. Perfect the cooperation mechanism among GNSS, deeply participate in the tasks under the ICG, ITU, IMO, ICAO, 3GPP and other international organizations, enhance coordination between BeiDou and GPS, GLONASS, Galileo in the field of compatibility and interoperability.
3. Grasp the opportunity of jointly building the “One Belt and One Road” national strategy, promote the international applications of BeiDou/ GNSS.



Contents

1

System Overview

2

System Application

3

International Cooperation

4

Recent Plan

5

Summary

Summary



The BeiDou System has been providing stable services to the Asia-Pacific area, successfully launched the first next-generation BeiDou satellite to verify new technologies, deploy the BeiDou augmentation system from all-round scale, and steadily push forward the construction of BeiDou System.

The BeiDou applications market has been preliminarily fostered, expanding from the typical industries to mass market, and the application industry is under fast development.

The BeiDou system deeply promotes cooperation among GNSS, and keeps strengthening international exchanges. "BeiDou" becomes one of the Chinese brands.





China Satellite Navigation Office