

CHINA SATELLITE NAVIGATION OFFICE



Development of the BeiDou Navigation Satellite System (BNSS)

China Satellite Navigation Office

Nov.12, 2011



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1.1 Development plan of the BNSS

1.1.1 Development objective



According to the general requirements of quality, safety, application and benefit, a cost-effective BNSS with high performance and high reliability will be established, which will provide regional passive positioning service in 2012 and provide global passive service in 2020.

quality

safety

application

benefit

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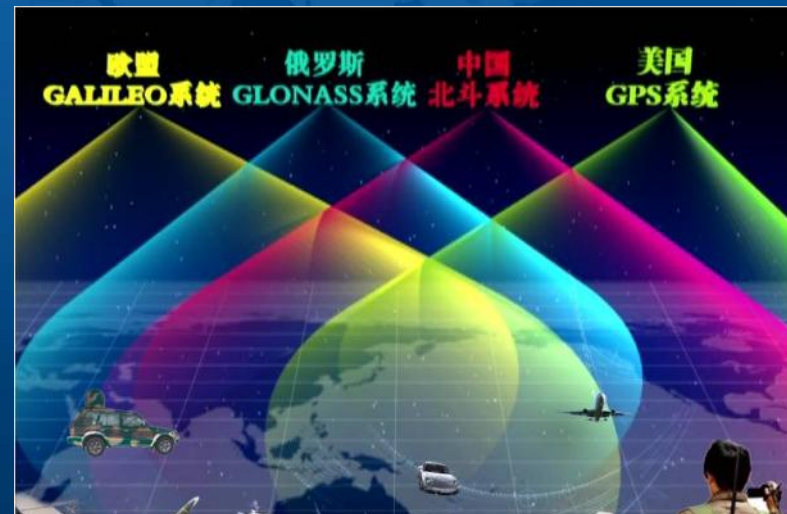
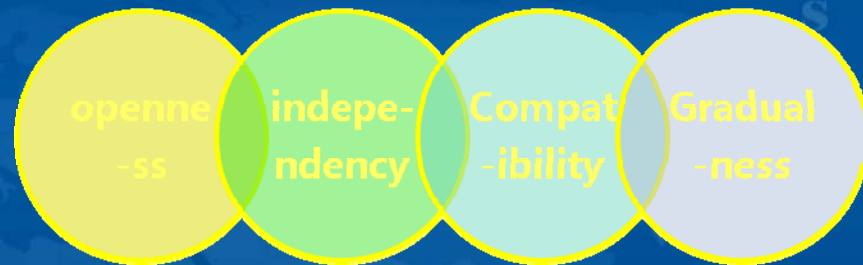


1.1 Development plan of the BNSS

1.1.2 Development principle

The basic development principles include **openness, independency, compatibility and gradualness.**

(1) Openness: The system will provide high quality open service free of charge for worldwide users. China will widely and thoroughly communicate with other countries in satellite navigation to facilitate the development of GNSS and associated technologies and industries.





1.1 Development plan of the BNSS

(2) Independency: China will develop and operate the BNSS independently.

The system can independently provide services for worldwide users and particularly provide higher quality services in Asia-Pacific region.

(3) Compatibility: The system will pursue solutions to realize compatibility and interoperability with other satellite navigation systems. Thus, users can get better services with interoperable receivers. To benefit both the current users and the industry, the BNSS will be improved based on the backward compatibility.

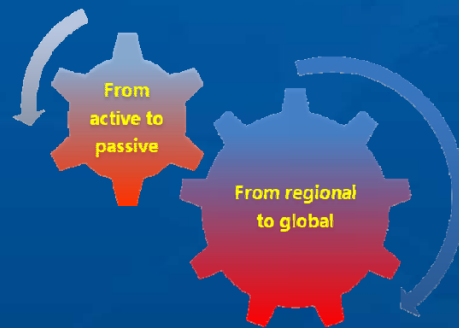
(4) Gradualness: By considering technical and economic risks, the construction of the BNSS will follow a step-by-step pattern based on technical and economic evolution in China. The system will provide long-term continuous services for users, improving system performance and ensuring seamless and smooth transition between the system construction phases.



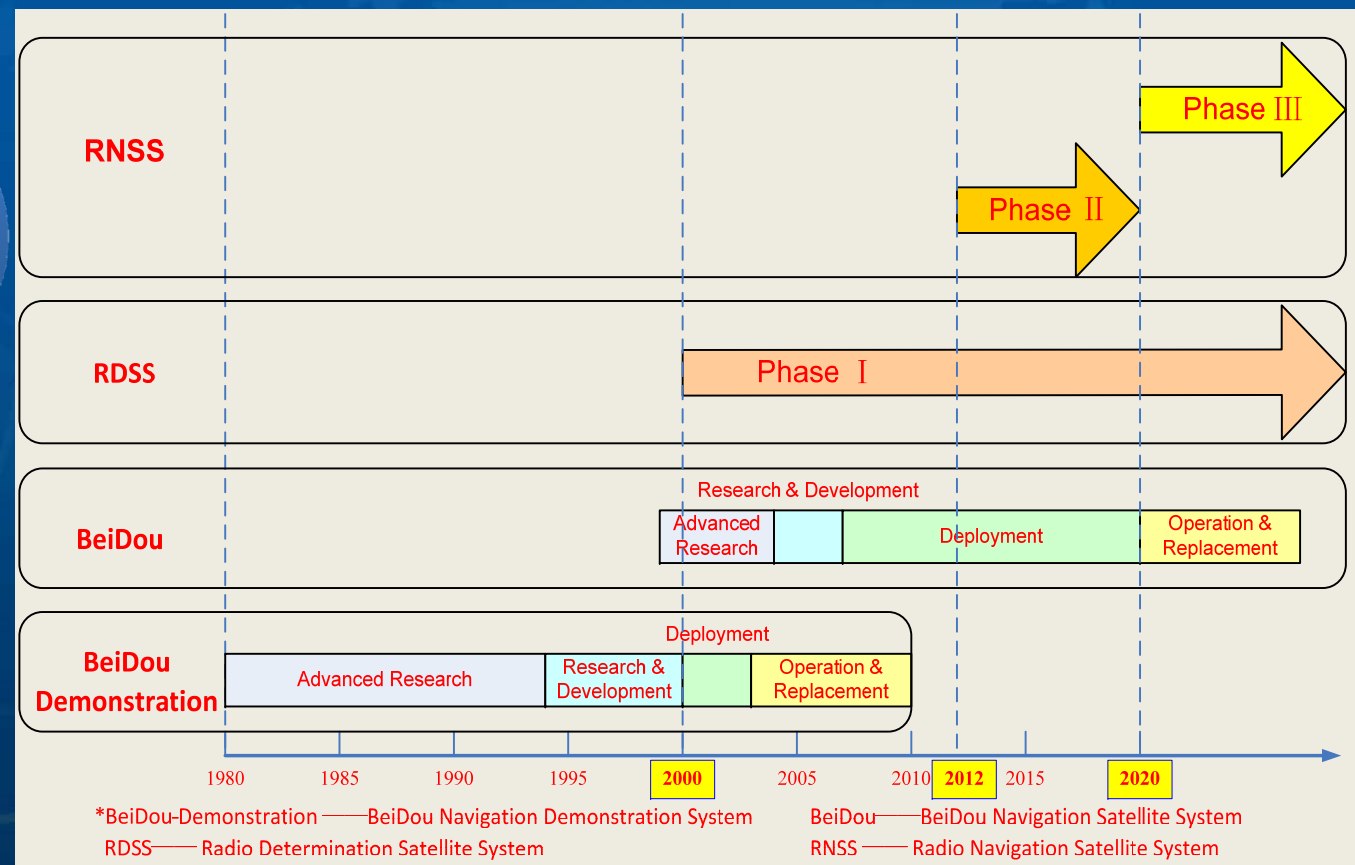
1.1 Development plan of the BNSS

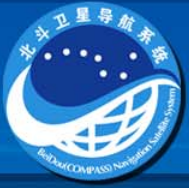
1.1.3 Development phases

The development of BeiDou system can be divided into three phases, **following the way from regional to global and from active to passive.**



Evolution of the BNSS





1.1 Development plan of the BNSS

Phase 1

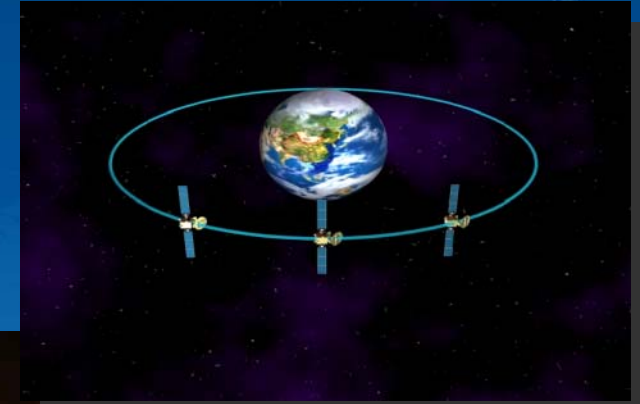
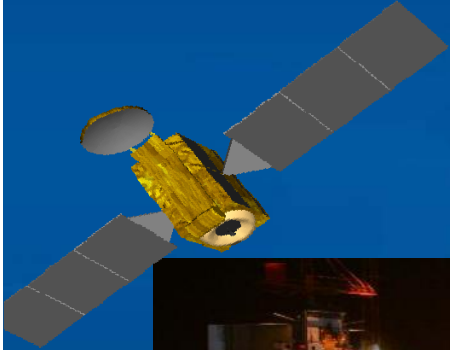
- The demonstration system started its construction in 1994 and began to provide regional active positioning in 2000.





1.1 Development plan of the BNSS

3 GEO satellites were launched from
2000 to 2003



31.10.2000
140E



21.12.2000
80E

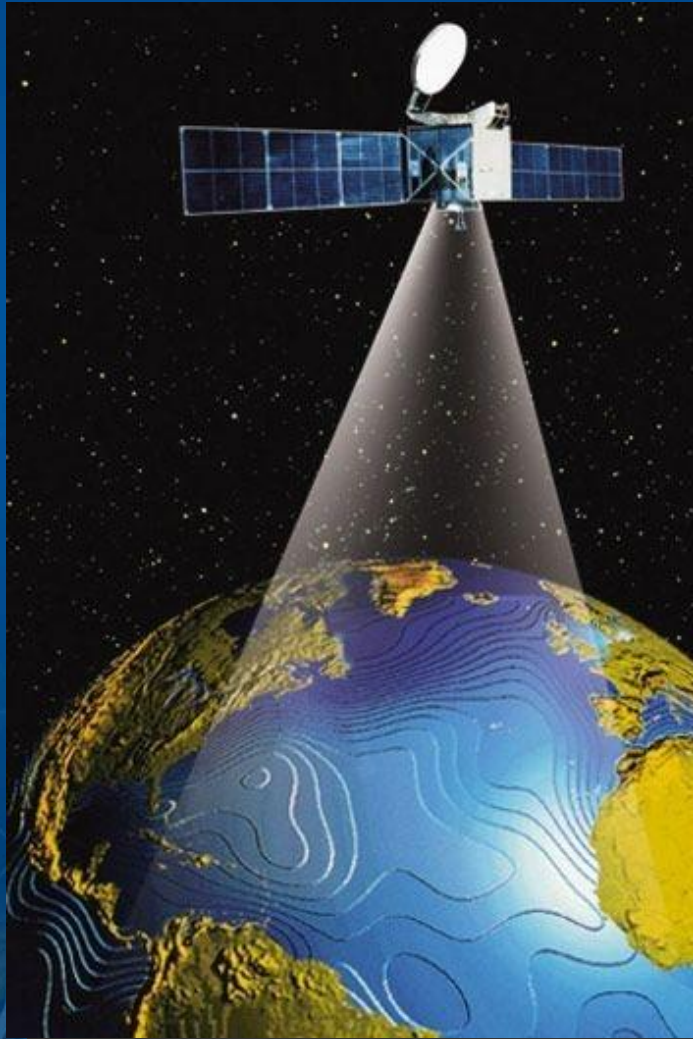


25.05.2003
110.5E

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1.1 Development plan of the BNSS



Phase 2

- The BNSS started its construction in 2004 and will provide regional passive positioning from 2012.





1.1 Development plan of the BNSS



14.04.2007



15.04.2009

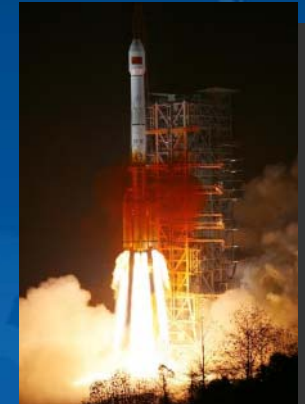
World 1st IGSO navigation satellite



01.08.2010



01.11.2010



17.01.2010



02.06.2010



18.12.2010



10.04.2011



27.07.2011



02.12.2011



1.1 Development plan of the BNSS

◆ Six more BeiDou navigation Satellites will be launched in 2012.



In 2012

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1.1 Development plan of the BNSS

Phase 3

- The BNSS will provide global passive positioning from 2020.



Prisoners and Criminals





1.1 Development plan of the BNSS

1.1.4 System description

The system can provide four types of services, including authorized service, open service, wide range differential service and position report service.





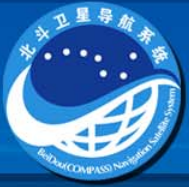
1.1 Development plan of the BNSS

1.1.5 Time and Coordinate System



- BeiDou time (BDT) is aligned to UTC
- The definition of China Geodetic **Coordinate System 2000 (CGCS2000) is consistent with ITRS**
- Both BDT and CGCS2000 keep improving





National GPS control network 2000

- points : 2609
 - average length of baselines: 106km

Frame: ITRF97

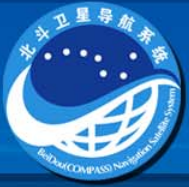
Epoch: 2000.0

The GPS network was combined with Astro-geodetic control network

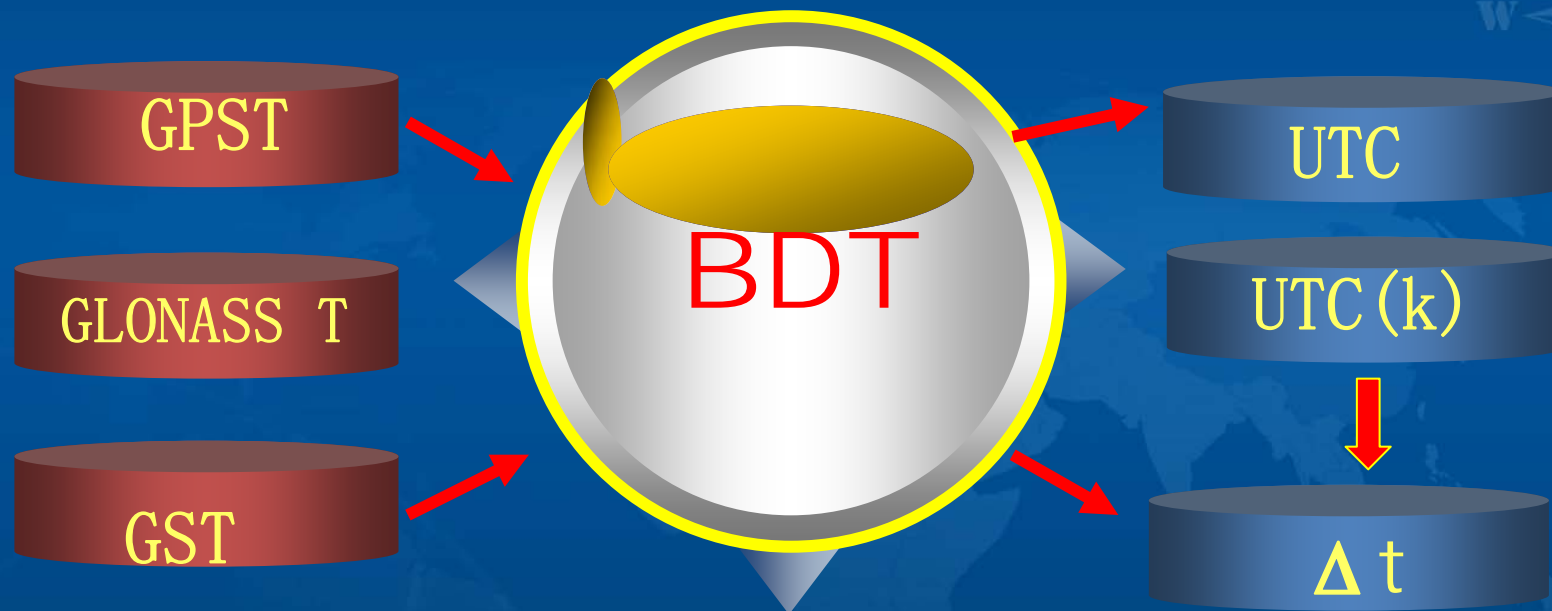


CGCS2000 Was Officially implemented on July 1, 2008.

The national GPS control network is currently used as control network of CGCS2000



■ BeiDou Time System

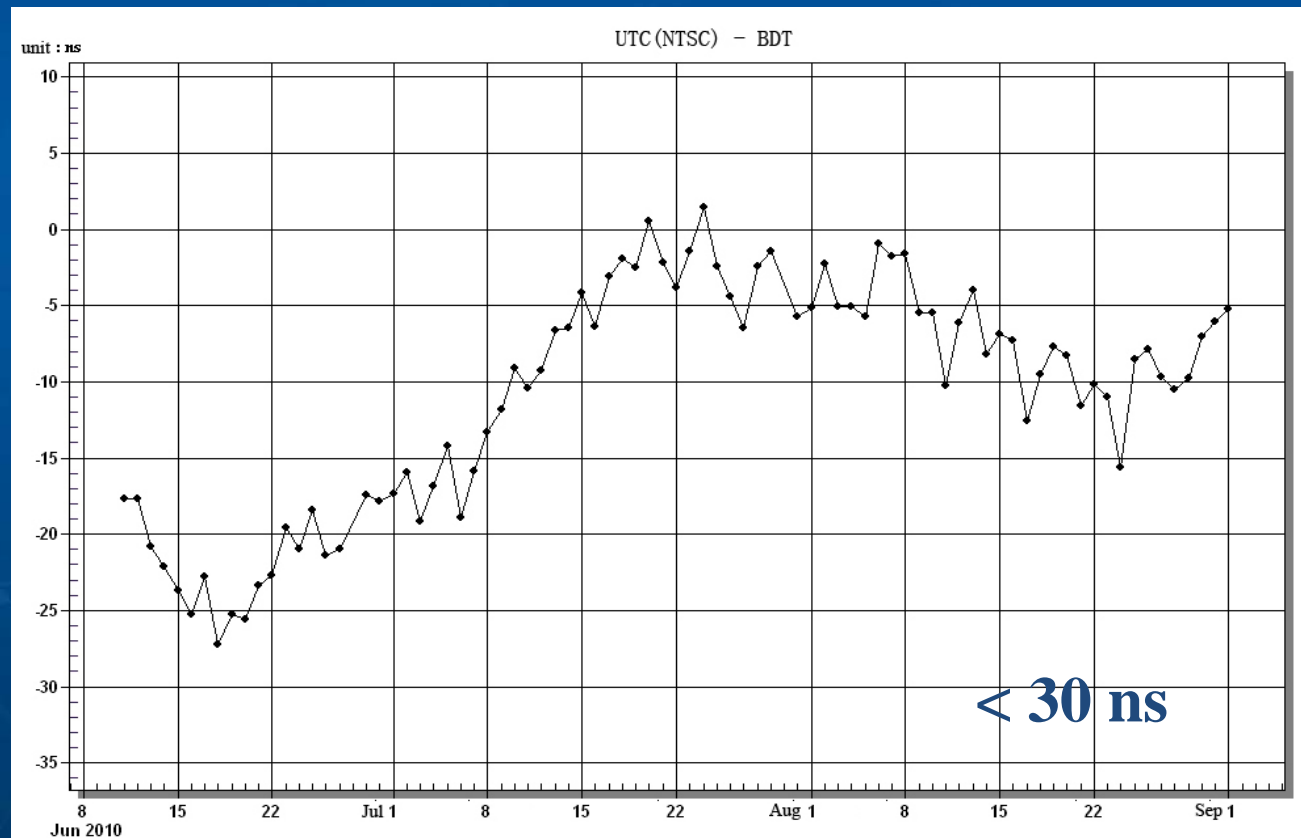


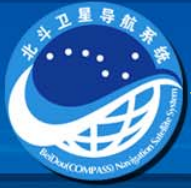
BDT Epoch is UTC 00d 2006

Synchronize with UTC 100ns



■ Difference between UTC and BDT



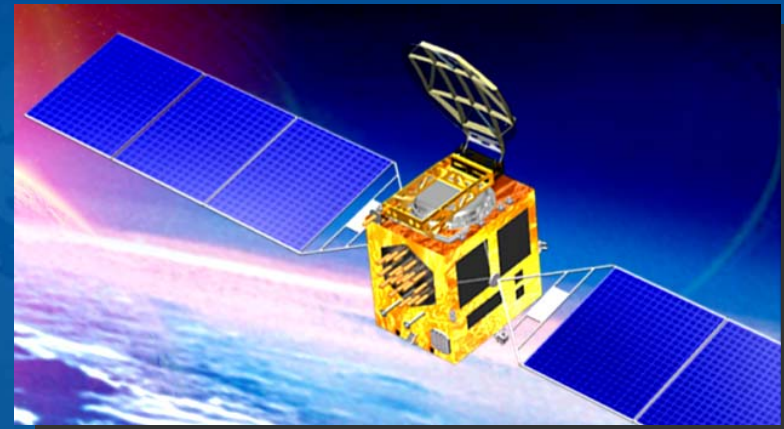


1.2 Development status of the BNSS

1.2.1 The demonstration system works well

The demonstration system has been operating for 10 years.

In 2010, it smoothly transformed into the BNSS, ensuring uninterrupted services.



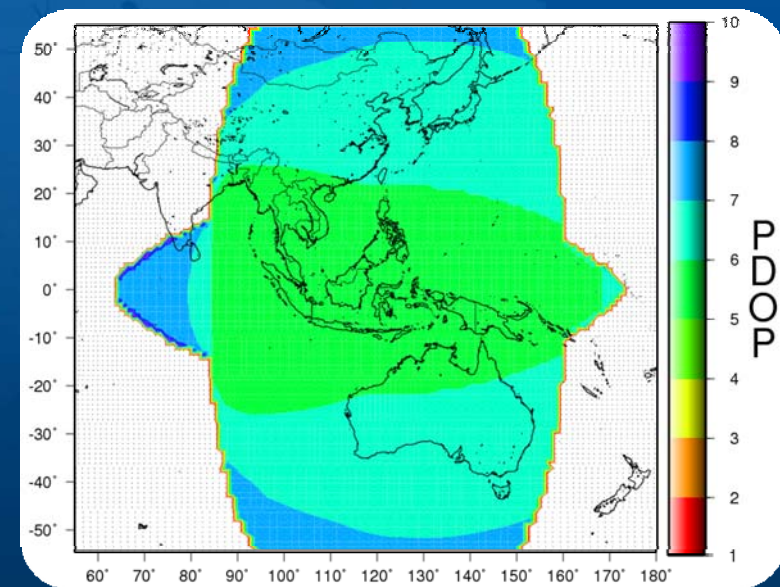
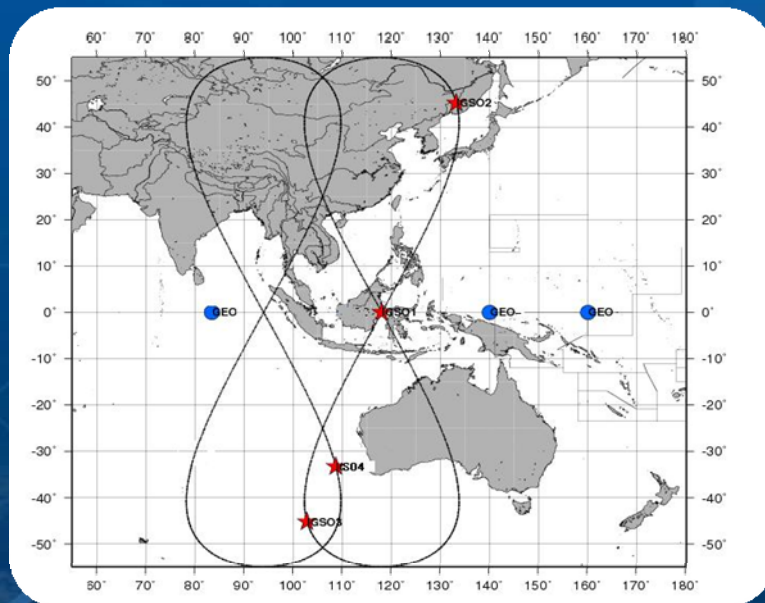


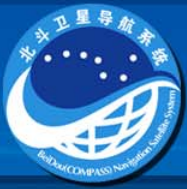
1.2 Development status of the BNSS

1.2.2 The BNSS is progressing well

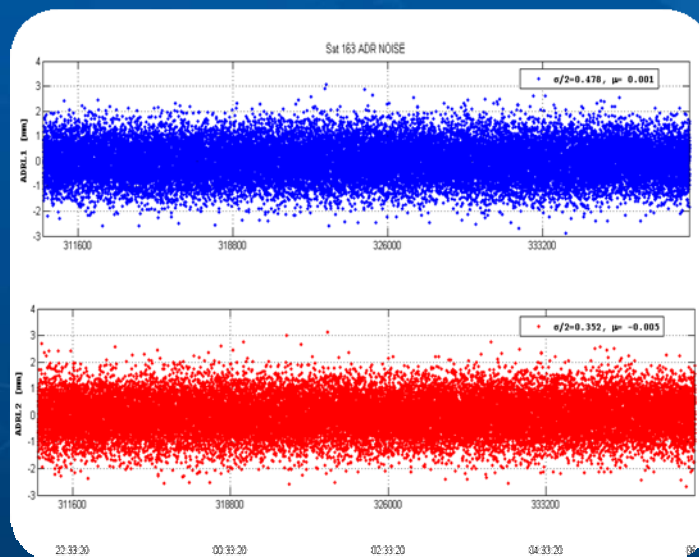
Since 2007, 10 satellites have been launched, showing good performance.

Since December, 2011, it will provide preliminary positioning, navigation and timing services for China and its surrounding areas.

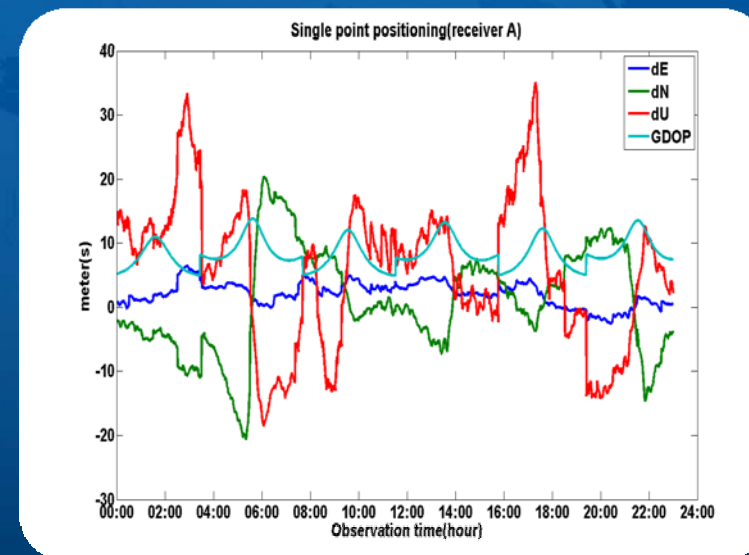




- **Integrated test of the system has been completed**, which verified the coordination of satellite constellation, ground control segment and user terminals, and tested the precision of system services.



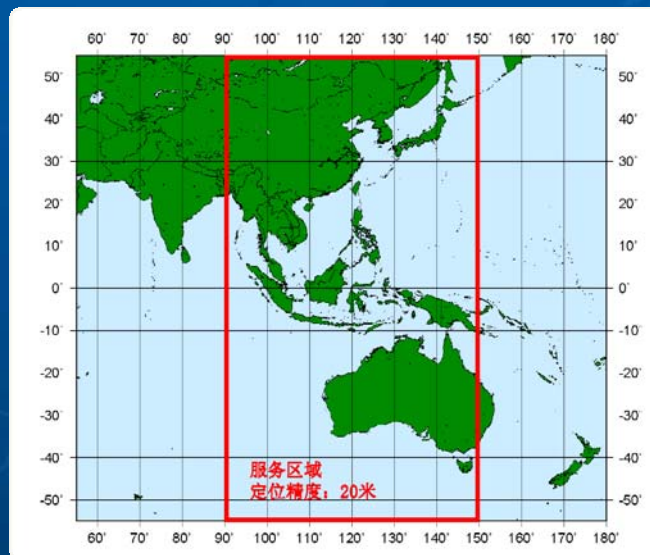
Pseudo Range Precision



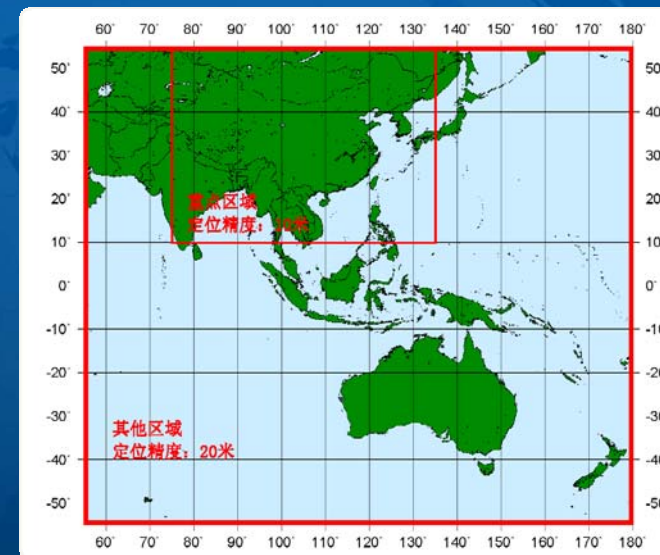
Positioning Result



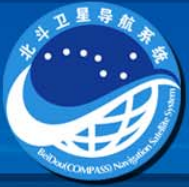
- BeiDou will gradually expand its service area, steadily improve performance, so as to provide services for uses in a broader region.



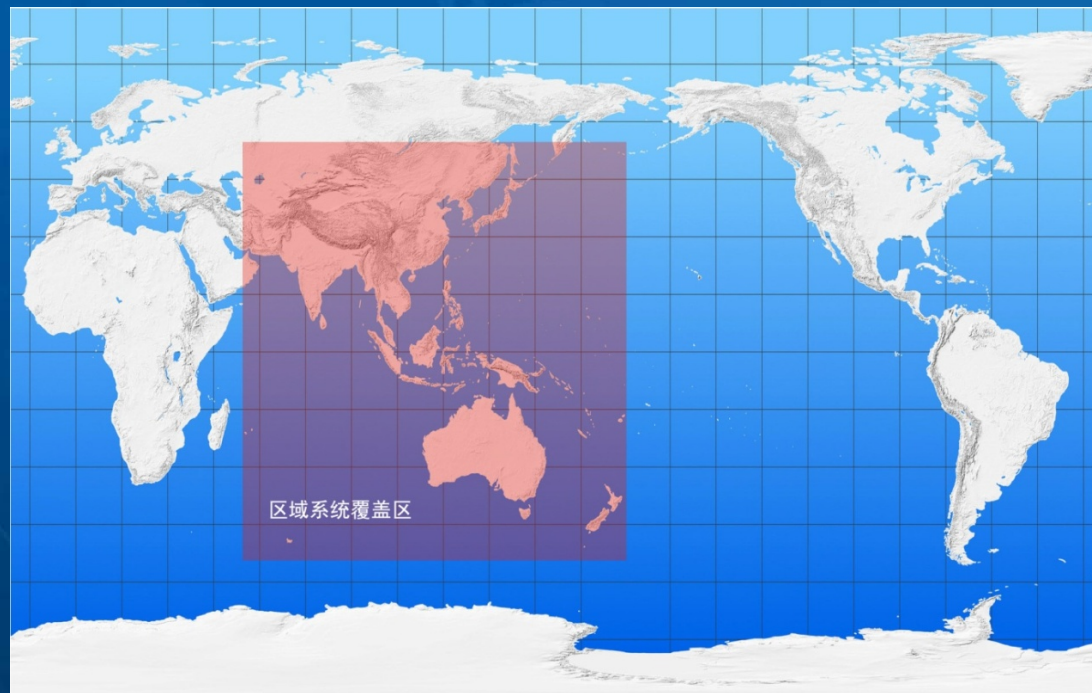
Coverage area in 2011



Coverage area in 2012



- Domestic users can evaluate the system performance through pilot operation. China has already promoted the demonstration of application programs in Asia-Pacific area.



Area of demonstration of application



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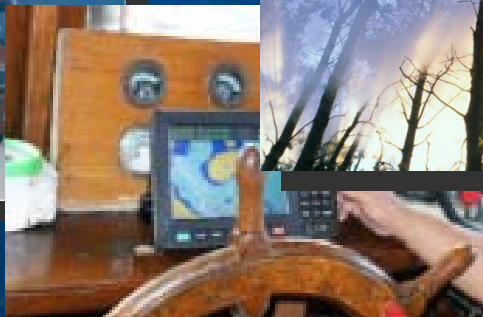




2.1 From construction to application

Since 2003, the demonstration system has been widely used in many fields, such as **transportation**, marine fishery, water conservancy, **weather forecast**, forest fire prevention, **telecommunication and timing**, electric power control and disaster mitigation, **etc.**

It has brought remarkable social and economic benefits, especially playing important roles in Southern frozen disaster, Wenchuan and Yushu **earthquakes**.





2.1 From construction to application

Some application fields

Terrestrial applications



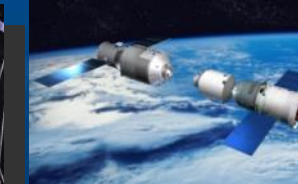
Marine applications



Aviation applications



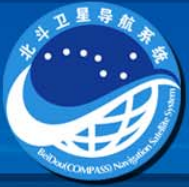
Space applications



Public applications



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- ◆ Fishery
- ◆ Disaster Prevention and Mitigation
- ◆ Timing
- ◆ Transportation
- ◆ Water conservancy
- ◆ Meteorology
- ◆ Forest Fire Prevention
- ◆ Soil Monitoring
- ◆ Coal Mine Safety Monitoring



Nowadays, BeiDou demonstration system has played an important role in many fields, such as fishery, disaster prevention, etc.

There are more than 90,000 users, which have created many social and economic benefits.



Fishery

- Fishermen safety of life
- Oceanic and economic security
- Protection of marine resources and sovereignty



Distribution of marine fishery applications

- 14,000 fisher users and more than 40,000 users with mobile terminals
- Since 2007, more than 500 fishing vessel rescue and coastal alarm systems have been equipped with BeiDou terminals.

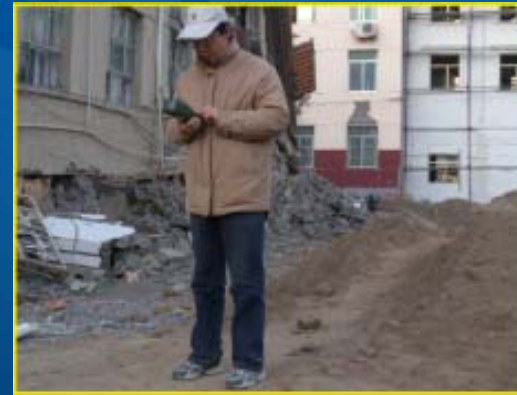




Disaster Prevention and Mitigation

Improve rescue response and decision-making capability

- Rapid and timely disaster alert
- Rescue command scheduling
- Rapid emergency communication



After the earthquakes in Wenchuan, Sichuan Province and Yushu, Qinghai Province, BeiDou terminals sent the disaster and rescue information to command center in the first time.



Timing

- BeiDou/GPS multi-mode time synchronization devices
- Embedded BeiDou/GPS timing module



- Timing test of **CDMA network** in 7 provinces of the southeast coast
- Successful trials in 200 sets of reference station equipments
- applied more than 4 years
- Synchronization accuracy : $< 100\text{ns}$

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2.2 From application to services

In parallel with construction of the **BNSS**, China is also building an integrated BeiDou application system. Through demonstration in certain industries and areas and integration of national resources, **Chinese government** are improving the system, turning it from single service into an integrative service.



Positioning
system

Single GPS system

GNSS with multi-system compatibility

Application

Mainly for vehicle positioning
and navigation

A number of applications for personal
location service combined with
telecommunication

**Business
model**

Product sale

A wide range of operational services



2.3 From regional to global

Currently, the users of the Beidou demonstration system are mostly in China, while the applications of the BNSS will gradually extend to the Asia-Pacific region, and further extend to the world around 2020.





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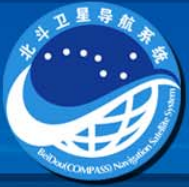


3.1 Basic considerations

Adhering to the policy of opening up to the outside world, and actively engaging in international space exchanges and cooperation. **China supports all activities that utilize outer space for peaceful purposes.** It will strengthen exchanges and cooperation in this field with other countries on the basis of the principles of equality, mutual benefit, peaceful utilization of outer space and common development.

According to the basic tasks of China's satellite navigation system, we will follow the established arrangement, actively select international communication and cooperation.



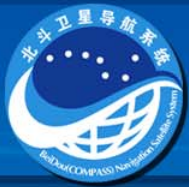


3.2 Policy Structure

1) Publish blue paper of BeiDou Navigation Satellite System – Update the Development of BeiDou Navigation Satellite System every half a year.



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2) Actively promoting monitoring and evaluation of GNSS performance, support application demonstration of multi-GNSS, and improve the service performance of GNSS.

3) Dedicated to realize compatibility and interoperability with other satellite navigation systems, and provide better services for global users.

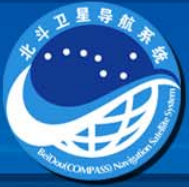
4) Integrated into international standards of civil aviation, maritime, etc., enabling the system to serve global users better.



3.3 Main activities

1. To **participate in and support communication and cooperation in compatibility and interoperability of international GNSS**;
2. To participate in and support **monitoring and evaluation of the service performance of GNSS**, as well as the improvement of performance and technology in satellite navigation;
3. To develop communication and cooperation in applications of GNSS;
4. To develop communication and cooperation in GNSS international standards of civil aviation and maritime;
5. To participate in and support interference monitoring and mitigation of GNSS open services.





1) Activities related to ICG

Organized the Working Group B Interim Meeting of **ICG-6 in Shanghai in May 2011**;
Attended the meetings of the ICG.

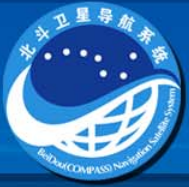




As one of the four core providers, **China delegation attended the 5th meeting of ICG in October, 2010.**

Currently, China has offered to host the 7th meeting of ICG in 2012, and has gained recognition by the UNOOSA and ICG members.





2) Compatibility and Interoperability Coordination

The Technical Working Group (TWG) on compatibility and interoperability between BeiDou and Galileo has held several meetings





China and the US have achieved common consensus on Radio Frequency compatibility;

Actively promote the coordination of satellite network frequency and orbit location with Japan, Russia and Australia;

Actively participate in meetings related to WRC-12 and consultation meetings on 609 resolution held by ITU.

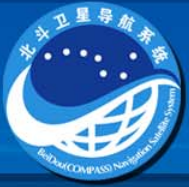




5) China Satellite Navigation Conference(CSNC 2010)

- Participants: **more than 1500 experts, scholars and representatives attended the conference** with over 630 proposed paper presented at the conference .





6) International Exchange

Participated in Institute of Navigation (ION) Conferences, the International Symposium on GPS/GNSS (ISGNSS), the Munich Satellite Navigation Summit, and Navigation Satellite Forum held in Moscow, Russia, European Navigation Conference, etc





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- ◆ The construction of BeiDou System goes smoothly, with 10 satellites launched, the initial service will be provided from December, 2011. ICD document (v1.0) will be published in the near future;
- ◆ **As an essential element of GNSS, BeiDou will further enhance compatibility and interoperability with other GNSS through international cooperation, promote monitoring and evaluation of GNSS open services,** as well as accelerate the demonstration application of BeiDou/GNSS.
- ◆ **China will promote the construction and application of BeiDou as planned, continue making contributions to GNSS, and keep improving service performance of GNSS through cooperation with other providers.**



Thank you!



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Welcome to the ICG-7 in China!

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