



International Committee on  
Global Navigation Satellite System

*The 8<sup>th</sup> Meeting of the International Committee on GNSS*

# **Development of BeiDou Navigation Satellite System**

**China Satellite Navigation Office**

**Dubai, UAE**

**November, 2013**

# Contents

Development Plan

Latest Progress

Recent Plan

# Contents

**Development Plan**

**Latest Progress**

**Recent Plan**



# 1. Objectives and Principles

- ★ Provide continuous, stable and reliable satellite navigation services
- ★ Meet the requirements of national security and eco-social development, realize social and economic benefits derived from satellite navigation industry

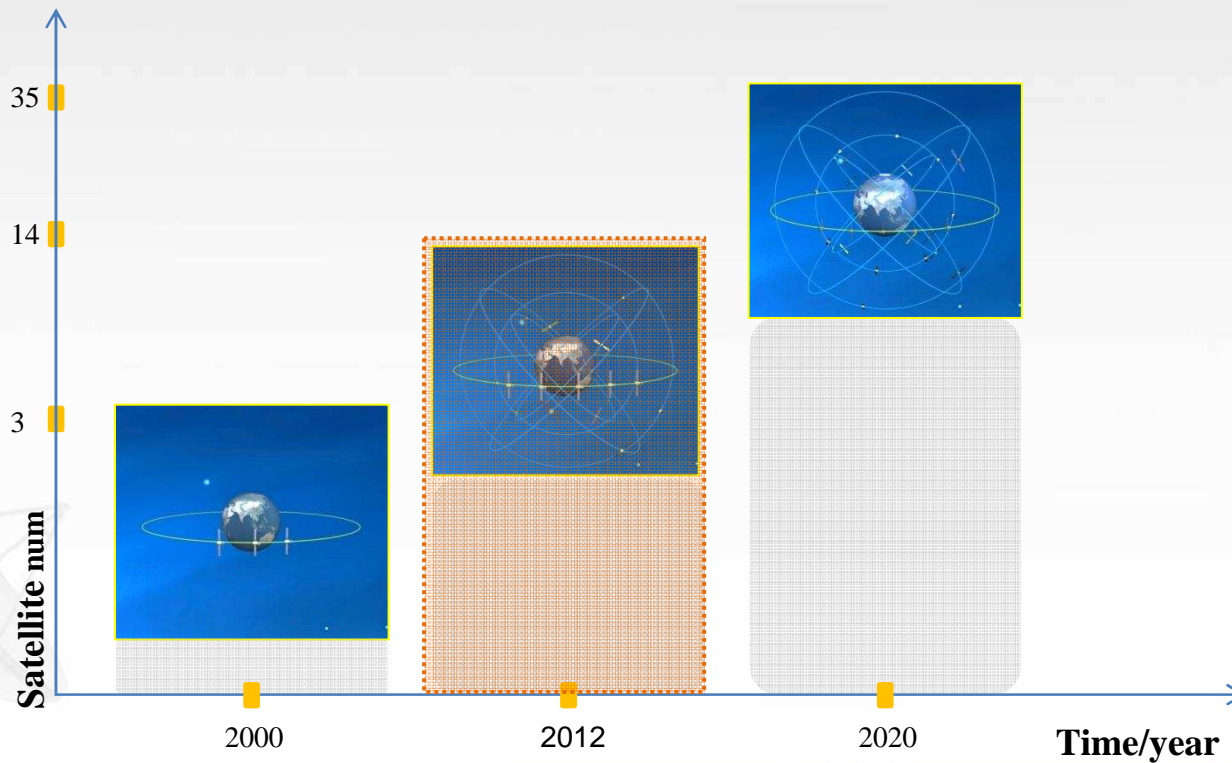




## 2. Deployment Plan

### ★ “Three-step” plan

- From regional to global, from active to passive
- 1<sup>st</sup> and 2<sup>nd</sup> Steps accomplished, 3<sup>rd</sup> Step under way

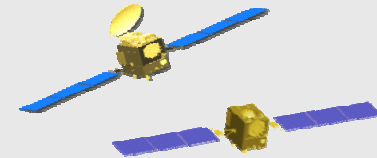




## 3. System Structure

### Space constellation

- 5 GEO
- 30 Non-GEO



### Ground control segment

- Master Control Stations (MCS)
- Uplink Stations(US)
- Monitoring Stations(MS)



### User terminals

- BeiDou user terminals
- Terminals compatible with other GNSS



**Four types of services: open, authorized, wide-area differential, short messages**

★ **Positioning accuracy: better than 10 m**

★ **Velocity accuracy: better than 0.2 m/s**

★ **Timing accuracy: better than 20 ns**



## 4. Policies and Measures

### (1) System Service

- ★ Provide global users with open services free of charge
- ★ Provide regional services to users in the Asia-Pacific area from the end of 2012
- ★ Persist in system maintenance and complement, and keep improving service performances
- ★ Promote compatibility and interoperability with other navigation satellite systems





## 4. Policies and Measures

### (2) Application industrialization

- ★ Formulate satellite navigation application policies, plans, national standard and IPR policies in the field of satellite navigation
- ★ BeiDou System is listed as a key national science and technology program. NDRC already established medium and long term development plan of national satellite navigation industry
- ★ Actively integrate in the international civil aviation, maritime, mobile communication standards





## 4. Policies and Measures

### (3) International cooperation

- ★ Adhering to the principle of “development, cooperation and win-win”, pursue compatibility and interoperability among multi-GNSS
- ★ Carry out international cooperation on GNSS performance monitoring & assessment
- ★ Release the *Report on the Development of BeiDou Navigation Satellite System (V2.1)* to promote international exchange and cooperation

# Contents

Development Planning

Latest Progress

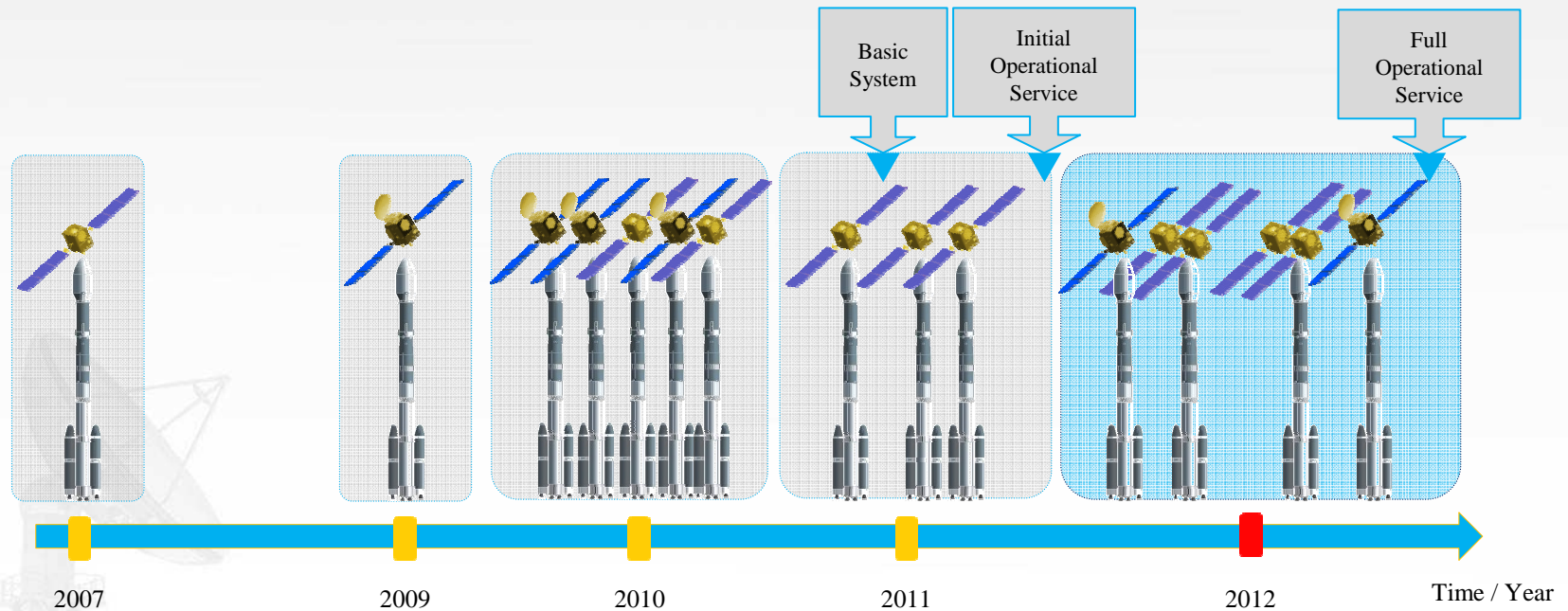
Recent Plan



# 1. System Construction

## (1) Accomplish the 2nd step of space constellation deployment

- ★ **6 BeiDou satellites have been launched by 4 launch vehicles in 2012.**
  - Twice dual-launch of MEO satellites
- ★ **14 operational satellites in orbit**
  - **5GEO+5IGSO+4MEO**





# 1. System Construction

## (2) Full Operational Service

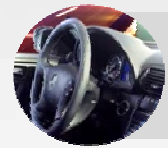


★ December 27, 2012: BeiDou System officially provide Full Operational Service for China and its surrounding areas



**Positioning Accuracy:**

**Horizontally, 10 m; vertically, 10 m**



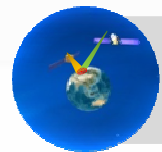
**Velocity Accuracy: 0.2 m/s**



**Timing Accuracy: one-way , 50 ns**



**Short message communications**



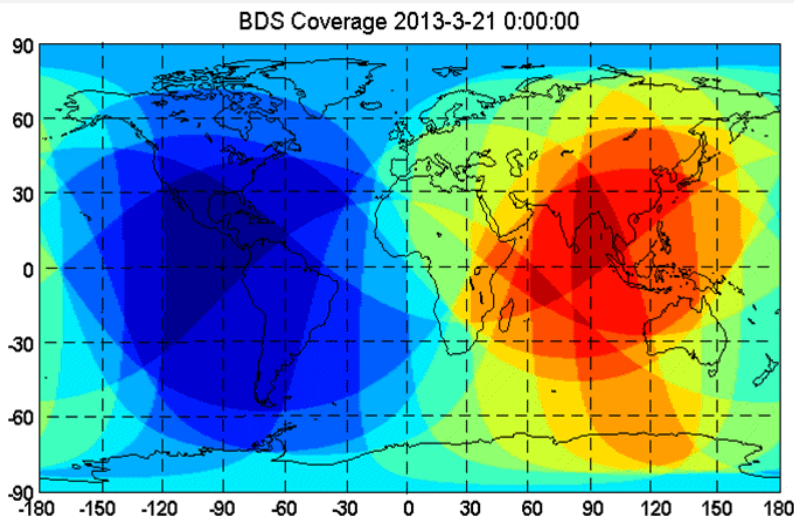
**Wide-area differential service**



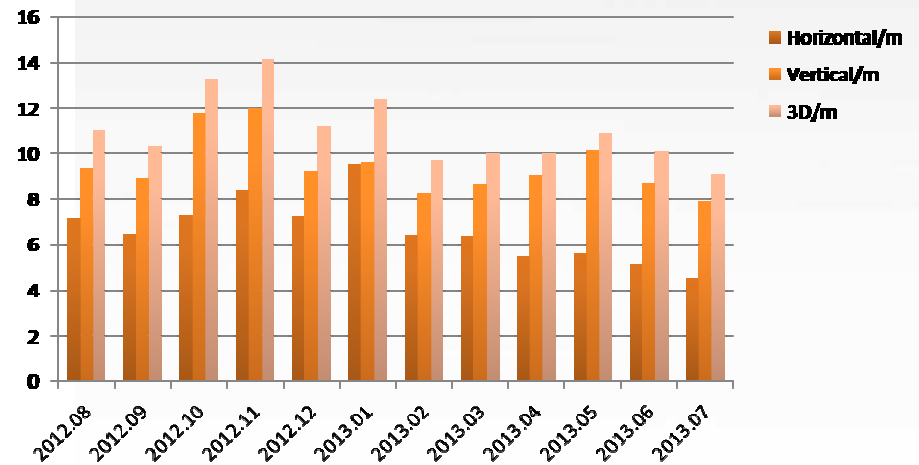
# 1. System Construction

## (3) Enhance regional service performance

- ★ BeiDou System is under continuous and stable operation
- ★ Availability of BeiDou SIS in the Asia-Pacific region
- ★ Positioning accuracy is improved gradually



Coverage

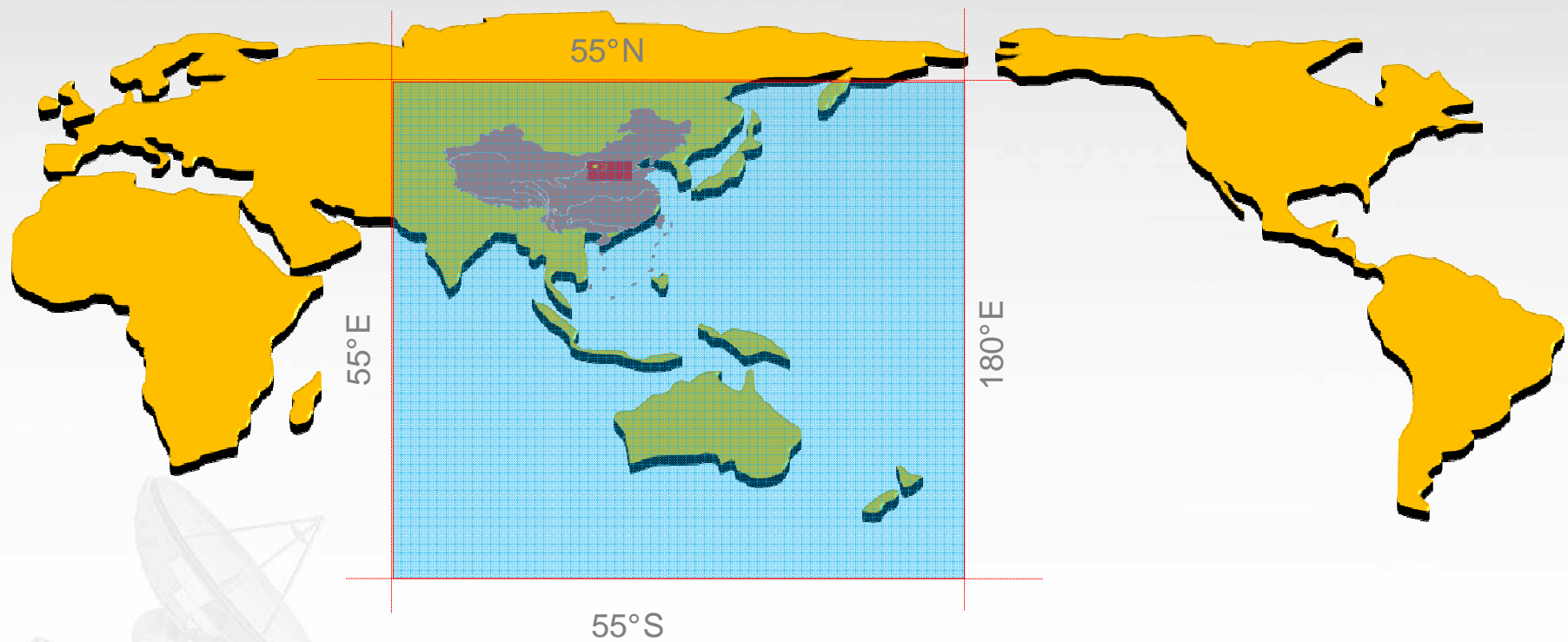


Positioning accuracy (95%)



## 2. System Performance

### (1) Service area

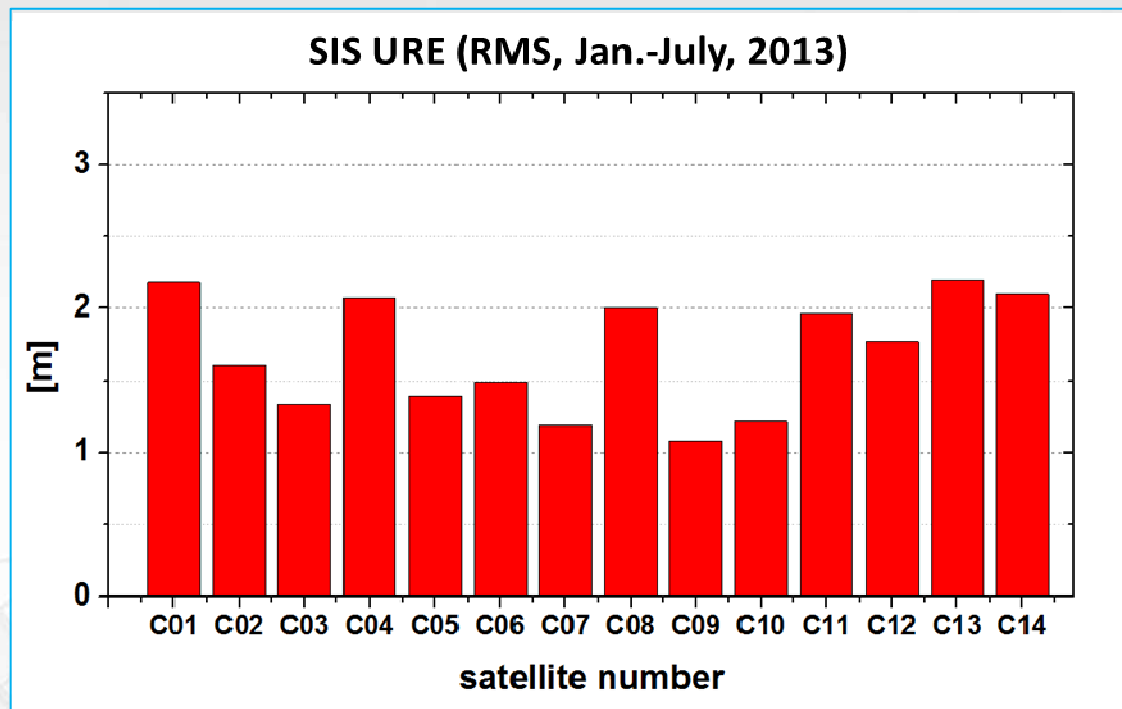




## 2. System Performance

### (2) SIS accuracy

★ SIS URE is about 1-1.5 m (RMS) since FOC



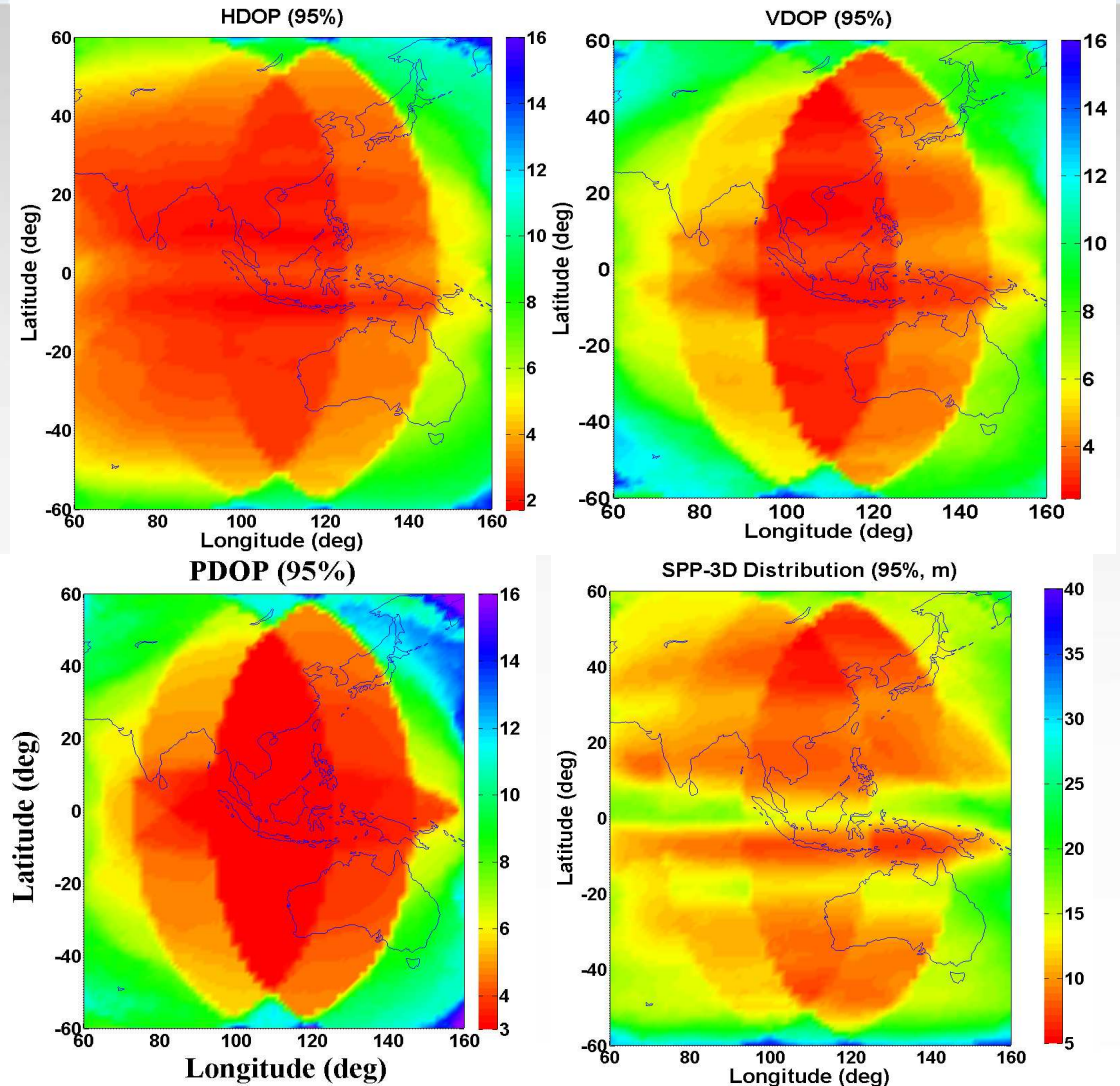
SIS URE of each BeiDou satellite (RMS)



## 2. System Performance

### (3) Positioning accuracy

★ Regional positioning accuracy of BeiDou System has achieved the designed specification.



Data: 2013/03/01 ~ 2013/03/07

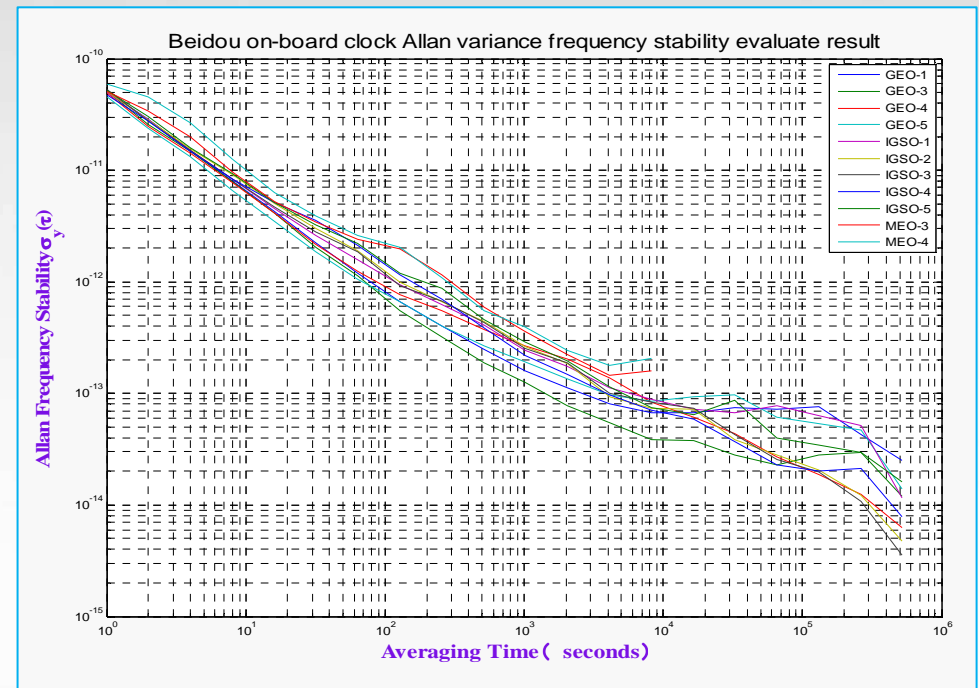




## 2. System Performance

### (4) Satellite clock

- ★ All primary rubidium clocks on-board BeiDou satellites are made by China.
- ★ ADEV of BeiDou RAFSs:  $5.5E^{-14} \sim 9.0E^{-14}$  at an averaging interval of 10000s,  $2.5E^{-14} \sim 9.4E^{-14}$  at an averaging interval of 1 day.



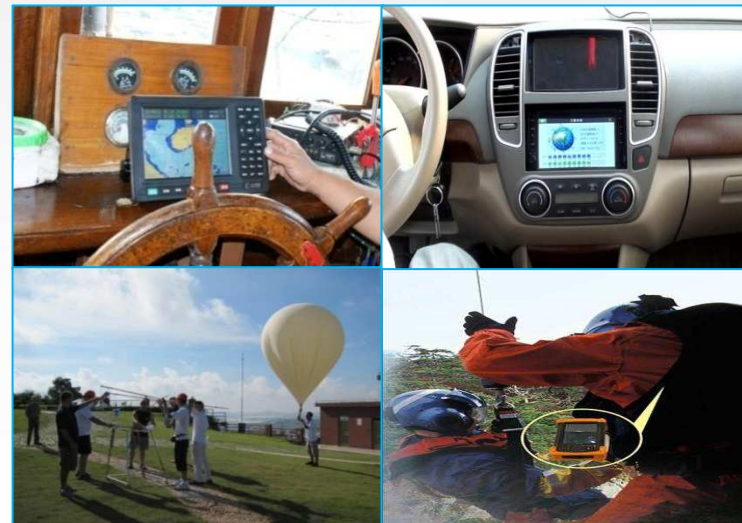
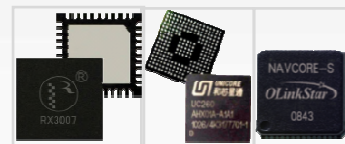
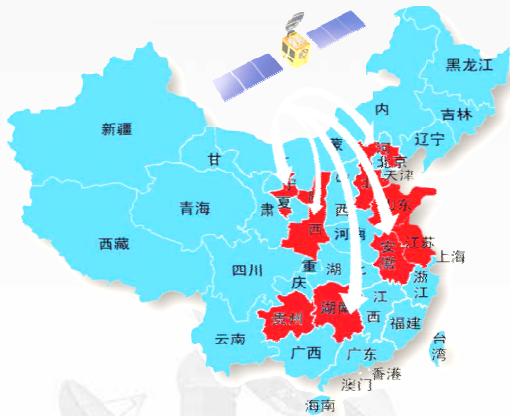
Clock performance for all operational BeiDou satellites



# 3. System Application

## (1) Domestic application

- ★ Make breakthroughs in the core technology of chips, antennas and OEM boards.
- ★ Push forward applications of BeiDou System in transportation, marine fishery, meteorology, emergency rescue, etc.

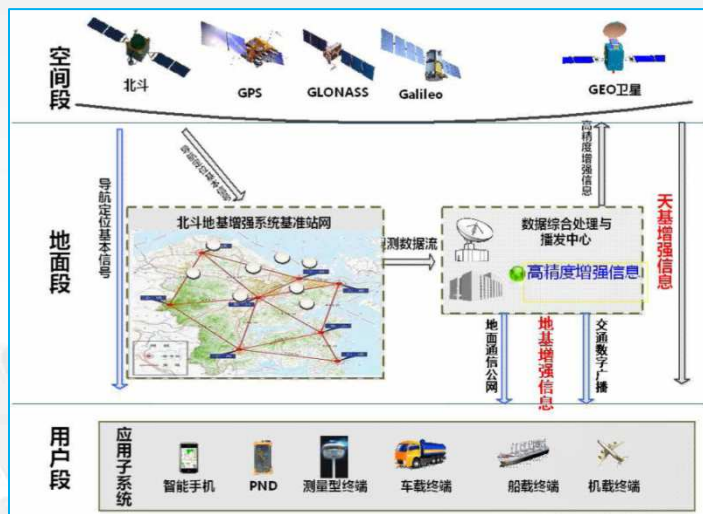




# 3. System Application

## (1) Domestic application

- ★ Accelerate the demonstration applications of BeiDou System in different industries and regions
- ★ Construct the BeiDou ground-based augmentation system and China Location Based Service Network



BeiDou ground-based augmentation system



China Location Based Service Network



## 3. System Application

### (2) International application

- ★ Participated in the “Workshop on Space Applications for Disaster Risk Reduction and Management and Second Workshop on the Use of Multi-GNSS for Sustainable Development” hosted by UN ESCAP
- ★ Attended the “United Nations International Conference on Space-based Technologies for Disaster Management” hosted by UN-SPIDER
- ★ To promote the integration of BeiDou with other space technologies, such as remote sensing, communication and GIS, to improve the disaster monitoring and emergency rescue in the Asia-Pacific region



UNITED NATIONS | UNOOSA | UN-SPIDER

*United Nations Platform for Space-based Information for  
Disaster Management and Emergency Response*



## 3. System Application

### (3) Standardization affairs

- ★ Prepare to establish National Technical Committee on BeiDou Satellite Navigation Standardization
- ★ Endeavoring to enter into the ICAO, IMO and 3GPP standard framework





## 4. International activity

### (1) Multilateral cooperation

- ★ Successfully hosted the ICG-7 in 2012
- ★ “*Statement of the Providers' Forum concerning the ICG*” was issued
- ★ More developing countries gathered together and were deeply involved



ICG International Committee on Global Navigation Satellite Systems  
Seventh Meeting of the International Committee on Global Navigation Satellite Systems (ICG-7)  
4 - 9 November 2012  
Beijing, China

Eighth Meeting of the Provider's Forum, 6 November 2012

Statement of the Provider's Forum concerning the International Committee on Global Navigation Satellite Systems

The International Committee on Global Navigation Satellite Systems (ICG) was established in 2007 and has evolved developed into an important platform for the system providers, the user communities, observers and interested United Nations member states to exchange views and information concerning the field of satellite navigation. The ICG has taken a leading role internationally to promote collaboration in the utilization of Global Navigation Satellite Systems (GNSS) services for a range of commercial, scientific and technological applications. Specific areas of interest to the ICG and its Working Groups include compatibility and interoperability, service performance and service performance enhancement, timing and provider reference frame, education and training, and global applications.

The Provider's Forum was established in 2007 at the second meeting of the ICG. Since then, each of the six current and future system providers has hosted the ICG, achieving an important milestone in demonstrating the commitment of the Providers to the goals and objectives of the ICG. This commitment serves as a foundation to enhance collaboration and to increase global awareness of GNSS.

During its series of meetings, and in particular, its Ninth meeting held in conjunction with ICG-7 Beijing, 4 - 9 November 2012, the Provider's Forum considered user accommodations, which dependability to enable better service, supports the provision of full-authorization satellite services, GNSS spectrum, consumer activities, fast protocol GNSS, research and education, and considers proposals to enhance service performance, and performance monitoring and assessment. The Provider's Forum promotes compatibility and interoperability among current and future global and regional space-based systems by exchanging detailed information shared on operating systems and the policies and procedures that govern their service provision. More importantly, the Provider's Forum is a mechanism to ensure discussions on important issues addressed by the ICG that require focused input from system providers.

In its Ninth meeting, the Provider's Forum considered the future role of the ICG and agreed to keep it on its agenda.



## 4. International activity

### (1) Multilateral cooperation

- ★ Participated in the “10th China ASEAN Expo” and “5th APSCO Executive Council”, to actively popularize BeiDou in ASEAN and the Asia-Pacific region
- ★ To bring BeiDou closer to wider areas and more diversified users





## 4. International activity

### (2) Bilateral cooperation

- ★ Held cooperation meetings with Pakistan and Thailand, to push forward precise positioning application and explore the integrated application of BeiDou with other GNSS
- ★ Further promoted the iGMAS initiative, explored cooperation with Russia, Australia, Pakistan and Thailand to initiate the construction of abroad iGMAS stations



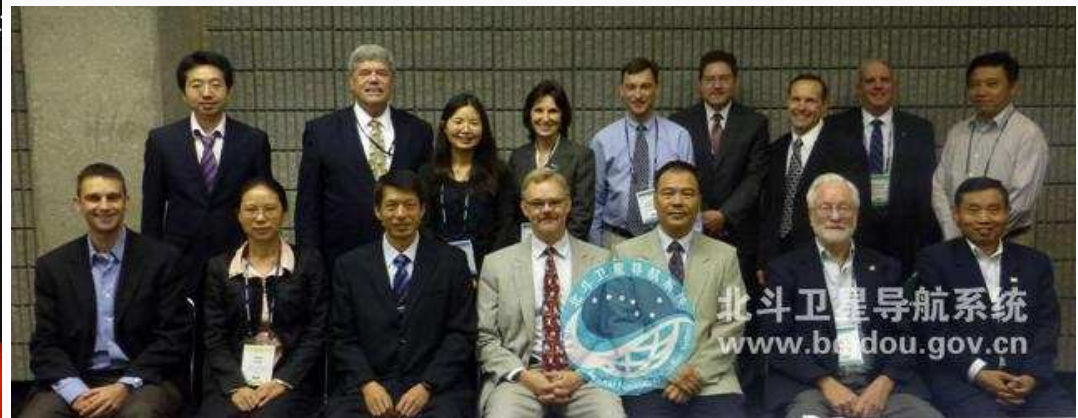
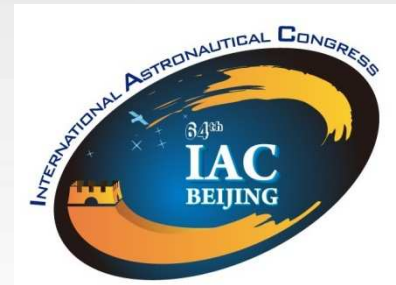




## 4. International activity

### (3) Academic exchange

- ★ Host China Satellite Navigation Conference annually since 2010, and organize CSNC-ION joint panel in the meeting
- ★ Participated in ION Pacific PNT Conference, ION GNSS+ 2013 Meeting, and the 64th International Astronautical Congress

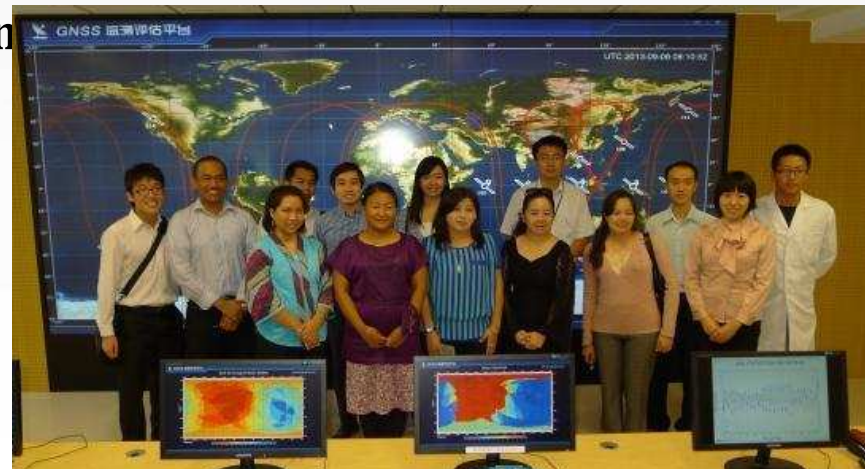




## 4. International activity

### (4) Education and training

- ★ Prepared for establishment of UN affiliated space science and technology education regional center and passed the UN organized evaluation
- ★ Held MASTA Program and summer school on GNSS frontier technology
- ★ Provided BeiDou/GNSS training for trainees in ASEAN plus 3



# Contents

Development Planning

Latest Progress

Recent Plan



# 1. System Construction

- ★ **Improve availability and stability of BeiDou System, and provide continuous, stable and reliable services for users**
- ★ **Initiate the third step of space constellation deployment. Test satellites will be launched in 2014**





## 2. System Application

- ★ **Continuously increase investment and improve the performance of chips to satisfy the market demands**
- ★ **Accelerate the construction of BeiDou ground-based augmentation system and China Location Based Service Network**





## 3. International cooperation

- ★ Continue to deepen bilateral cooperation
- ★ Carry out BADEC event on basis of multilateral platform
- ★ Promote cooperation in the sector of international GNSS monitoring and assessment





# Conclusions

- ★ **BeiDou System has completed the 2<sup>nd</sup> step of development plan.**
  - Provide Full Operational Service
  - Provide free-of-charge, stable and reliable PVT services
- ★ **Application of BeiDou System is gradually entering into public.**
  - Based on breakthroughs in core technology
  - Guided by demonstration and stimulated by innovation
- ★ **BeiDou belongs to both China and the world.**
  - Actively boost the joint development of GNSS
  - Enable resource-sharing and mutual complementarity in the development of navigation satellite systems



**Thanks**

**China Satellite Navigation Office**

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