



International Committee on
Global Navigation Satellite System

The 8th Meeting of the International Committee on GNSS

Development of BeiDou Navigation Satellite System

**China Satellite Navigation Office
Dubai, UAE
November, 2013**





Development Plan

Contents

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

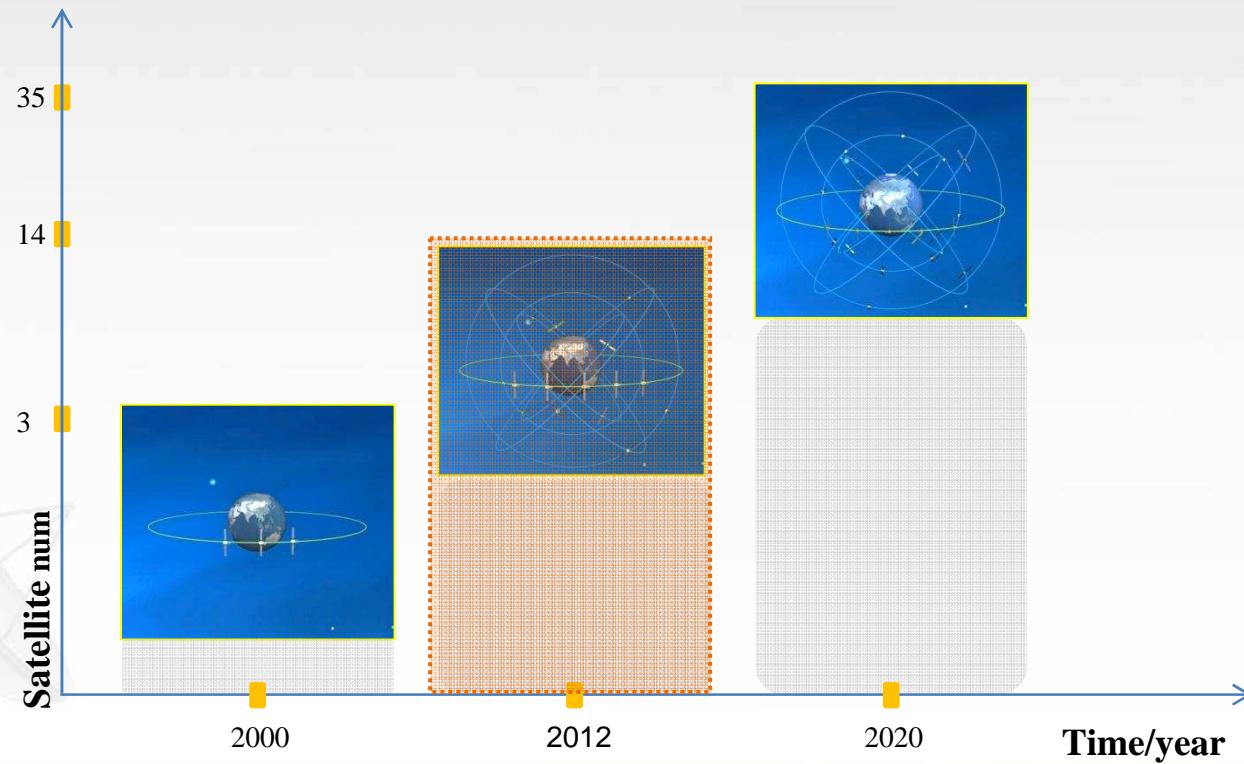




2. Deployment Plan

★ “Three-step” plan

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

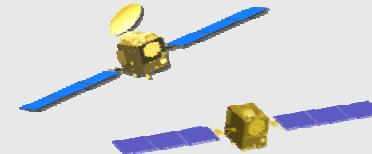




3. System Structure

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



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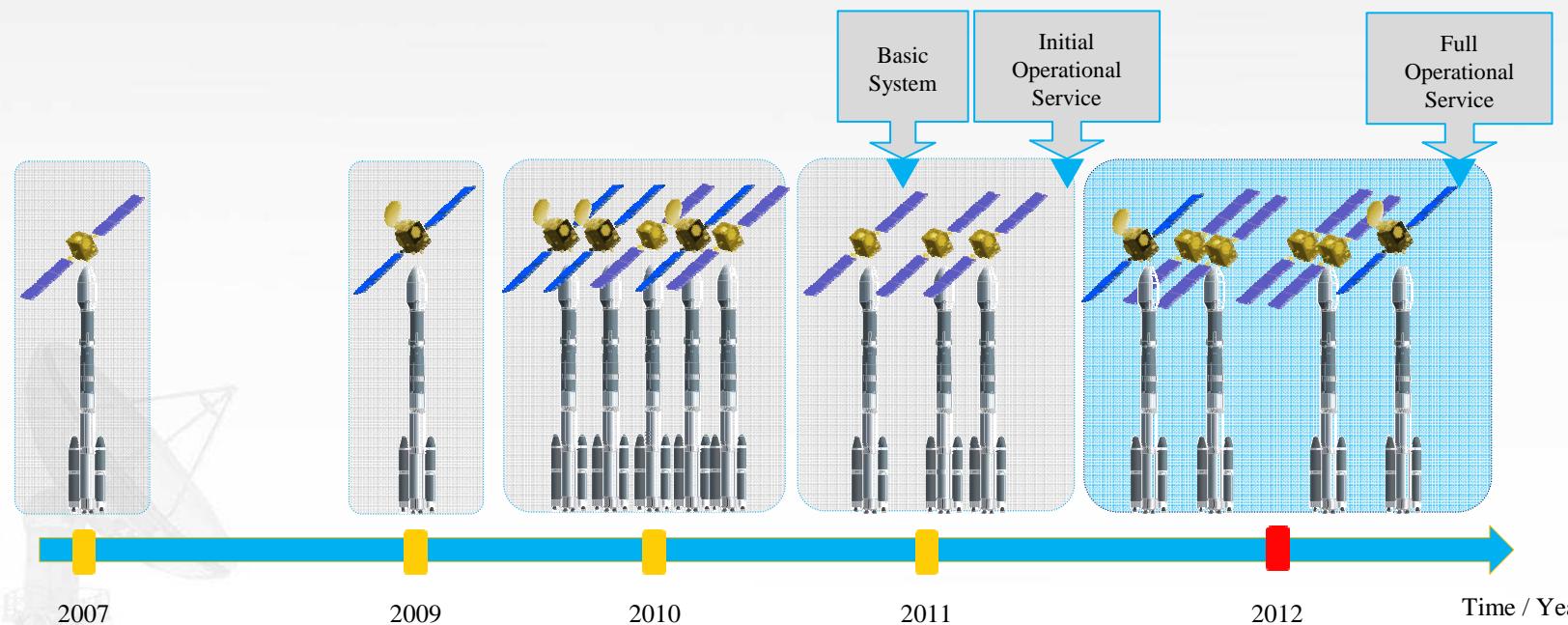
Recent Plan



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



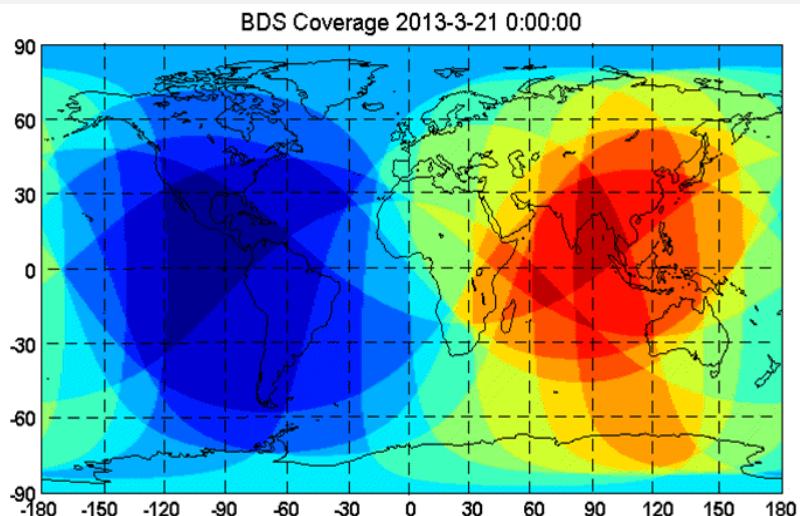
Wide-area differential service



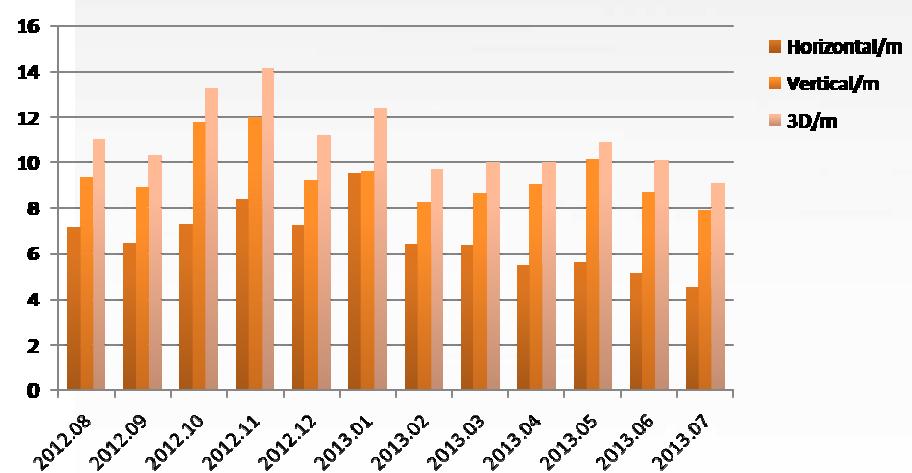
1. System Construction

(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



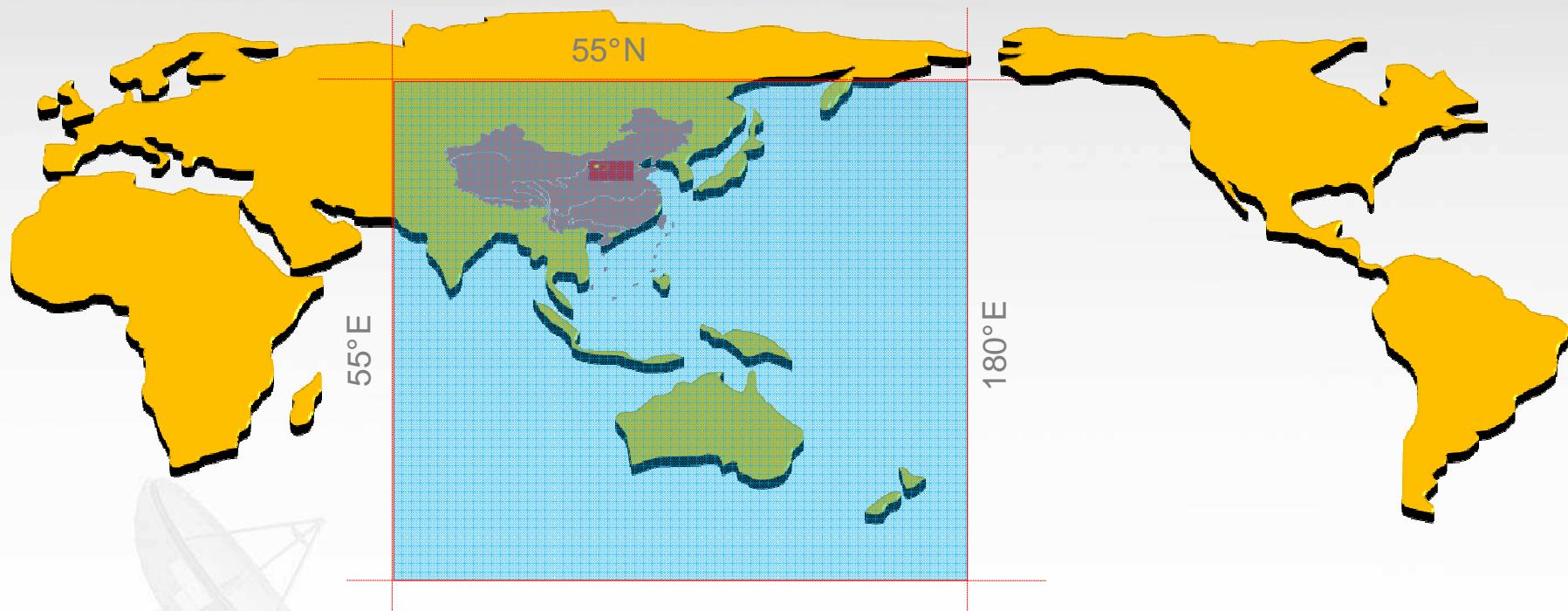
Coverage





2. System Performance

(1) Service area

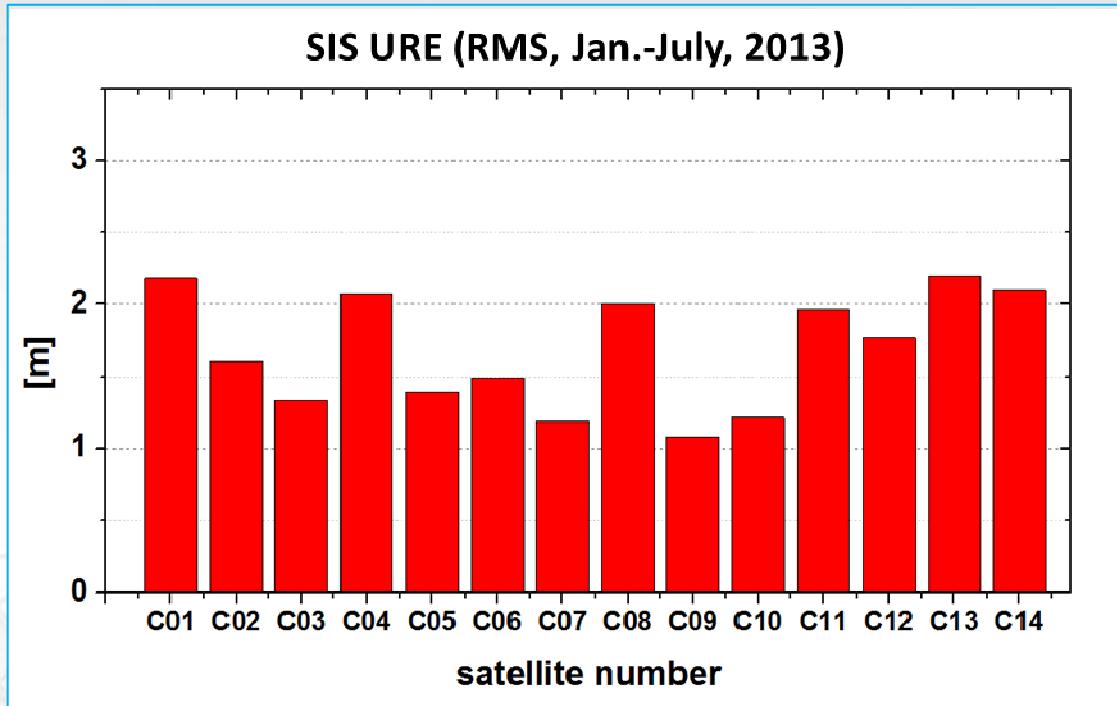




2. System Performance

(2) SIS accuracy

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



SIS URE of each BeiDou satellite (RMS)

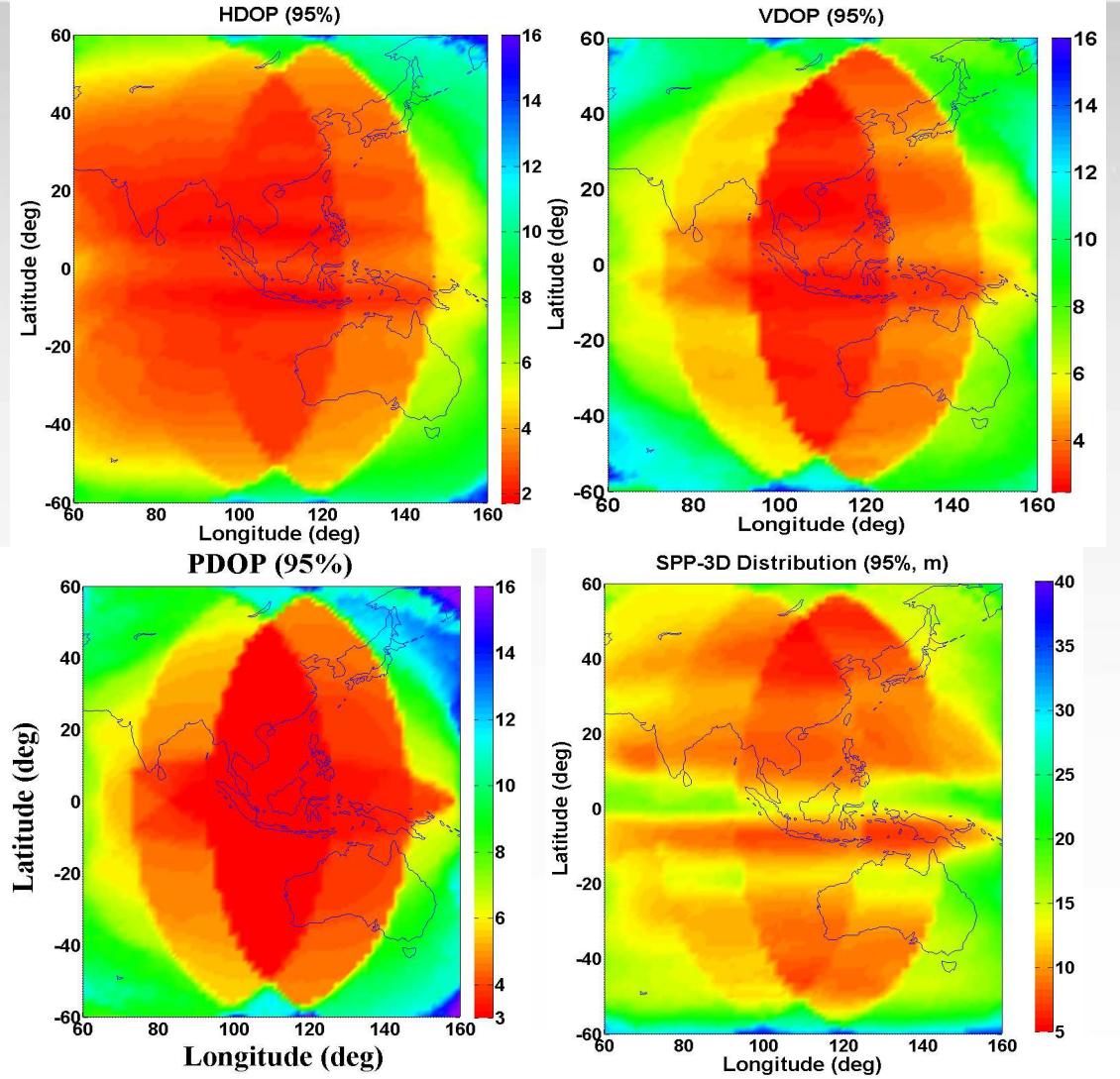


2. System Performance

(3) Positioning accuracy

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

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

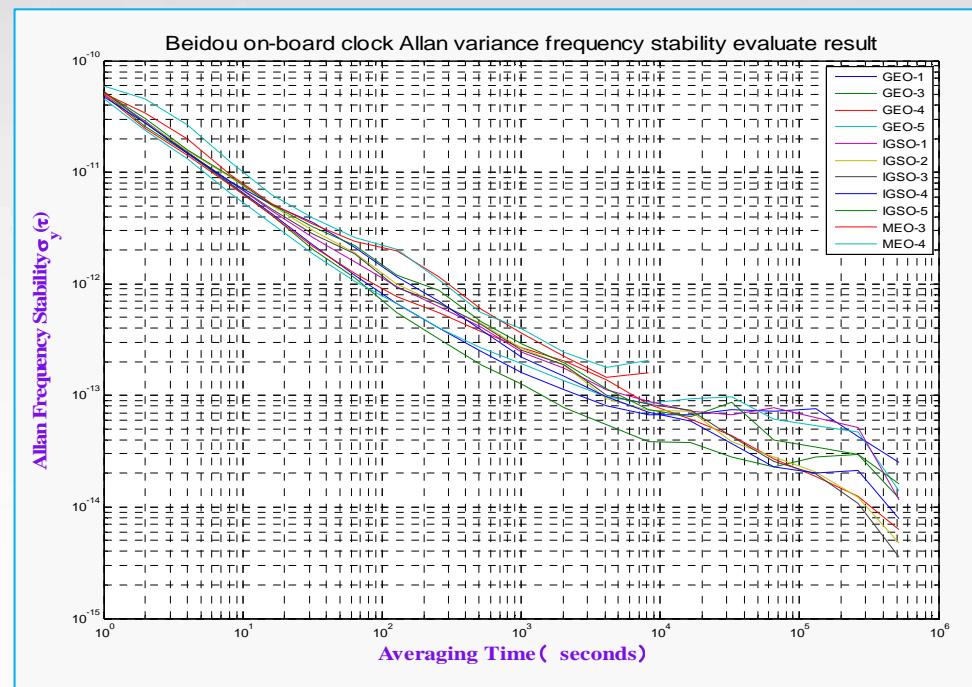




2. System Performance

(4) Satellite clock

- ★ All primary rubidium clocks on-board BeiDou satellites are made by China.
- ★ ADEV of BeiDou RAFSs: $5.5\text{E}^{-14}\sim9.0\text{E}^{-14}$ at an averaging interval of 10000s, $2.5\text{E}^{-14}\sim9.4\text{E}^{-14}$ at an averaging interval of 1 day.



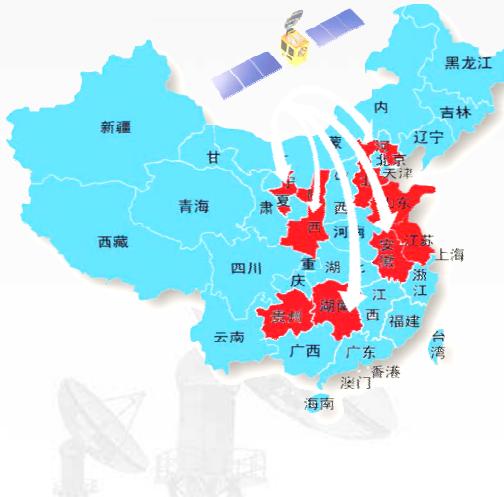
Clock performance for all operational
BeiDou satellites



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

The screenshot shows the homepage of the China Location Based Service Network, featuring:

- A login form with fields for username/mobile number, password, and checkboxes for记住密码 (Remember Password) and 自动登录 (Automatic Login).
- A banner with images of people, a satellite, and a smartphone.
- Four promotional cards: "一种模式" (One mode), "一套标准" (One standard), "一个平台" (One platform), and "更多产品介绍" (More product introduction).
- Links for 快速链接 (LINK), 常见问题 (FAQ), 热门应用 (HOT), and 联系我们 (CONTACT).
- Footer links for 客户端下载 (Client download), 产品介绍 (Product introduction), 我要做开发者 (I want to be a developer), and 注册 (Registration).
- Footer links for 什么是Android设备? (What is an Android device?), 我是普通用户 (I am a general user), 怎么上轨我开发的应用 (How do I upload my application to the track?), 别处中心 (Other centers), 轨道监控 (Orbit monitoring), 卫星导航 (Satellite navigation), 我的位置轨迹 (My location trajectory), 定位 (Positioning), 轨道监控2 (Orbit monitoring 2), and 分享到 (Share to).

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*

China Satellite Navigation Office



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)
4 – 8 November 2012
Beijing, China

Ninth meeting of the Providers' Forum, 6 November 2012

Statement of the Providers' 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 since developed into a forum for the providers, the communications, observers and interests. United Nations member states to exchange views and information regarding the field of satellite navigation. The ICG has taken a leading role in the development of the Global Navigation Satellite System (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, standardization, frequency assignment, timing and precise reference frames, education and training, and global applications.

The Providers' 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, offering an important platform for the providers to meet and discuss the needs and goals of the members 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, in its Ninth meeting held in conjunction with the ICG-7, the Providers' Forum has been instrumental in encouraging the providers to work together to establish better service, support the protection of radio-frequency satellite services (RFSS) spectrum, consider activities for projects GNSS resources and education, and promote the use of GNSS in mobile communications and other applications on important areas addressed by the ICG that require focused input from system providers.

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

China Satellite Navigation Office



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

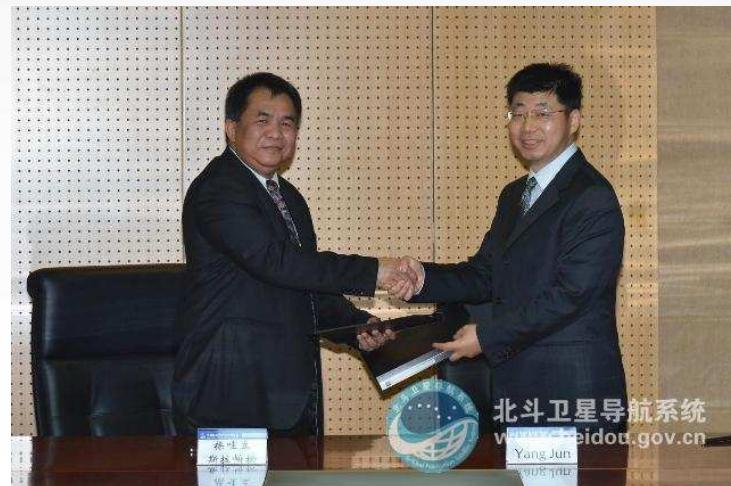




4. International activity

(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





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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 2nd 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>