

**CHINA SATELLITE NAVIGATION OFFICE**

**The 50<sup>th</sup> session of the Scientific and Technical Subcommittee  
of the Committee on Peaceful Uses of Outer Space**



# **BeiDou Navigation Satellite System and International Activities**

**China Satellite Navigation Office**

**Feb 18, 2013**



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## Part I Update of BDS

## Part II International Activities

## Part III Summary





# 1. Development Objective

- **Stable, reliable and high quality service**
- **Serve the world, benefit the mankind**



## Objective:

- **Meet the requirements of national security and social economic development.**
- **Accelerate informationization drive as well as economy development mode transformation.**
- **Realize social and economic benefits.**
- **Make contribution to international GNSS community.**



## 2. Basic Policy

- **Provide continuous space-based PVT services for global users free of charge, continue maintenance and complement in order to enhance service performance.**
- **Formulate application industry plan and standard to push forward development of GNSS industry and promote worldwide use.**
- **Strengthen international cooperation, including advocating for international GNSS Monitoring and Assessment, achieving compatibility and interoperability between BDS and other GNSS, ensuring diversified applications.**



# 3. System Description

## Space segment

- 5 GEO Satellites
- 30 Non-GEO Satellites



## Ground Control Segment

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



## User Segment

- BeiDou user terminals
- Terminals compatible with other GNSS





# 3. System Description

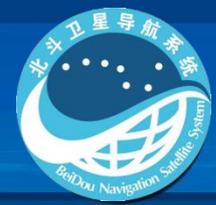
## Service and Performance



Positioning accuracy  
 $\leq 10$  meters

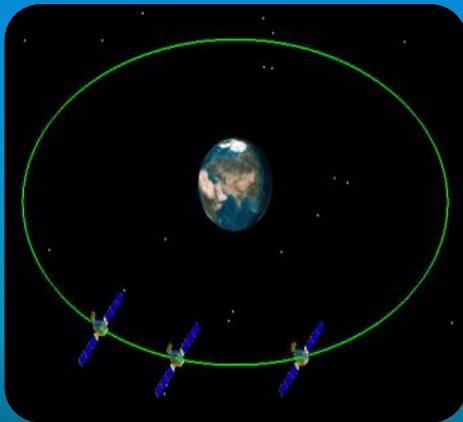
Timing accuracy  
 $\leq 20$  ns

Velocity accuracy  
 $\leq 0.2$  m/s



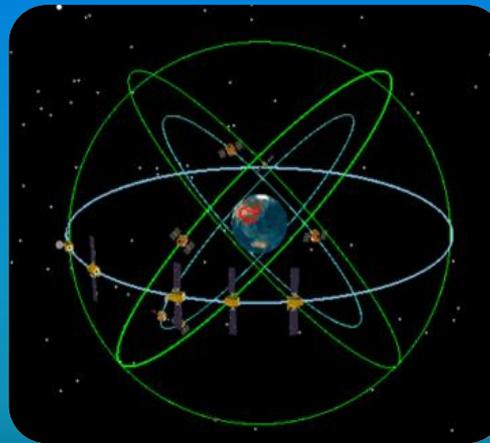
# 4. Development Plan

## 1<sup>st</sup> Step



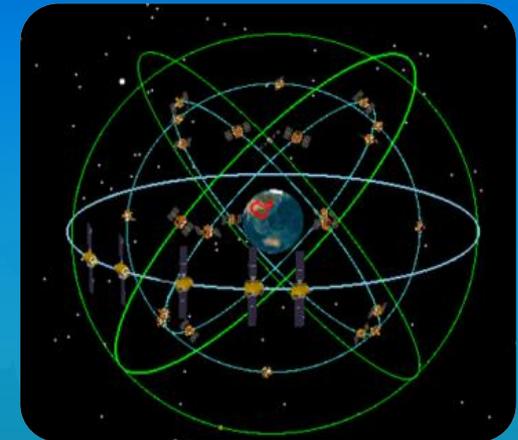
BeiDou Demonstration System

## 2<sup>nd</sup> Step



BeiDou Navigation Satellite System

## 3<sup>rd</sup> Step



BeiDou Navigation Satellite System

1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020



# 4. Development Plan

1<sup>st</sup> step

2<sup>nd</sup> step

3<sup>rd</sup> step

First initiated in 1994, BeiDou demonstration system was able to provide regional active services in 2000.





# 4. Development Plan

1<sup>st</sup> step

2<sup>nd</sup> step

3<sup>rd</sup> step

BeiDou system construction was initiated in 2004 and will provide regional passive services by 2013.





# 4. Development Plan

1<sup>st</sup> step

2<sup>nd</sup> step

3<sup>rd</sup> step

BeiDou system will be developed continuously to provide global passive services by 2020.



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# 5. Development Status

## Satellite launch record



Launch Time	Satellite Number
2007	1
2009	1
2010	5
2011	3
2012	6

2012. 2. 25



GEO

2012. 4. 10



2 MEO

2012. 9. 19



2 MEO

2012. 10. 25



GEO



# 5. Development Status

## Constellation status

- 14 BeiDou operational satellites in orbit.
- Constellation of 5GEOs, 5IGSOs and 4MEOs.



Stage	BeiDou Navigation Satellite System															
Num	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Type	MEO	GEO	GEO	GEO	IGSO	GEO	IGSO	IGSO	IGSO	IGSO	GEO	MEO	MEO	MEO	MEO	GEO
Date	2007. 4.14	2009. 4.15	2010. 1.17	2010. 6.2	2010. 8.1	2010. 11.1	2010. 12.18	2011. 4.10	2011. 7.27	2011. 12.2	2012. 2.25	2012. 4.30	2012. 4.30	2012. 9.19	2012. 9.19	2012. 10.25
Status	Flight test	In maintenance	Operational	Operational	Operational	Operational	Operational	Operational	Operational	Operational	Operational	Operational	Operational	Operational	Operational	Operational



Operational



Flight test



In maintenance



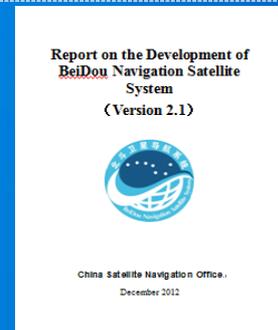
# 5. Development Status

## Service provision in December 27, 2012

- Provide Full Operational Service for China and its surrounding areas since December 27, 2012



- Publish BDS Interface Control Document (ICD) for signal-in-space



- Logo of BDS





## 5. Development Status

**Service performance status**

**Positioning accuracy: Horizontally, 10 m, vertically, 10 m;**

**Velocity accuracy: 0.2 m/s**

**Timing accuracy: one-way 50 ns**

**short message communications service: 120 Chinese characters per time**



# 6. System Application

## 1) Fundamental Products



**Chips**



**OEM**



**Antenna**

## 2) Popular Application

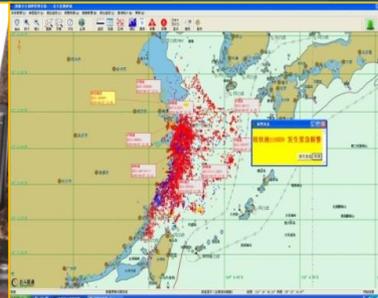
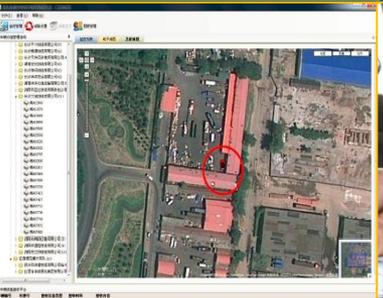




# 6. System Application

## 3) Industry Popularization

- Transportation
- Marine Fishery
- Rescue
- Meteorology





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# International Activities

- **Undertake more international responsibilities through ICG related activities.**
- **Cooperate with major GNSS, and popularize applications with neighboring countries.**
- **Promote international technical exchange.**
- **Promote BDS to merge into international standards.**





# 1. International Exchange

- World-oriented CSNC
- Academic exchange activities
- Education and training



International GNSS exchange and training center



GNSS frontier technology summer school

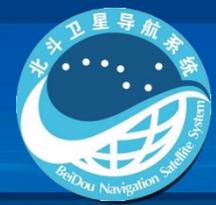


# The 4<sup>th</sup> CSNC

- Will be held on May 15-17, 2013 in Wuhan, China
- An open platform for academic exchanges
- Theme: BeiDou Application---- Opportunities and Challenges



➤ [www.beidou.org](http://www.beidou.org)



## 2. Coordination

### 1) Multilateral Coordination

- Deeply participate in activities of ICG as one of core system providers.
- Host the 7<sup>th</sup> meeting of ICG.
- Speed up iGMAS construction, strengthen cooperation with IGS, related organizations and other GNSS.



8<sup>th</sup> meeting of ICG Providers' forum



55<sup>th</sup> meeting of COPUOUS



iGMAS tracking stations



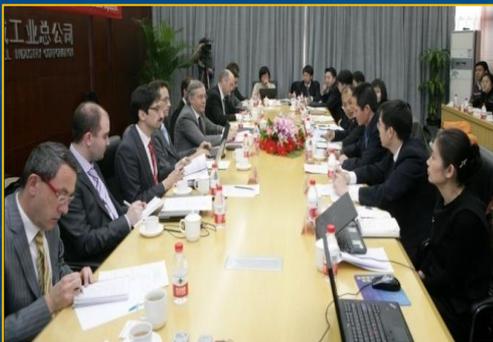
## 2. Coordination

### 2) Bilateral Coordination

- Comply with radio regulations of ITU.
- carry out more than 10 rounds of bilateral and multilateral coordination to jointly share frequency and orbit resources.



2011 orbit safety consultation meeting for 140E



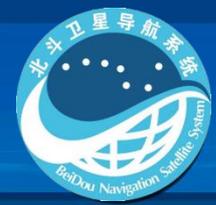
Technical Working Group meeting on C&I between China and Europe



5<sup>th</sup> Frequency coordination of China and US



12<sup>th</sup> Satellite Network coordination meeting between China and Japan



## 2. Coordination

### 2) Bilateral Coordination

- Meetings between China and Russia Satellite Navigation Cooperation to promote satellite navigation monitoring, interoperability and application.
- Satellite navigation cooperation meetings between China and Pakistan to jointly promote BeiDou/GNSS international popularization.



2<sup>nd</sup> China-Russia Aerospace cooperation working group meeting



The 2<sup>nd</sup> China-Pakistan Satellite Navigation Cooperation Meeting

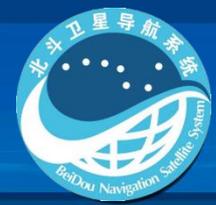


## 3. The 7th meeting of ICG

### 1) The aim of ICG

- **International Committee on Global Navigation Satellite Systems (ICG)**
  - **To promote cooperation**
  - **Compatibility and interoperability of global navigation satellite systems**
  - **Civilian satellite-based positioning, navigation, timing and value-added services**
  - **Support sustainable development**



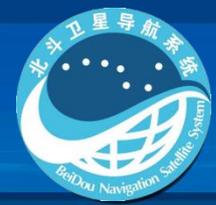


# 3. The 7th meeting of ICG

## 2) ICG-7 Overview

- Held from 4-9 November 2012 in Beijing, hosted by Chinese government
- About 200 participants attended
- System updates presented by providers
- Status and perspectives on GNSS presented by related countries, international and regional organizations





## 3. ICG-7

### 3) ICG-7 - Presentations

- **WG-A: 13 presentations on Compatibility and Interoperability**
- **WG-B: 8 presentations on Enhancement of GNSS Services Performance**
- **WG-C: 8 presentations on Information Dissemination and Capacity Building**
- **WG-D: 7 presentations on Reference Frames, Timing and Applications**
- **Applications and Experts Seminar:**
  - **6 presentations on Mass-market Applications**
  - **6 presentations on Professional Applications**
  - **6 presentations on Scientific Applications**





## 3. ICG-7

### 4) ICG-7 - Recommendations

No.	WG	Recommendation
1	A	Participate in the ITU-R and regional WRC-15 preparatory work on new IMT spectrum allocations
2		Education & Outreach regarding sources of GNSS Interference
3		Continuation of IDM Workshops
4		International GNSS Monitoring and Assessment (IGMA) Subgroup
5		Interoperability Workshop
6	B	Statement of Interest in GNSS Space Service Volume
7		Dual Frequency Multi Constellation RAIM for Maritime Integrity
8		Emergency Warning Service as new Message Broadcast
9		Application Subgroup meeting in the margin of the Munich Satellite Navigation Summit 2013



## 3. ICG-7

### 4) ICG-7 - Recommendations

No.	WG	Recommendation
10	C	ICG Website redesign
11		International Centre for GNSS Science Technology and Education at Beihang University as ICG Information Centre
12		New action item "Information Dissemination" for WG-C Workplan
13		Participation to Navipedia
14	D	Interrelationship of the GNSS geodetic references through the International Terrestrial Reference System (ITRS)
15		Improving the GNSS contribution to the ITRF defining parameters
16		Information on the works related to the redefinition of UTC
17		Declaration on the computation of Rapid UTCr



## 3. ICG-7

### 5) PF Statement

- Statement agreed by all participants at PF meeting during ICG-7, 1<sup>st</sup> PF statement since the establishment of ICG

ICG was established in 2005 and has steadily developed into **an important platform** for the system providers, user communities, observers and interested UN member states to exchange views and information concerning the field of satellite navigation. ICG has taken **a leading role** internationally to promote collaboration in the utilization of GNSS services for a range of commercial, scientific and technological applications.



## 3. ICG-7

### 5) PF Statement

**Specific areas of interest** to the ICG and its Working Groups include compatibility and interoperability, service performance and service performance enhancement, timing and geodetic reference frames, education and training, and global applications.

The PF was established in 2007 at ICG-2. Since then, each of the 6 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.



## 3. ICG-7

### 5) PF Statement

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 9th meeting held in conjunction with ICG-7, Beijing, November, 2012, the PF **considers user recommendations, works cooperatively** to enable better service, **supports the protection** of RNSS spectrum, **considers activities** that promote GNSS awareness and education, and considers proposals to enhance service performance, and performance monitoring and assessment.



## 3. ICG-7

### 5) PF Statement

The PF promotes compatibility and interoperability among current and future global and regional space-based systems by **exchanging detailed information** about planned or operating systems and the policies and procedures that govern their service provision. More importantly, the PF is a mechanism to continue discussions on important issues addressed by the ICG that require focused inputs from system providers.

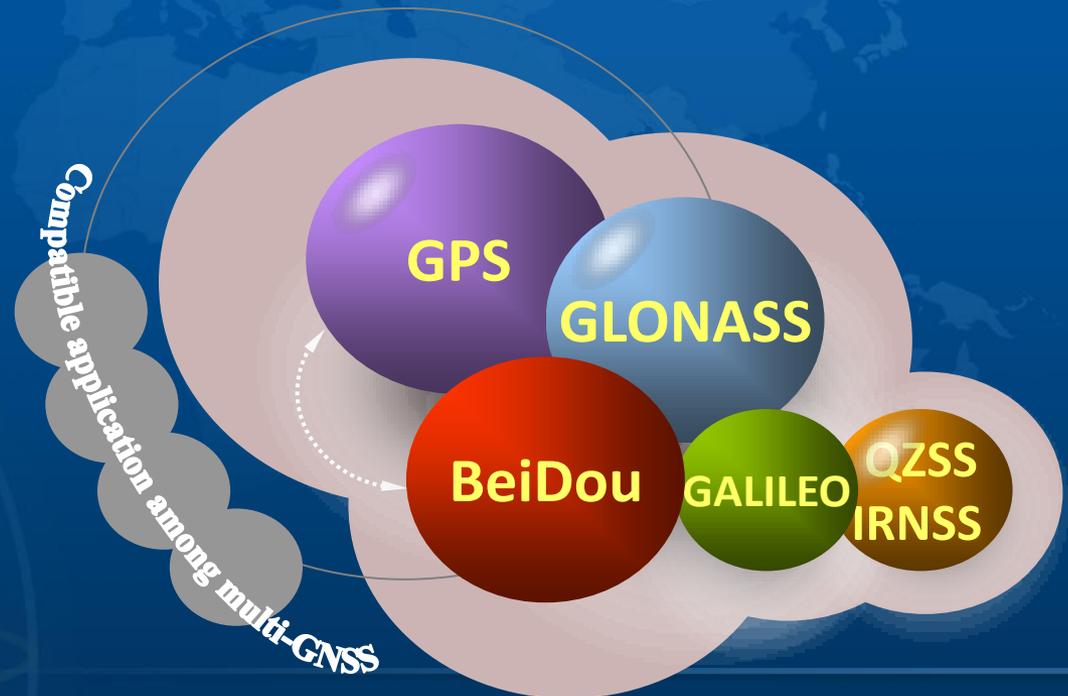
In its 9th meeting, the PF considered **the future role of the ICG** and agreed to keep it on its agenda.



## 4. BADEC

### 1) BADEC Overview

BADEC, is short for BeiDou+ Application Demonstration & Experience Campaign (BeiDou+ stands for multi-GNSS including BeiDou).





## 4. BADEC

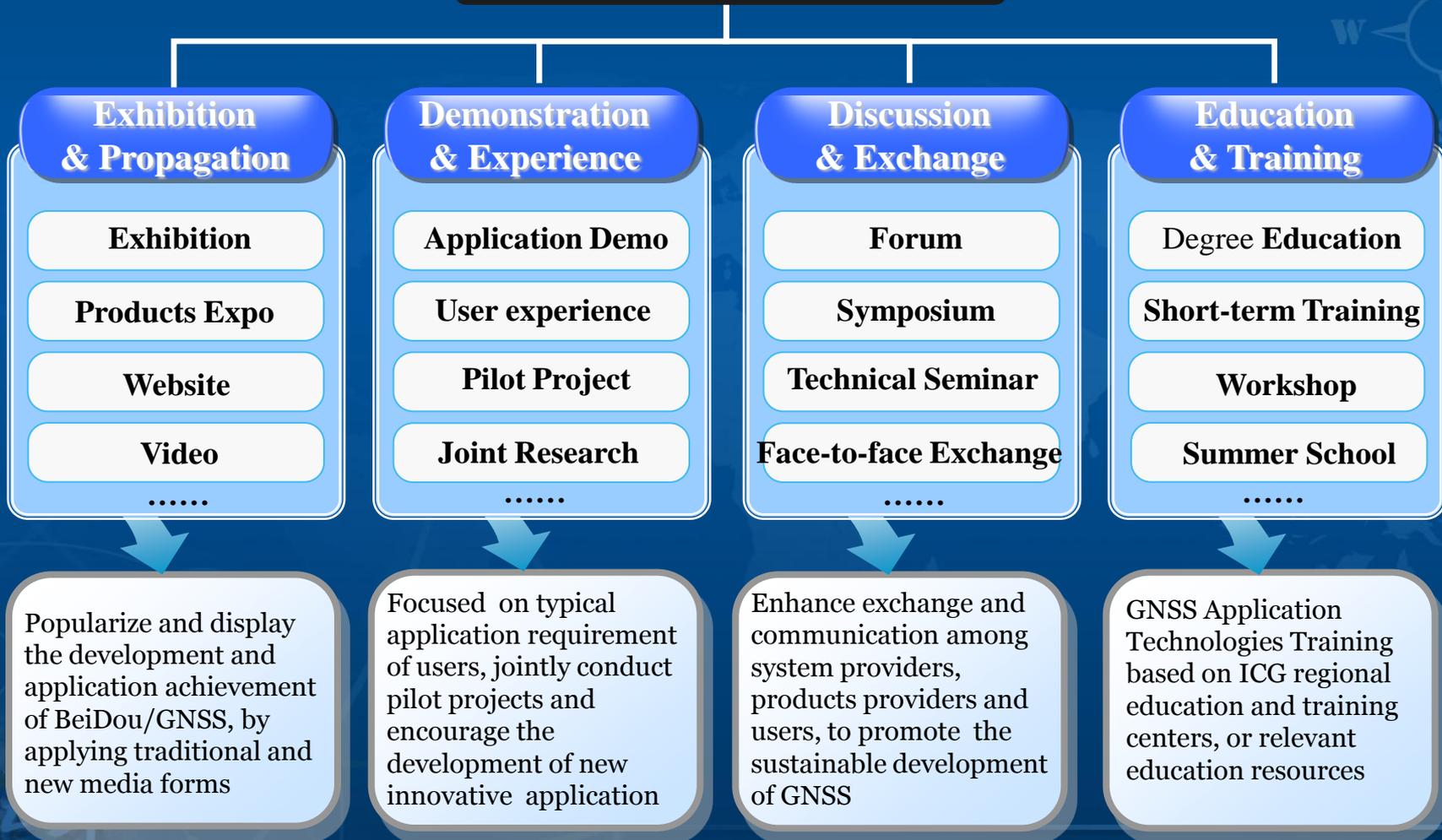
### 1) BADEC Overview

To advocate international users, to learn about and apply BeiDou/GNSS, encourage governmental departments, industries and relevant enterprises to jointly carry out multi-GNSS Application Demonstration & Experience Campaign, survey and collect requirements from international users, explore new applications together, so as to provide better GNSS services to the mankind and realize mutual development of all GNSS.



# 4. BADEC

## BADEC CONTENT



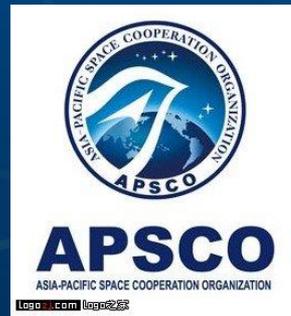


## 4. BADEC

### 2) Cooperation with APSCO

In August 2012, CSNO and APSCO signed the tentative agreement to jointly carry out BADEC event.

- International GNSS Monitoring & Assessment System
- BeiDou/GNSS Application Training in the Asia-Pacific region
- Joint R&D *and cooperation* on GNSS civil technologies

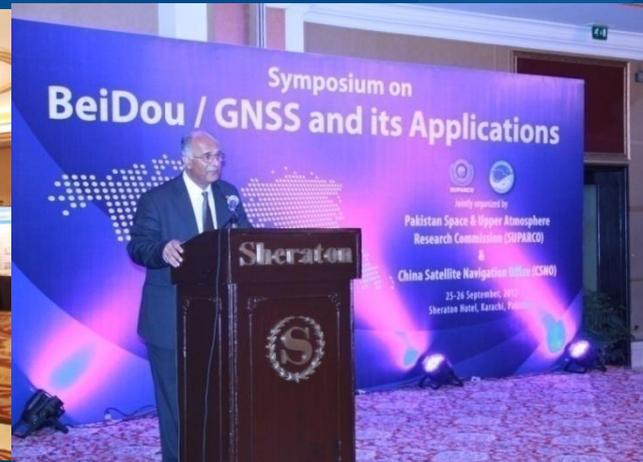




## 4. BADEC

### 3) BADEC in Pakistan

- From September 25 to 26, 2012
- In Karachi, Pakistan
- Jointly organized by CSNO and SUPARCO
- Theme: Sensing BeiDou and applying BeiDou
- Aim: To promote technical and practical cooperation

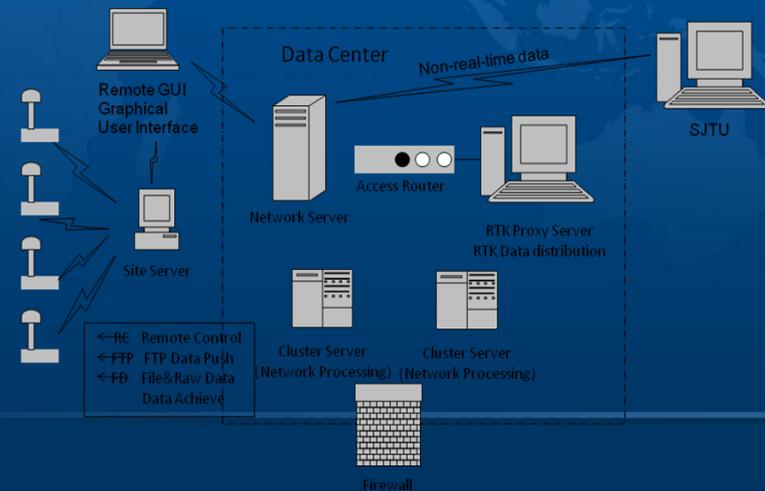
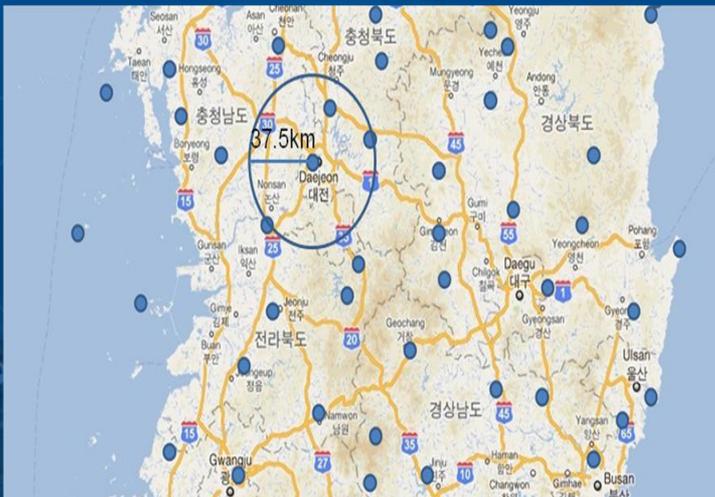




# 4. BADEC

## 4) BADEC in Korea

- Under the framework of BADEC, in cooperation with National GNSS Research Center (NGRC) of Korea, started to establish a small-scale CORS network test system in late October 2012, to carry out test and research in fields of high-accuracy mapping, timing, differential navigation, and worked out primary results.





## 4. BADEC

### 5) Current and follow-up activities

**BeiDou Tour:** To conduct itinerant BADEC activities majorly in the Asia- Pacific region, make detailed scheme and arrangement based on specific status and requirements of different countries.

**International projects:** To jointly launch application pilot project and focus on the fields with wide application requirements, such as disaster monitoring, emergency management, transportation, marine fishery, personal LBS, etc.



# 5. iGMAS

## 1) iGMAS Overview

Several GNSS monitoring activities are underway. e.g.

- preliminary experience of iGMAS,
- the long-term successful operation of IGS,
- the achievements in GNSS signal monitoring made by Stanford University, DLR, Information Analysis Center of Roscosmos, MGA and others.

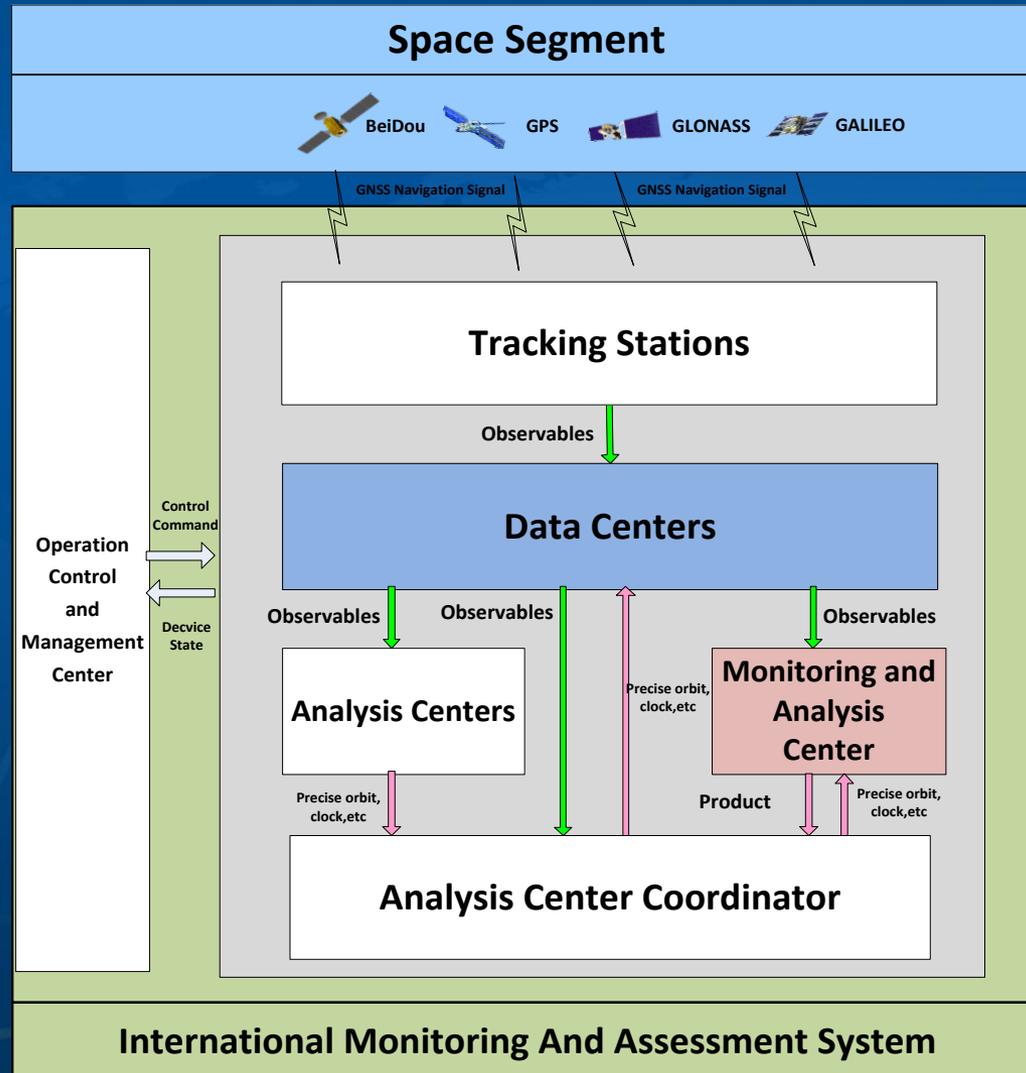
### Objective & tasks:

- ✓ To promote the sharing of the global monitoring resource and provide better GNSS service for users.
- ✓ to support related activities and develop proposals to optimize existing and planned capabilities, and identify additional necessary activities
- ✓ To discuss the related standards, the sharing mode of resource
- ✓ To develop the monitoring and assessment products
- ✓ To provide assessment service effectively



# 5. iGMAS

## 1) iGMAS Overview

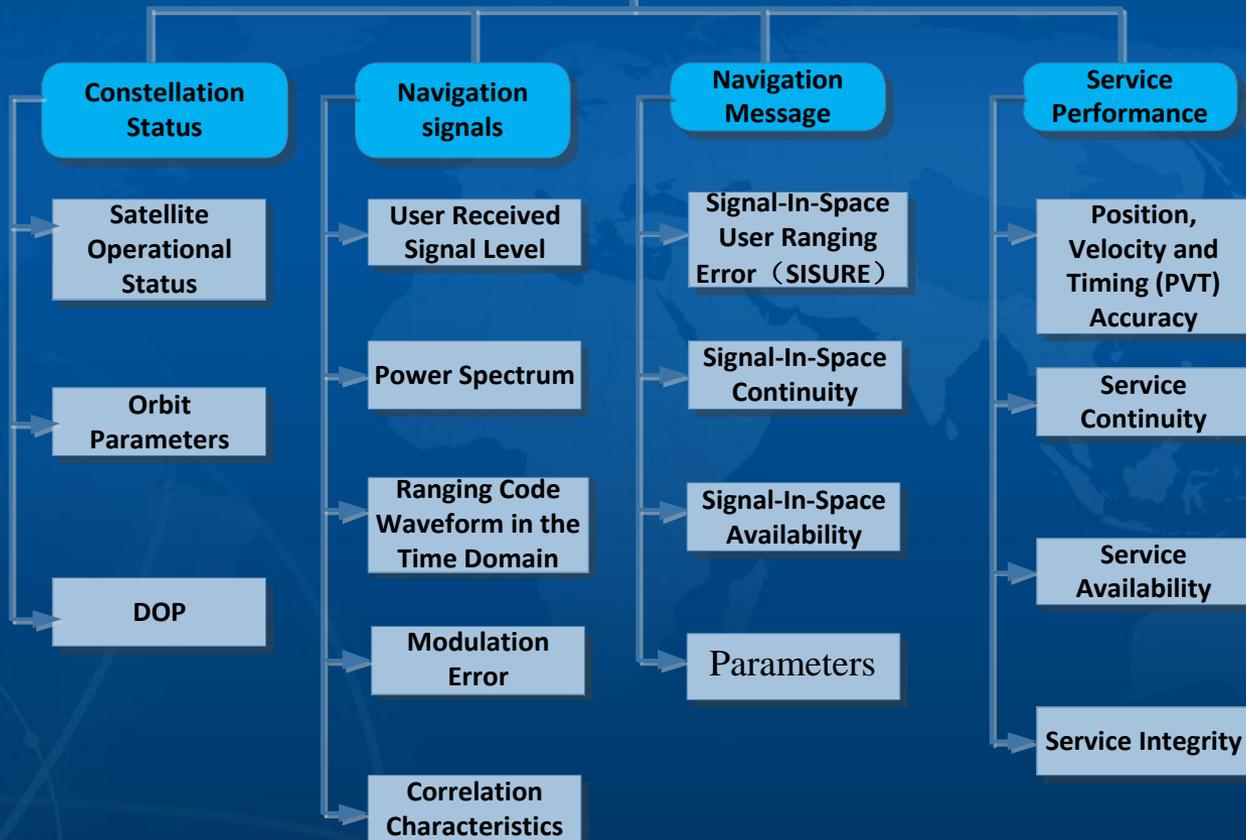




# 5. iGMAS

## Monitoring and Assessment Item

### GNSS Monitoring and Assessment Item



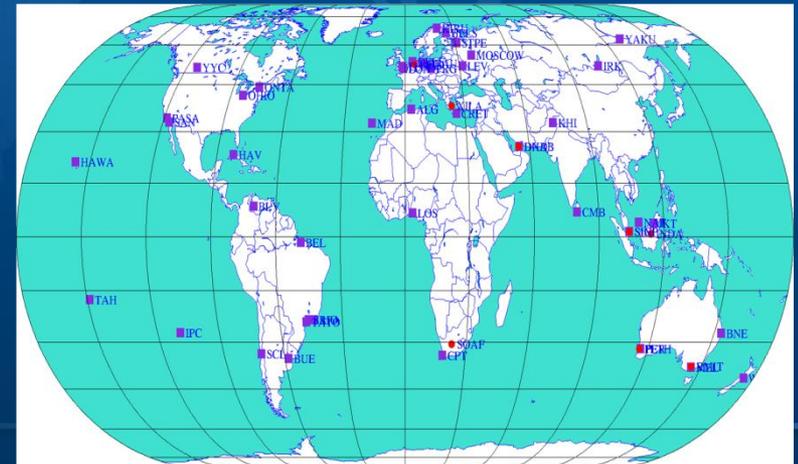


# 5. iGMAS

## 2) iGMAS Progress

### Tracking Station

- Signal monitoring station, ten domestic tracking stations established.
- Cooperation intentions reached for 43 stations with 37 organizations in 23 countries.
- The specific plan of establishing stations with Russia, Pakistan and other countries is consulting.





# 5. iGMAS

## 2) iGMAS Progress

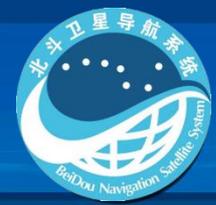
### Data Center

- Two data centers are under construction at Wuhan University and National Time Service Center.



### Operation Control Center





# 5. iGMAS

## 2) iGMAS Progress

### Specifications

- Specifications for construction, operation and maintenance of the iGMAS tracking stations, Data Center and Analysis Center.
- Data and product format.
- Monitoring and Assessment Items Standards will be formulated after reaching a consensus with related countries and organizations.





## 5. iGMAS

### 3) Current and Follow-up activities

- ✓ ICG Subgroup activities on International GNSS Monitoring and Assessment
- ✓ Need more countries and organizations to take part in, e.g. building stations jointly, sharing data and products with each other etc. Call for Participation! [www.beidou.gov.cn](http://www.beidou.gov.cn)
- ✓ Monitoring and Assessment Item is being under discussion.
- ✓ To support various campaign e.g. IGS M-GEX, by sharing stations, raw data and geodetic receivers with other system capabilities.



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# Summary

## BDS Construction

- The second deployment step has been accomplished.
- BDS has possessed full operational capability for most Asia-Pacific area since the end of 2012.

## BDS Application

- ICD has been released to support industry development .
- BDS chips is matured day by day.
- Application is promoted in large scale.





# Summary

## International Activity

- International exchange, coordination and cooperation.
- BADEC, promote multi-GNSS applications.
- International monitoring and assessment, ensure reliable GNSS services for global users.



# Thank you!

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[www.compass.gov.cn](http://www.compass.gov.cn)

