The 5th meeting of International Committee on GNSS

BeiDou Navigation Satellite System

China Satellite Navigation Office

Oct. 18th-22nd, 2010, Turin Italy

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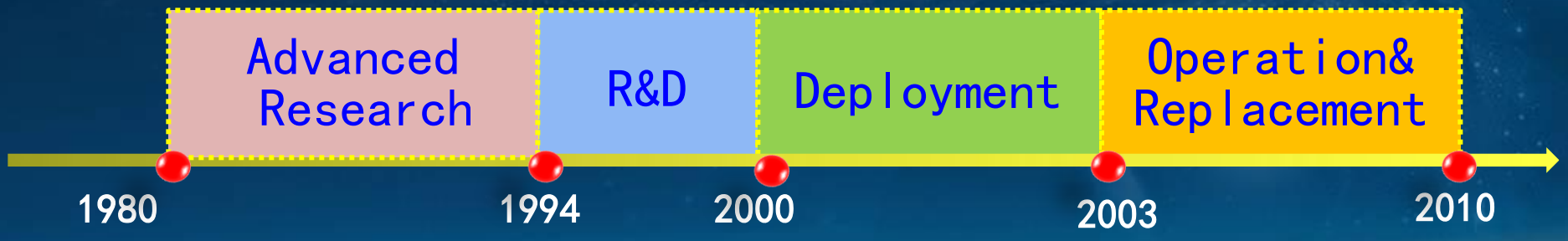
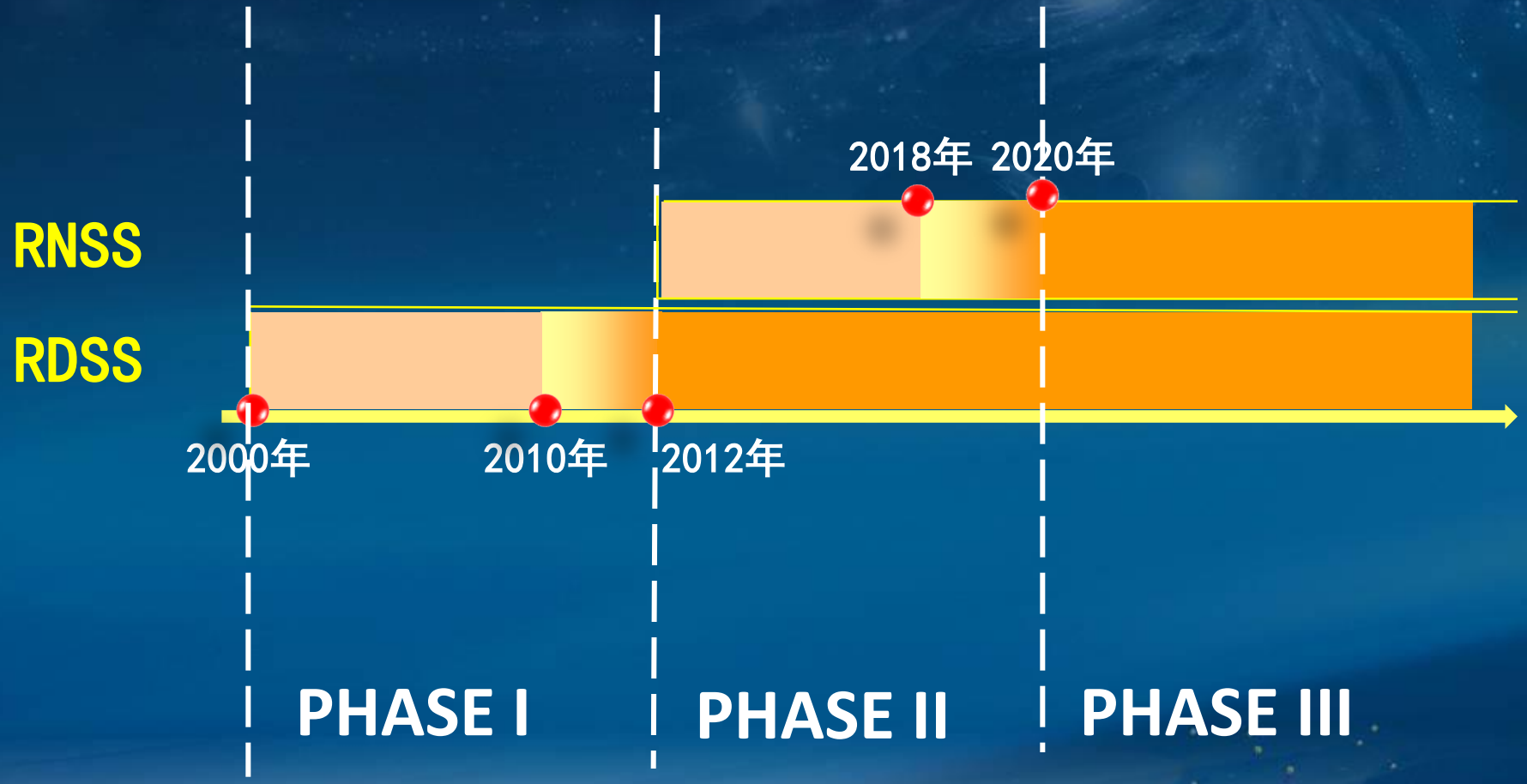
Contents

- Attaching great importance to the construction and development of satellite navigation system and working hard to explore and develop this important space information infrastructure.
- To provide global accurate and reliable PNT services in any place of the world, any time and any weather, as well as short-message services.

BeiDou Navigation Demonstration System



BeiDou Navigation Satellite System


RNSS
RDSS
2000年
2010年
2012年
2018年
2020年
PHASE I
PHASE II
PHASE III

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2. System Brief

2.1 System Infrastructure

2.2 Signal Characteristics

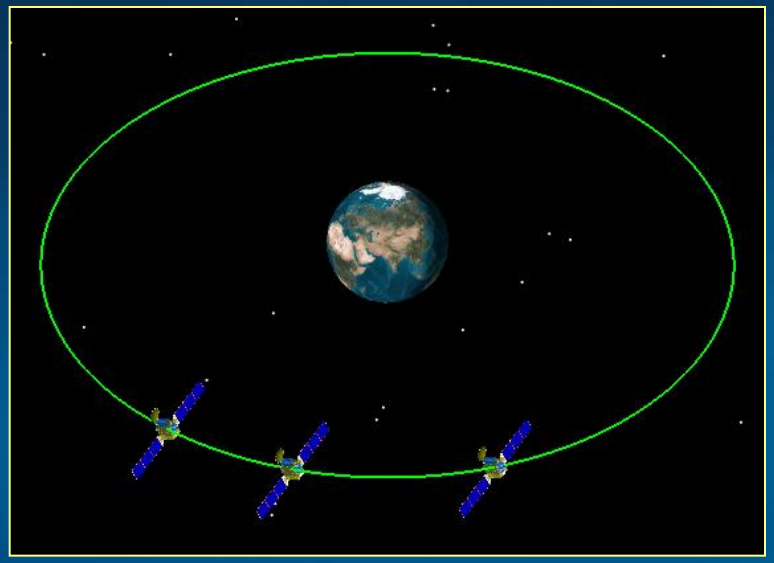
2.3 Service

2.4 Time & Coordinate System

2.1 System Infrastructure

- Space segment
- Ground segment
- User segment

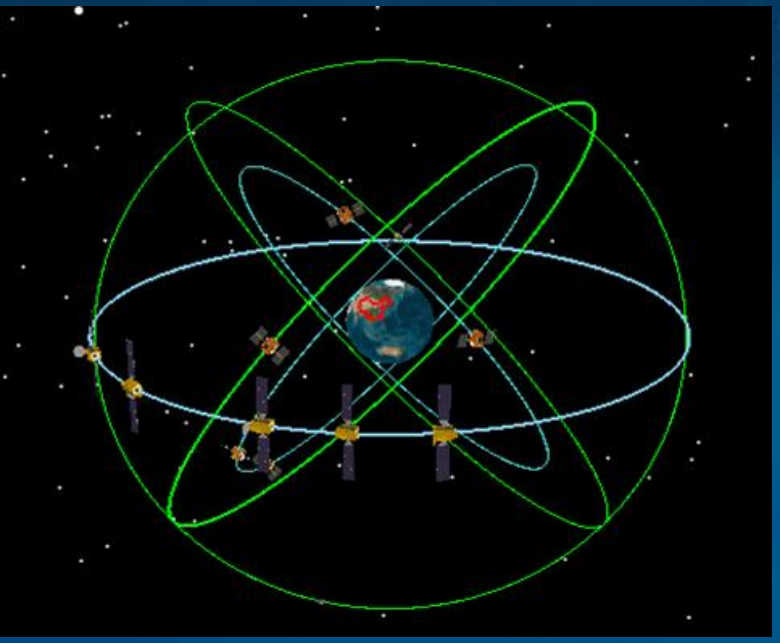
Space Segment Phase I:



Orbit	GEO
Semi-major Axis (km)	42164
Eccentricity	0
Inclination (deg)	0
RAAN (deg)	180E, 210.5E, 240E
Argument Perigee (deg)	0
Mean Anomaly (deg)	0
Satellite Number	2 operational 1 spare

Space Segment

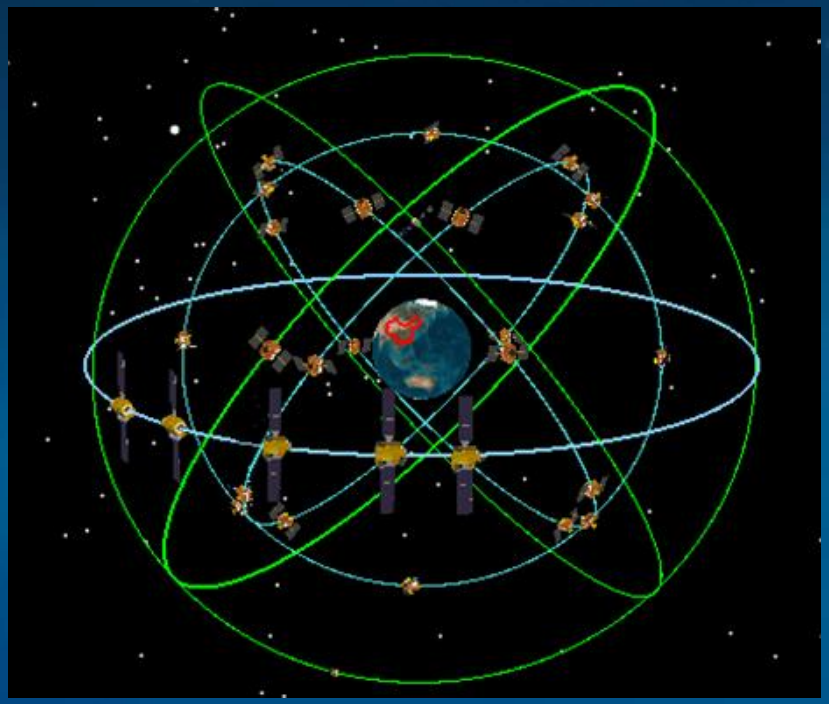
Phase II:



Orbit	GEO	IGSO	MEO
Semi-major Axis (km)	42164	42164	27878
Eccentricity	0	0	0
Inclination (deg)	0	55	55
RAAN (deg)	158.75E, 180E, 210.5E, 240E,260E	218E,98E,338E,218E,98E	0E,120E
Argument Perigee (deg)	0	0	0
Mean Anomaly (deg)	0	218E:0,98E:120,338E:240,218E:337,98E:97	105,150,270,315
Satellite Number	5	5	4
Plane Number	1	3	2

Space Segment

Phase III:

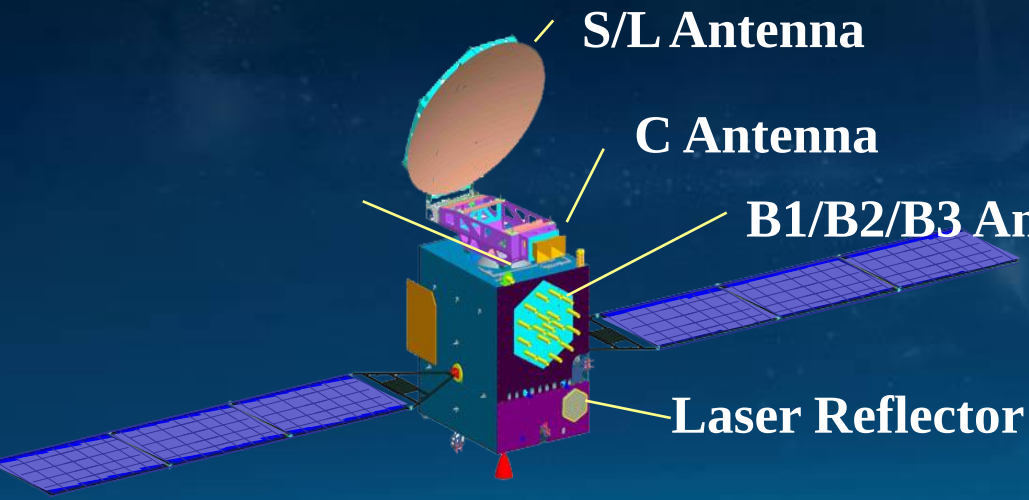


MEO constellation：

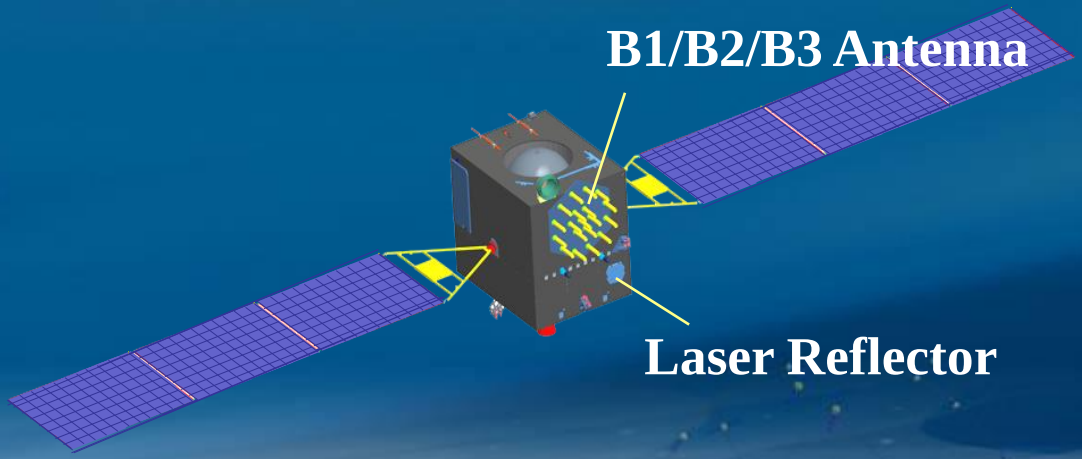
Walker 24/3/1 plus 3 spares

Orbit	GEO	IGSO	MEO
Semi-major Axis (km)	42164	42164	27878
Eccentricity	0	0	0
Inclination (deg)	0	55	55
RAAN (deg)	158.75E, 180E, 210.5E, 240E,260E	218E,98E,338E	——
Argument Perigee (deg)	0	0	
Mean Anomaly (deg)	0	218E:0,98E:120,338E:240	
Satellite Number	5	3	27
Plane Number	1	3	3

GEO Satellite



MEO/IGSO Satellite



2.1 System Structure

Ground Segment

- Master Control Station
- Uplink Station
- Monitor Station

2.1 System Structure

User Segment

- BeiDou user terminals
- Interoperable terminals with other GNSS

2.2 Signal Characteristics

◆ Signals of PHASE II

Component	Carrier Frequency (MHz)	Chip Rate (cps)	Bandwidth (MHz)	Modulation Type	Service Type
B1(I)	1561.098	2.046	4.092	QPSK	Open
B1(Q)		2.046			Authorized
B2(I)	1207.14	2.046	24	QPSK	Open
B2(Q)		10.23			Authorized
B3	1268.52	10.23	24	QPSK	Authorized

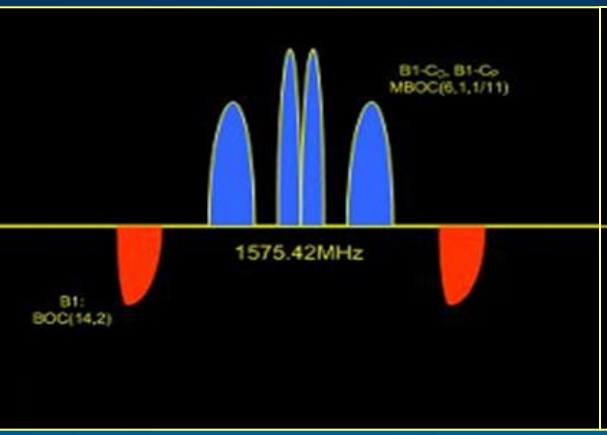
2.2 Signal Characteristics

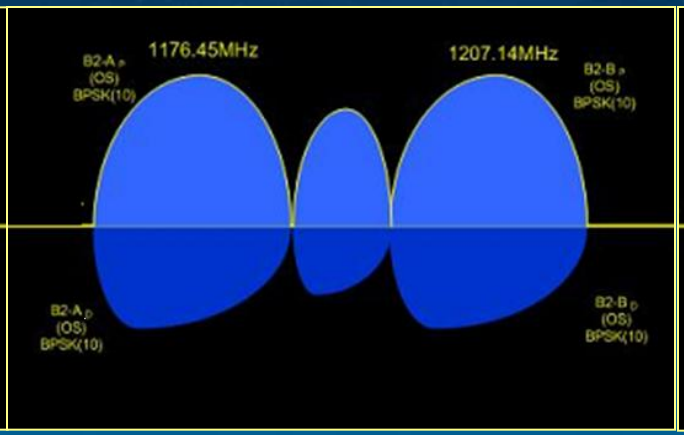
◆ Signals of Phase III

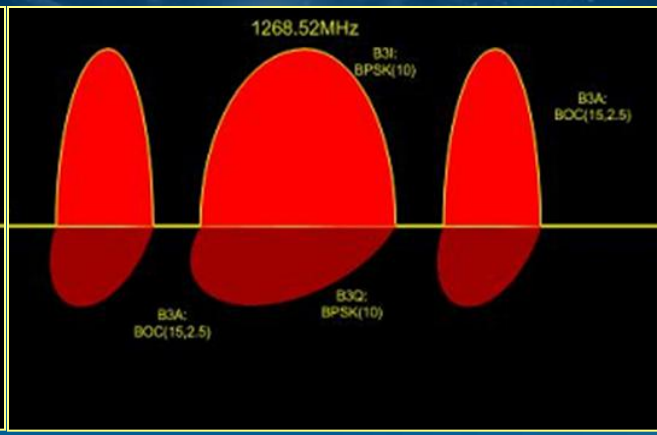
Component	Carrier frequency (MHz)	Chip rate (cps)	Data/Symbol rate (bps/sps)	Modulation Type	Service type
B1-C_D	1575.42	1.023	50/100	MBOC(6,1,1/11)	Open
B1-C_P			No		
B1		2.046	50/100	BOC（14，2）	Authorized
			No		
B2a_D	1191.795	10.23	25/50	AltBOC(15,10)	Open
B2a_P			No		
B2b_D			50/100		
B2b_P			No		
B3	1268.52	10.23	500bps	QPSK(10)	Authorized
B3-A_D		2.5575	50/100	BOC(15,2.5)	Authorized
B3-A_P			No		

Open Services

Authorized Services







B1 Signals **B2 Signals** **B3 Signals**

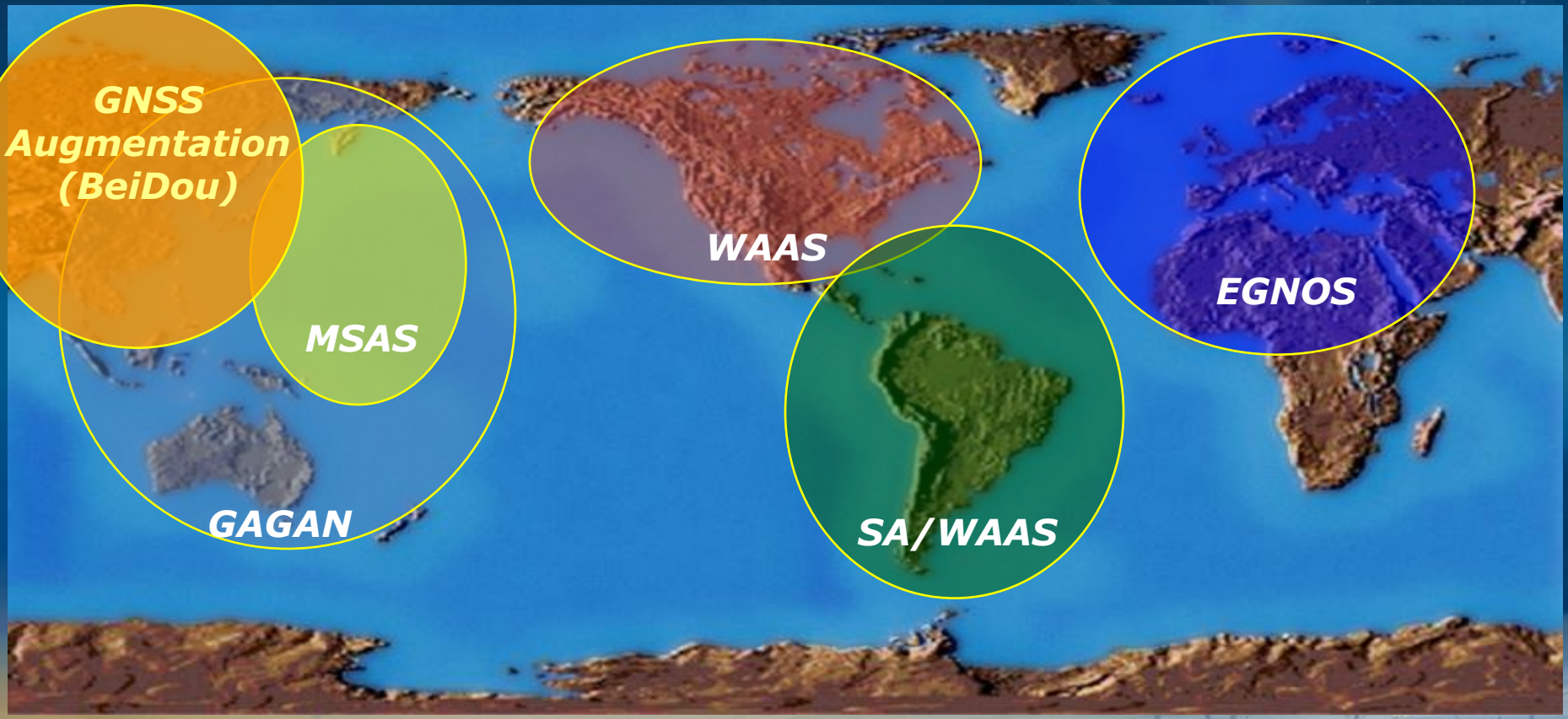
2.3 Services and Performances

- Two kinds of global services

Open Service open and free to users	Positioning Accuracy: 10 m
	Timing Accuracy: 20ns
	Velocity Accuracy: 0.2 m/s
Authorized Service	Ensure highly reliable use even in complex situations

Two regional services from BeiDou

Wide range differential service: Positioning accuracy: 1 m
Short message service



Augmentation Systems in the world

2.4 Time and Coordinate System

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

Contents

3. System Status

3.1 System Deployment

3.2 Recent Satellite Launch Plan

3.3 In-orbit Verification

3.1 System Deployment

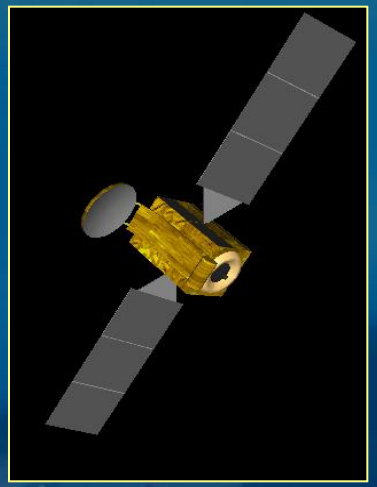
◆ Phase I—Demonstration System

- ➢ From 2000 to 2003, 3 GEOs were launched

Oct 31, 2000
140E

Dec 21, 2000
80E

May 25, 2003
110.5E



3.1 System Deployment

At present, system construction has come into the phase II.

Date	*Type*	*Launch Center*	*Launch Carrier*	*Launch Cabin*	*Orbit*
2007.04.14	MEO	Xichang	CZ-3A	DFH-3	~21,500km
2009.04.15	GEO	Xichang	CZ-3C	DFH-3	In-orbit maintenance
2010.01.17	GEO	Xichang	CZ-3C	DFH-3	144.5° E
2010.06.02	GEO	Xichang	CZ-3C	DFH-3	84° E
2010.08.01	IGSO	Xichang	CZ-3A	DFH-3	Intersecton node:118° E

1st IGSO navigation satellite in the world

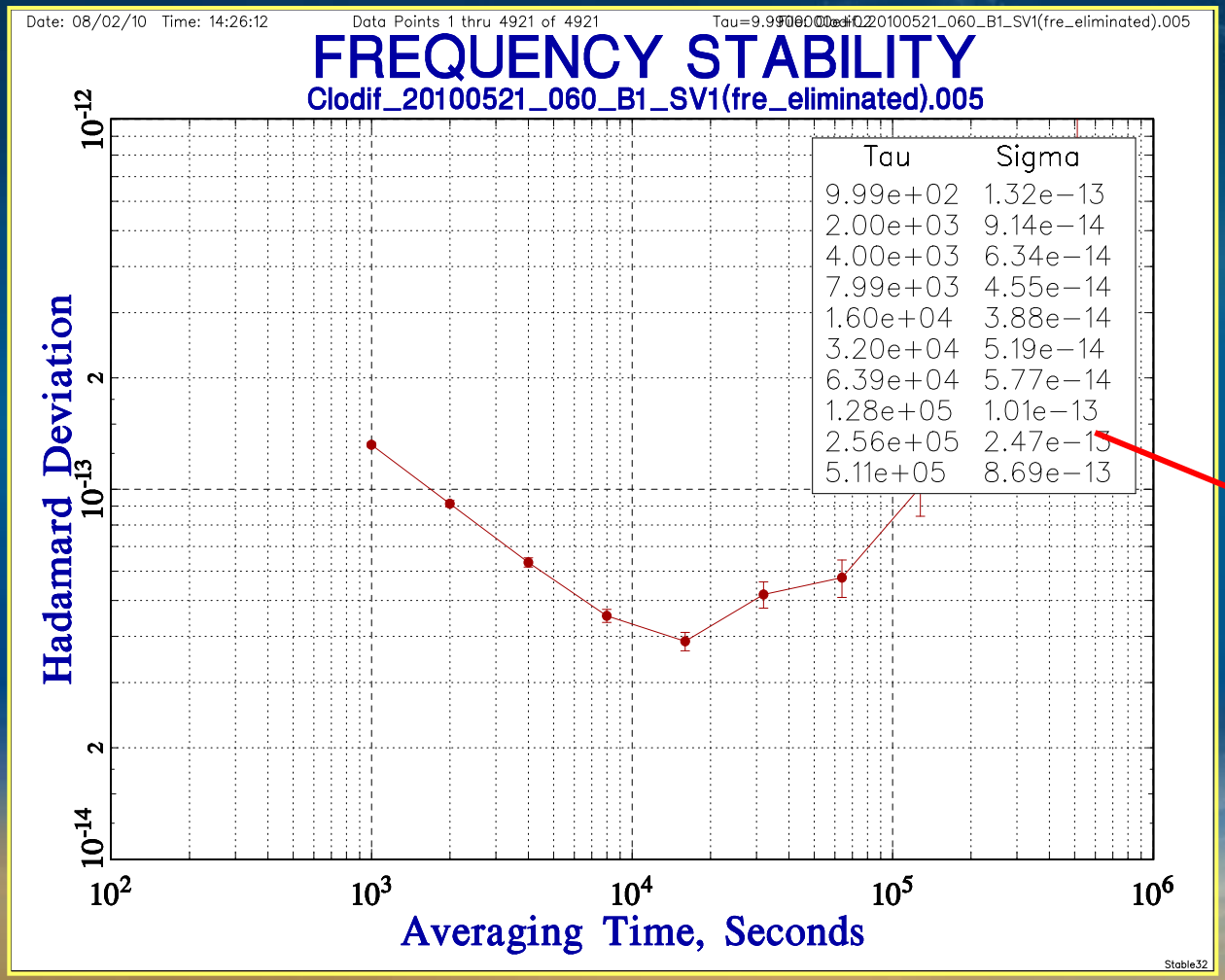
3.2 Recent Satellite Launch Plan

- **Launch plan in 2010**

  - **In November, 6th satellite — 4th GEO**
  - **In December, 7th satellite — 2nd IGSO**

3.3 In-orbit Verification

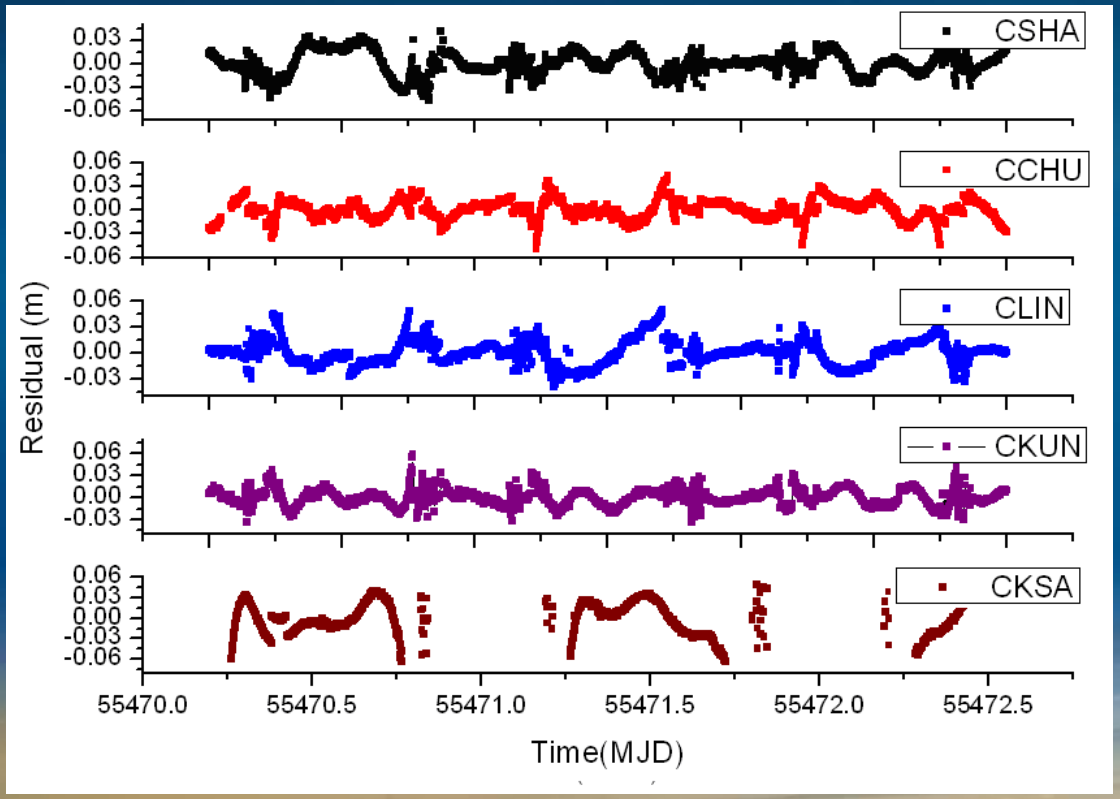
◆Rubidium Atom Frequency Standard Stability：

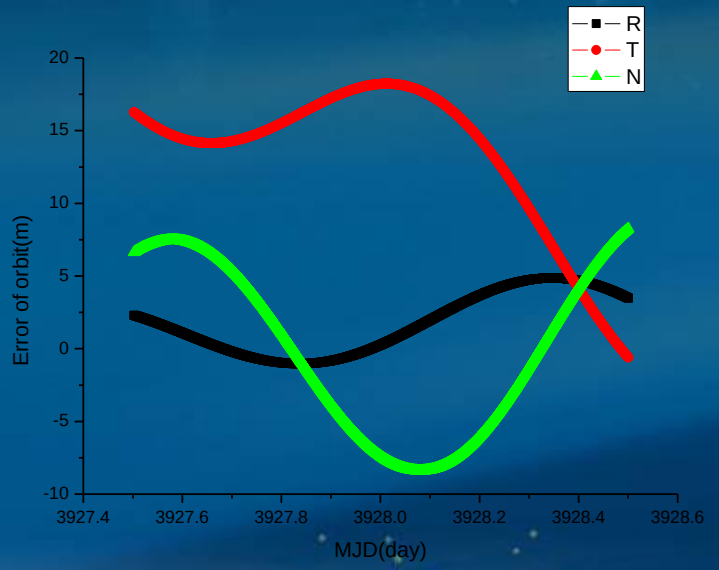


Stability:
5e-14/day

3.3 In-orbit Verification

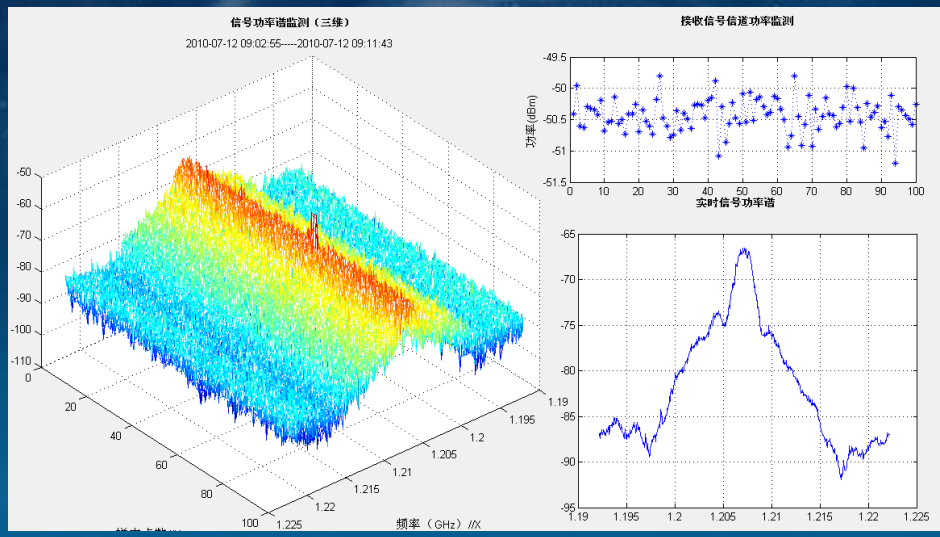
- Orbit determination precision: < 10 m
- Time synchronization precision: < 2ns



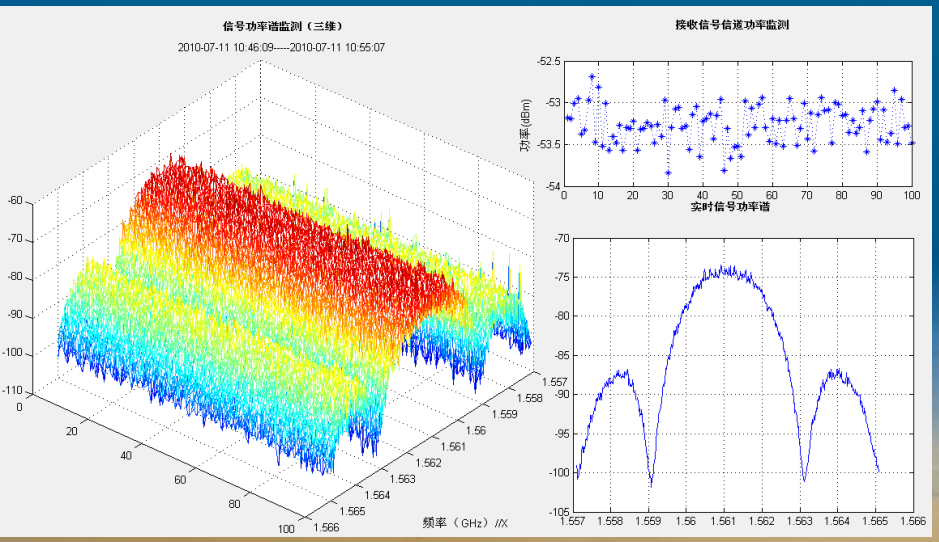


3.3 In-orbit Verification

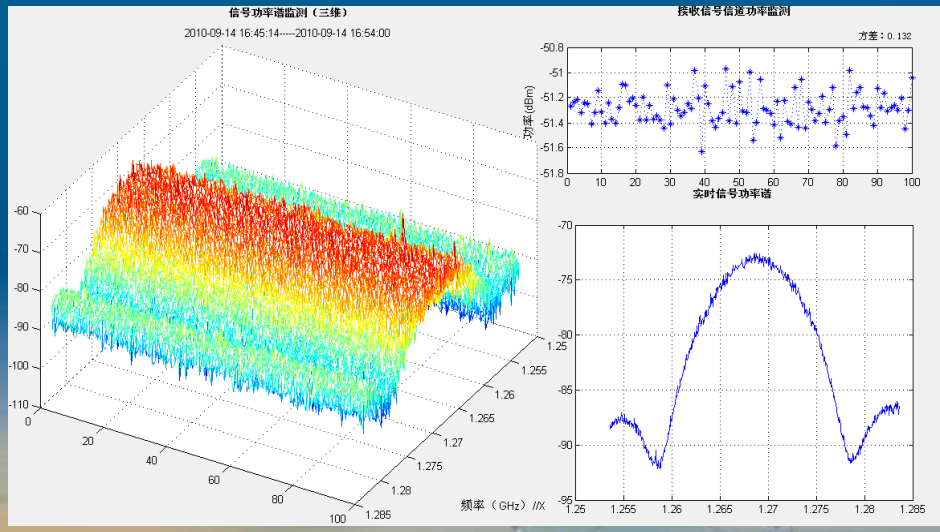
- **Signal Spectrum**



B2 Signal



B1 Signal



B3 Signal

Contents

- Fishery
- Transportation
- Water conservancy
- Meteorology
- Forest Fire Prevention
- Timing
- Disaster Prevention and Mitigation
- Soil Monitoring

Fishery

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

Distribution of marine fishery applications

BeiDou-based integrated information service network

- Fishery management services
- Fishing boat services
- SMS services

Fishery

- 14,000 fishing users, more than 40,000 mobile phone users
- Since 2007, more than 500 fishing boat emergency alarms and hundreds of vessel cross-border warnings




Transportation

- Ship monitoring system
- Road infrastructure safety monitoring system

Water conservancy

BeiDou based hydrologic monitoring system:

- **more than 4,000 users**
- **Southern regions of Shaanxi**
- **Changjiang valley**
- **Yellow river basin**
- **Especially in Barrier lake during Wenchuan earthquake**

Meteorology

Series of weather forecasting terminals and system application solutions:

- **Automatic digital information transmission and collection among national administration, regional centers and various weather stations**
- **Visualization of weather station distribution map**
- **hundreds of Beidou terminals**

Forest Fire Prevention

- Fire positioning and detection, guided fire fighting, logistic support and damage assessment
- In 2001, study of Beidou application in forest fire prevention
- In 2002, application demonstration completed
- In 2003, practical use in forest fire prevention
- More than 200 terminals equipped in forest fire prevention systems,more than 500 terminals equipped in forest headquarter and affiliated forces

Timing

- Beidou/GPS dual-mode time synchronization devices
- Embedded Beidou/GPS timing module

- Timing test of CDMA network in 7 provinces of southeast coast
- Successful trials in 200 sets of base station equipments
- applied more than 4 years
- Synchronization accuracy : < 100ns

Disaster Prevention and Mitigation

Improving rescue response and decision making capability

- **Rapid and timely disaster forecast warning report**
- **Rescue command scheduling**
- **Rapid emergency communication**

After earthquake happened in Wenchuan Sichuan Province and Yushu Qinghai Province, Beidou terminals sent the disaster and rescue information to command center at the first time.

Soil Monitoring

- Remote data collection
- **BeiDou system**
- GIS technology
- Satellite remote sensing

- Real-time monitoring of the soil moisture, temperature, humidity and location
- Comprehensive drought condition analysis
- Land area and distance measurement

Contents

◆Frequency coordination

	Sequence	Time	Location
BeiDou & GPS	1	Jun 2007	Geneva, Switzerland
	2	May 2008	Xi'an, China
	3	Oct 2008	Geneva, Switzerland
	4	Dec 2009	Sanya, China
	5	Sep 2010	Chengdu, China
BeiDou & Galileo	1	May 2007	Beijing, China
	2	Jan 2010	Beijing, China
BeiDou & GLONASS	1	Jan 2007	Moscow， Russia

Technical Working Group on Compatibility and Interoperability

	Sequence	Time	Location
BeiDou & Galileo	1	Sep 2008	Beijing, China
	2	Dec 2008	Beijing, China
	3	Jun 2009	Brussels， Begium
	4	Jan 2010	Beijing, China
	5	Oct 2010	Brussels， Begium

Contents


- On Sep 8th, 2010, the documents of “The decision on striving to cultivate and develop strategic emerging industries” adopted by State Department
- A new generation of information technology established as one of seven strategic emerging industries

- **Satellite navigation technology: one important member of the new generation of information technologies.**
- **Included in the "12th Five-Year" plan of many Ministries, Commissions and Administrations of the government**
  - **Development and Reform**
  - **Transportation**
  - **Meteorology**
  - **Agriculture, etc.**

Domestic Events

- **CSNC (China Satellite Navigation Conference)**
- **Shanghai Intelligent Traffic and Navigation Industry Technology Development Forum**
- **CPGPS (Chinese Professionals in Global Positioning Systems) Forum**

CSNC 2010

- 1st China Satellite Navigation Conference(CSNC2010)
- May 19 to 21, 2010, China National Conference Center
- Large number of participants: More than 1000 experts, scholars and other representatives, more than 400 proposed paper, dozens of enterprises entrance into satellite navigation exhibitions
- Exchange platform on system construction, navigation technology, application and industrialization

Intelligent Traffic and Navigation Industry Technology Development Forum

- Sep. 1st to 2nd, 2010, Shanghai
- Focus New generation satellite navigation system and innovation navigation technology application
- More 800 officers, experts, scholars and enterprise representatives

CPGPS Forum

- Chinese Professionals in Global Positioning Systems (CPGPS) &Satellite Navigation and Positioning Technology Forum
- August 18 to 19, 2010, Shanghai
- Focus on Navigation and Location Service - Emerging Industry and International Communication
- More than 400 experts, scholars and representatives from home and abroad

Contents

7. Conclusions

- China highly emphasizes on BeiDou system development and applications, and satellite navigation has great prosperity in China.
- 3 satellites were launched after ICG-4 and 2 satellites will be launched in later of 2010. System construction is being developed smoothly .
- BeiDou is contributing to better services, wider applications through international coordination, extensive academic exchange and domestic activities, especially on compatibility and interoperability.

Thanks for your attention!

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