

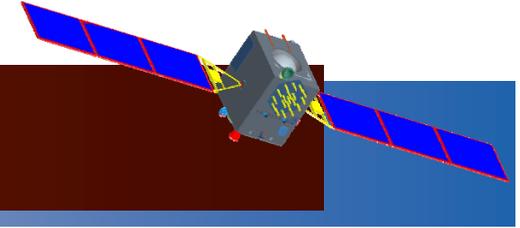
International Committee on GNSS

COMPASS/Beidou Navigation Satellite System Development

China Satellite Navigation Project Center

Dec. 8th-12nd, 2008, Pasadena USA

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1. Basic principles of the State Policy

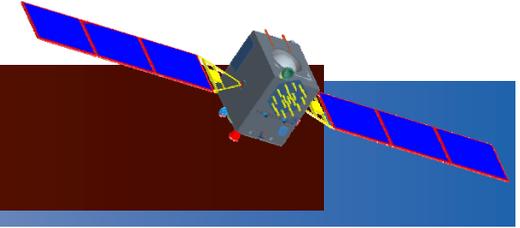
2. System General Description

3. System Deployment

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5. Compatibility and Interoperability

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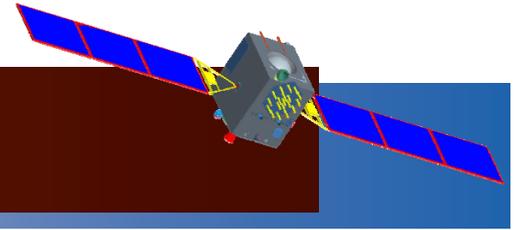
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China decided to build an independent satellite navigation system in 1980's.

In 2003, the COMPASS/Beidou navigation demonstration system was built and has been used in many areas. Now the COMPASS/Beidou global navigation system is under construction.

A graphic of a satellite with blue solar panels and a grey body, positioned in the top right corner of the slide.

Principles of the State Policy

- **Openness**
- **Independency**
- **Compatibility**
- **Gradualness**

◆ **Openness**

COMPASS/Beidou will provide high quality public services free of direct user charge, and we encourage COMPASS/Beidou use all over the world.

China will communicate with other countries widely and deeply in the field of satellite navigation to promote compatibility and interoperability among GNSS, and push the advancement of world satellite navigation technology and industry. 。

◆ **Independency**

China will develop and operate COMPASS/Beidou system independently. COMPASS/Beidou can provide services for users and higher quality services in Asia-Pacific region independently.

◆ **Compatibility**

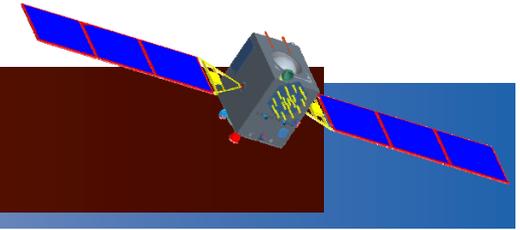
COMPASS/Beidou will pursue solutions to realize compatibility and interoperability with other satellite navigation systems, and users can get better services with interoperable receivers. Based on the protection of current users and industry, all users will enjoy the improvement of COMPASS/Beidou navigation satellite system.

◆ **Gradualness**

To control the technical and economic risks, COMPASS/Beidou will be developed step by step based on technology and economy level of China.

And COMPASS/Beidou will provide long-term continuous services for users, and incessantly improve system performance to realize seamless link and smooth transition of every phase.

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A small illustration of a satellite with solar panels, positioned in the top right corner of the slide.

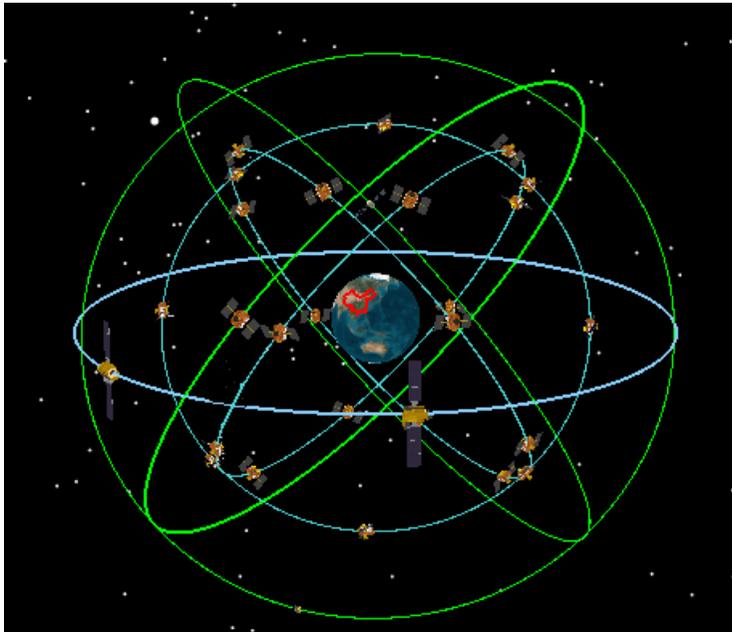
System General Description

- **System structure**
- **Signal Characteristics**
- **Time System**
- **Coordinate System**
- **Services and Performances**

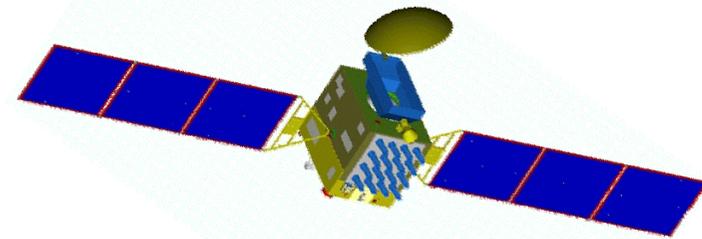
System Structure

◆ *Space Segment*

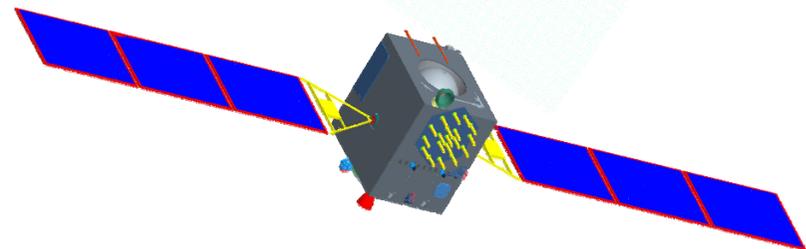
5 GEO and not more than 30 MEO satellites



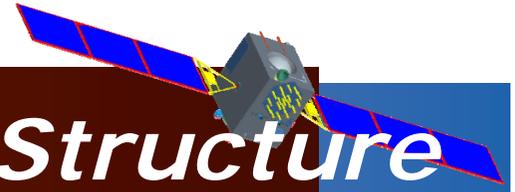
Constellation



GSO Satellite



MEO Satellite



◆ *Ground Segment*

The ground segment consists of Master Control Station, Upload Stations and Monitor Stations.

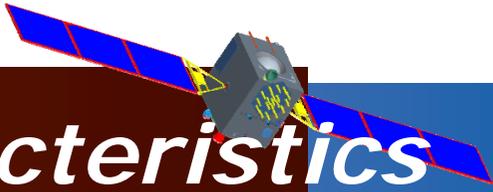


◆ *User Segment*

The user segment consists of COMPASS/Beidou user terminals and interoperable terminals.



User terminals of COMPASS/Beidou system



Signal Characteristics

- ◆ Frequencies

 - B1, B2, B3

- ◆ Signals:

 - B1(QPSK), B1-MBOC , B1-2 (QPSK),

 - B2(QPSK), B2-BOC

 - B3(QPSK), B3-BOC

 - L5 (QPSK).

- ◆ COMPASS/Beidou time named as BDT, traced to UTC, and be synchronized with UTC in 100ns. The epoch time of BDT is UTC 00^d 2006.
- ◆ Interoperability of BDT with GPS/Galileo time is considered in the design of COMPASS/Beidou time system. The offset between BDT and GPST/GST will be measured and broadcast.



Coordinate System

- ◆ COMPASS/Beidou coordinate system is named as China Geodetic System (CGS2000).
- ◆ Coinciding with ITRF at few cm level, and for most applications the difference between CGS2000 and ITRF can be neglected.

A small illustration of a satellite with blue solar panels and a grey body, positioned in the top right corner of the slide.

Services and Performances

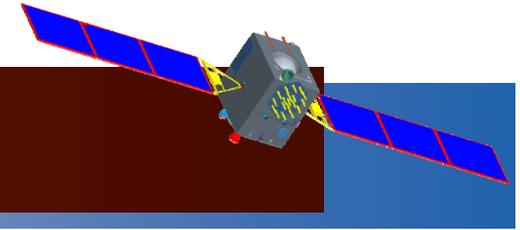
- ◆ Two kinds of global services
 - Open Service: free and open to users
 - Positioning Accuracy: 10 m
 - Timing Accuracy: 20 ns
 - Velocity Accuracy: 0.2 m/s
 - Authorized Service: ensure highly reliable use even in complex situation.

A small illustration of a satellite with two large blue solar panels and a grey body, positioned in the upper right corner of the slide.

Services and Performances

- ◆ Two kinds of regional services
 - Wide area differential service:
 - Positioning accuracy: 1 m
 - short message service.

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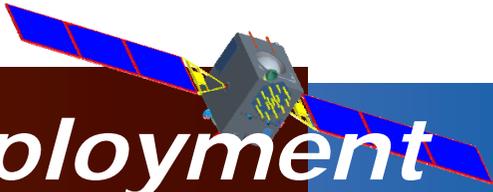
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A small satellite with two blue solar panels and a grey body is positioned in the top right corner of the slide, partially overlapping the title bar.

System Deployment

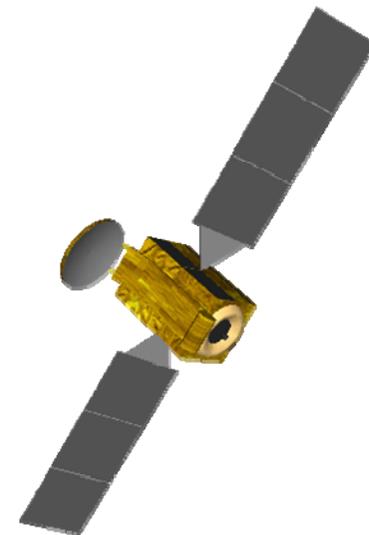
- **Deployment Step**
- **Launch schedule**
- **COMPASS-M1 Experimentation**



Deployment Step

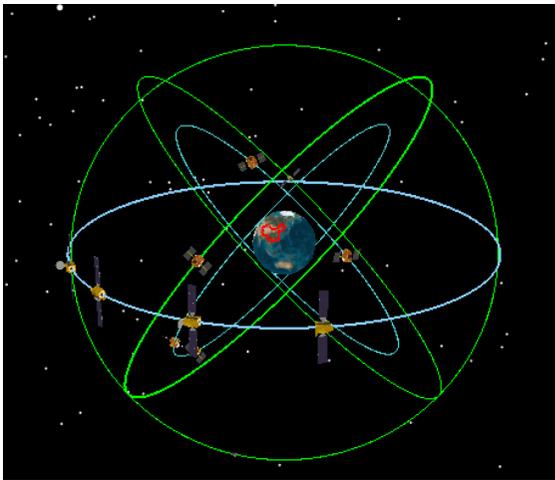
◆ *1st Step—Demonstration System*

After 3 GEO satellites launched since 2000, the demonstration system can provide basic services including positioning, timing and short-message telecommunication in regional area.

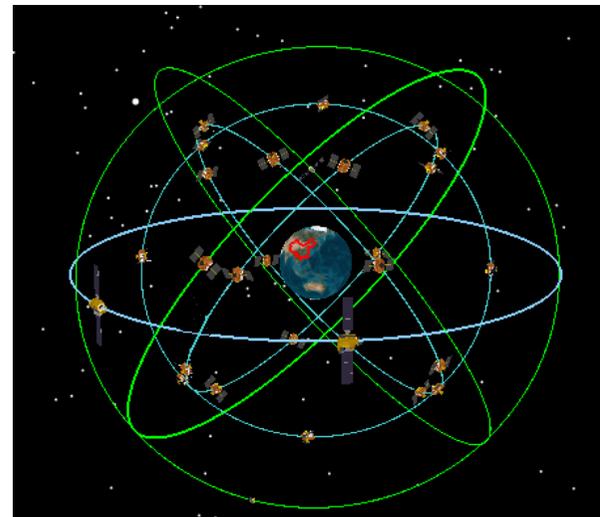
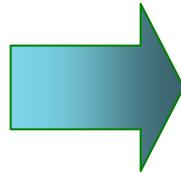


◆ 2nd Step—Global System

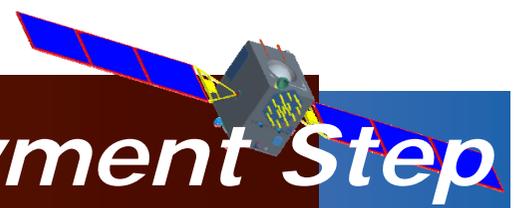
COMPASS/Beidou will cover Asia-Pacific area firstly about 2010, and will cover all over the world about 2015.



About 2010



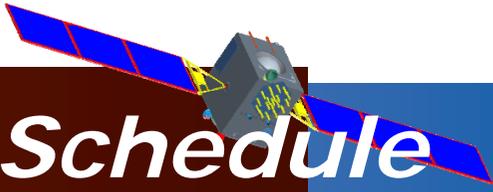
About 2015



Deployment Step

The first MEO satellite was launched in
Apr. 2007.



A 3D illustration of a satellite with a grey central body and two large blue solar panel arrays extending outwards. The satellite is positioned in the upper right corner of the slide, partially overlapping the title bar.

Launch Schedule

◆ *Planned launches in recent two years*

During 2009, 3-4 satellites will be launched, and more than 10 satellites will be put into use in recent two years by Long-March launchers. About 2010, the system can offer services regionally.

COMPASS-M1 Experimentation

◆ *Rubidium Atom Frequency Standard*

4 RAFS has been operating continuously for 18 months. The test results showed that the RAFS worked normally and the performance satisfied the design requirements.



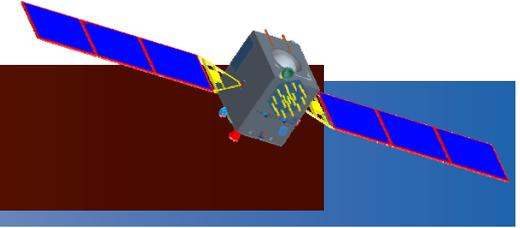
A 3D rendering of the COMPASS-M1 satellite, showing its central body and two large solar panel arrays extending outwards.

COMPASS-M1 Experimentation

◆ *Orbit determination and Time synchronization*

- Orbit determination precision: < 5 m
- Orbit prediction precision : < 10 m (24 hours)
- Time synchronization precision: < 2ns

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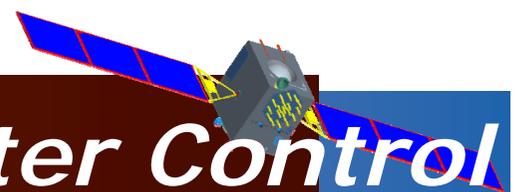
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- ◆ *COMPASS/Beidou Navigation Demonstration System has played important roles in many areas.*
- ◆ *For Example:*
 - Disaster Control
 - Marine application
 - Transportation application



Disaster Control



Daxinganling Forest Fire Prevention Command System



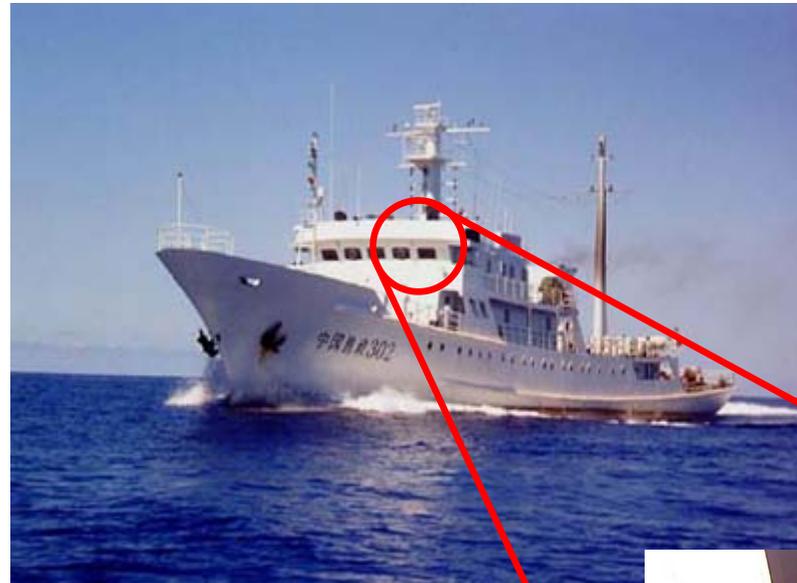
Disaster Control

- ◆ In Sichuan Earthquake, COMPASS/Beidou provided multi-type Position & Emergency Information Services.



**Real Time Position Monitor &
Public Emergency Information Services**

Marine Application



Offshore Fishing Ship Control System

Marine Application



**Offshore Tide Monitor
Data Transmission**



Marine Search and rescue

Transportation Application



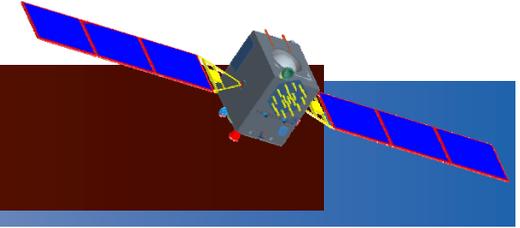
Qinghai-Tibet Railway

Monitor and Control System



**Dangerous Truck Tracing
and Control System**

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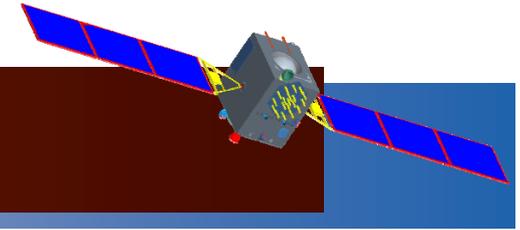
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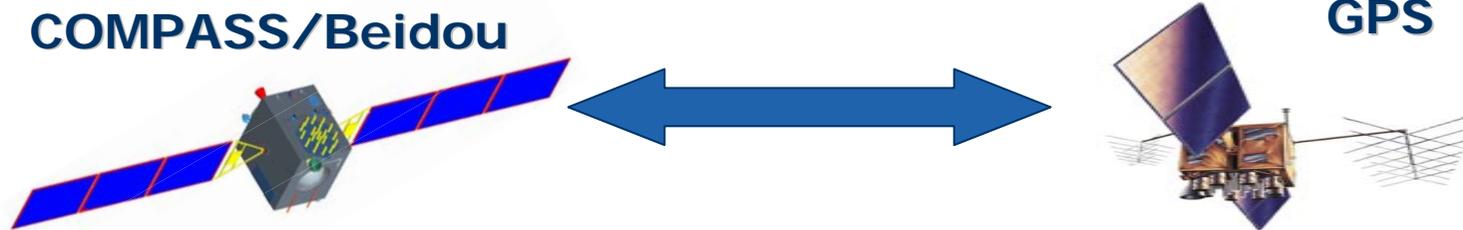
Compatibility and Interoperability

- **Comprehension on Compatibility and Interoperability**
- **Related Bilateral Activities**



- ◆ **Compatibility:** the ability of multiple satellite navigation system services to be used separately or together, without the generated interference to affect the navigation performance of each system.
- ◆ **Interoperability:** the ability of multiple satellite navigation system services to be used together to provide better capabilities at the user level than would be achieved by relying solely on one service or signal, without significantly increasing the complexity of receivers.

Related Bilateral Activities

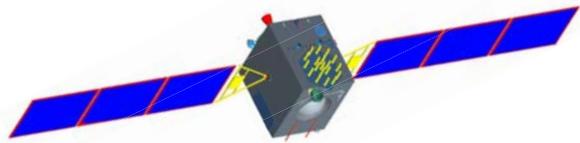


Three frequency compatibility coordination meetings:

- ◆ The 1st Meeting was held in Geneva in June 2007.
- ◆ The 2nd Meeting was held in Xi'an in May 2008.
- ◆ The 3rd Meeting was held in Geneva in Oct 2008.

Related Bilateral Activities

COMPASS/Beidou



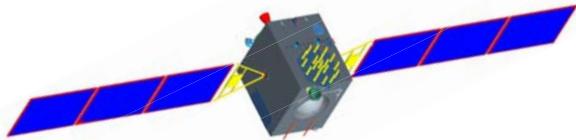
Galileo



- ◆ The 1st frequency compatibility coordination meeting was held in Beijing in May 2007.
- ◆ The 1st Technical Working Group meeting on Compatibility and Interoperability was held in Beijing in Sep 2008.
- ◆ The 2nd TWG meeting on Compatibility and Interoperability was held in Beijing in Dec 2008.

Related Bilateral Activities

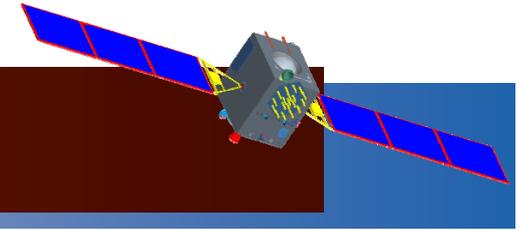
COMPASS/Beidou



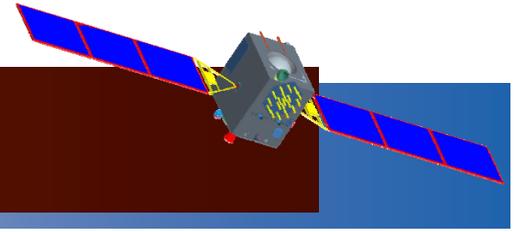
GLONASS



- ◆ The frequency compatibility coordination meeting was held in Moscow in Jan 2007.



- ◆ The development of COMPASS/Beidou is a national strategy of China.
- ◆ COMPASS/Beidou is an essential element of the international GNSS.
- ◆ COMPASS/Beidou is being constructed efficiently and smoothly.
- ◆ China encourages international cooperation to ensure compatibility and interoperability with other navigation systems.



**Thanks
for your attention!**