The Centispace-1：
A LEO Satellite-Based Augmentation System

14th Meeting of the International Committee on
Global Navigation Satellite Systems

Yang Long
Beijing Future Navigation Technology Co., Ltd.

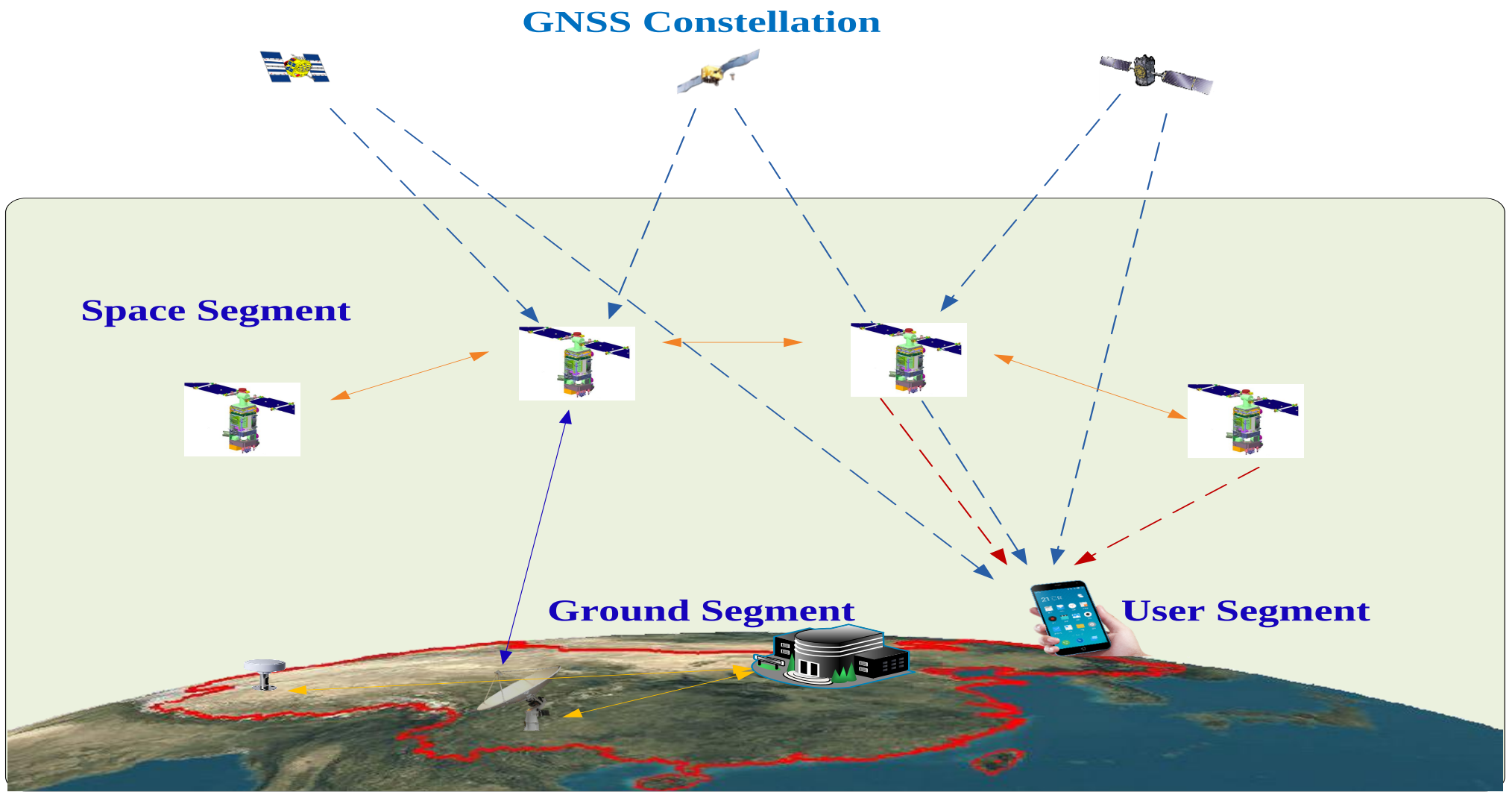
2019-12-10

CONTENT

01

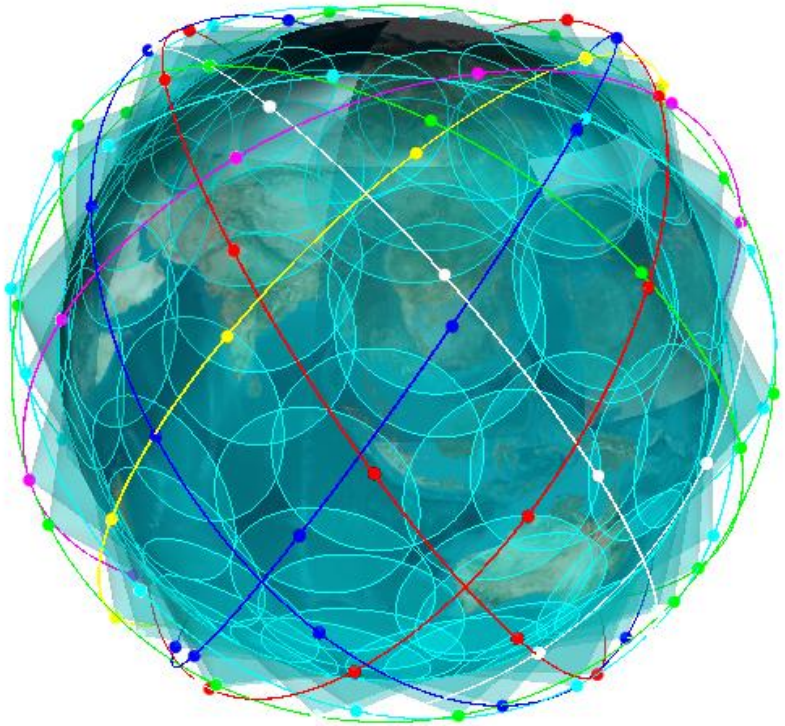
System Description

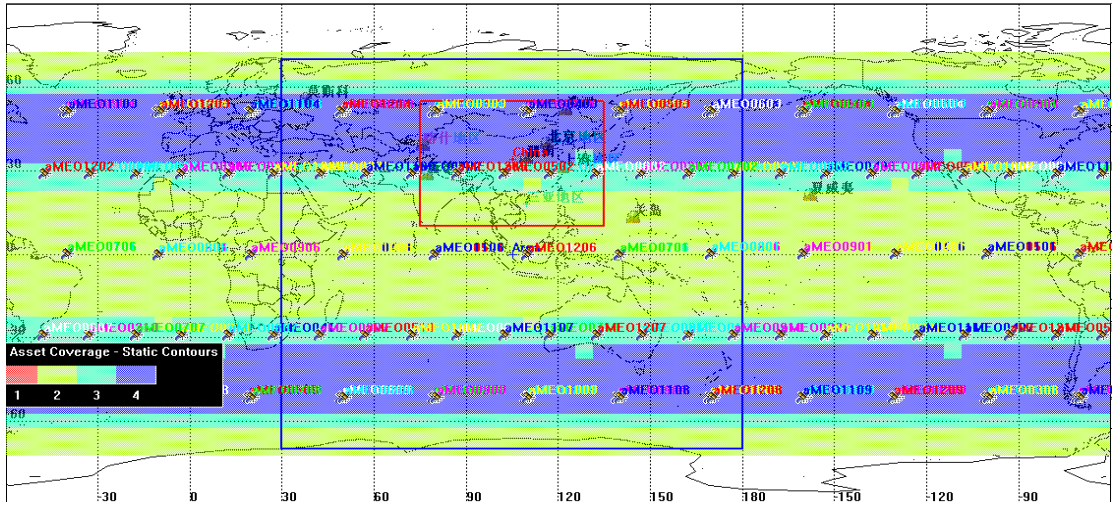
01 System Description



01 System Description

- ★ WALKER Constellation：120/12/0
- ★ Orbit altitude：975km
- ★ Inclination：55 degree





Lat，Lon	Visable sats	Lat，Lon	Visable sats
(0°，0°)	2-6	(40°，0°)	5-7
(5°，0°)	2-5	(45°，0°)	5-7
(10°，0°)	3-4	(50°，0°)	5-7
(15°，0°)	3-5	(55°，0°)	4-7
(20°，0°)	3-4	(60°，0°)	4-6
(25°，0°)	3-5	(65°，0°)	2-5
(30°，0°)	4-5	(70°，0°)	2-3
(35°，0°)	5-6		
Above 2 coverages between 70 degree north and 70 degree south			

01 System Description

Radiocommunication

ITU:

Network info

ID number (SNS)	adm	Satellite name	long_nom	Date of receipt	ssn_ref	ssn_no	WIC/IFIC (ific.mdb)	WIC/IFIC date
up down	up down	up down	up down	up down	up down	up down	up down	
118520283	CHN	CENTISPACE-2	N-GSO	11.09.2018	API/C	539	2881	16.10.2018
118545172	CHN	CENTISPACE-2	N-GSO	11.09.2018	API/A	12252	2885	11.12.2018
118520283	CHN	CENTISPACE-2	N-GSO	11.09.2018	CR/C	4847	2886	08.01.2019
118545172	CHN	CENTISPACE-2	N-GSO	11.09.2018	API/B	1071	2896	28.05.2019

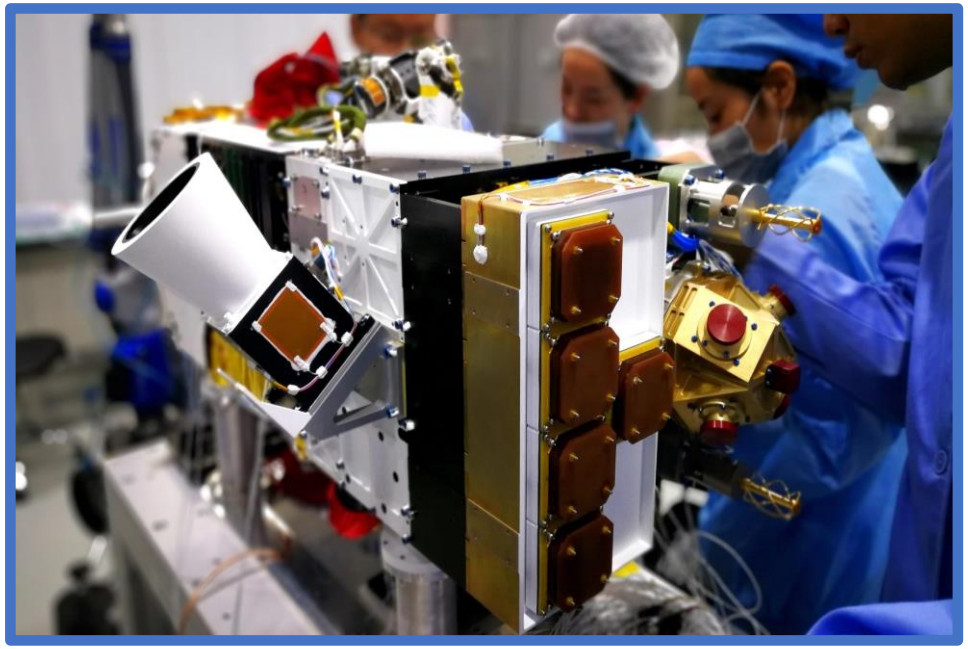
Frequency info

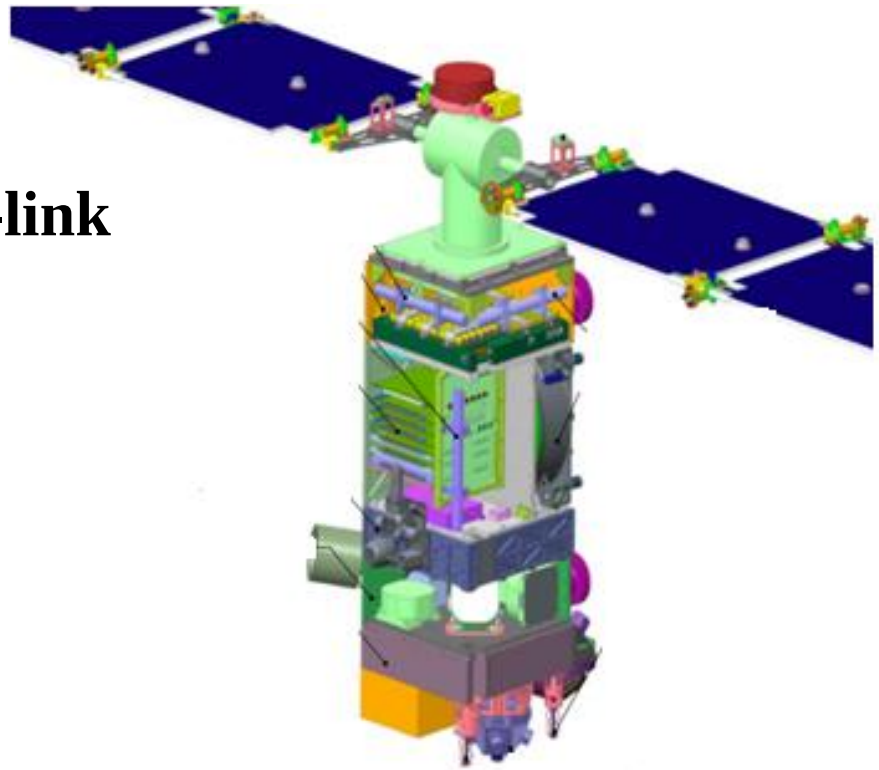
FREQUENCY INFORMATION

BEAM NAME	EMISS/REC	FREQUENCY (MHz)	BANDWIDTH (kHz)	FREQUENCY MIN (MHz)	FREQUENCY MAX (MHz)	CLASS OF STN
L1D	E	1575.42000	12276	1569.282	1581.558	EN
L1D	E	1575.42000	12276	1569.282	1581.558	EO
L1D	E	1575.42000	12276	1569.282	1581.558	EQ
L5D	E	1176.45000	12276	1170.312	1182.588	EN
L5D	E	1176.45000	12276	1170.312	1182.588	EO
L5D	E	1176.45000	12276	1170.312	1182.588	EQ

01 System Description

- ★ Satellite weight：≈100 kg
- ★ Satellite life：10 years
- ★ Inter satellite link：High speed cross-link





01 System Description

- ★ Master station：1
- ★ Gateway station：2
- ★ Monitor station：10

01 System Description

- ★ Chips
- ★ OEM、modules
- ★ Receivers
- ★ Product solutions
- ★ ……

01 System Description

➢ High accuracy service

- **Dm level service：<50cm，(cold start, 5s)**
- **Cm level service：<10cm，(cold start, 1min)**
- **Number of user： unlimited**
- **Features: high accuracy, fast convergence, low cost, low power consumption**

01 System Description

- **High accuracy service**
- **Integrity augmentation service**

- **Availability：99.99%，50cm**
- **Alarm time：<3s**
- **Number of user：unlimited**
- **Features: easy to get, both for professional and public users**

01 System Description

- High accuracy service
- Integrity augmentation service
- GNSS monitoring service

  - **GNSS：BDS, other GNSS**
  - **Coverage：Global**
  - **Features: space based monitoring stations, real time observation data transferring with inter-satellite links**

02

Working Principle

02 Working Principle

Normal Point Positioning Technique

- **Accuracy： 5m~10m**
- **Hot Start Time: 1s**
- **Cold Start Time： 30s~50s**

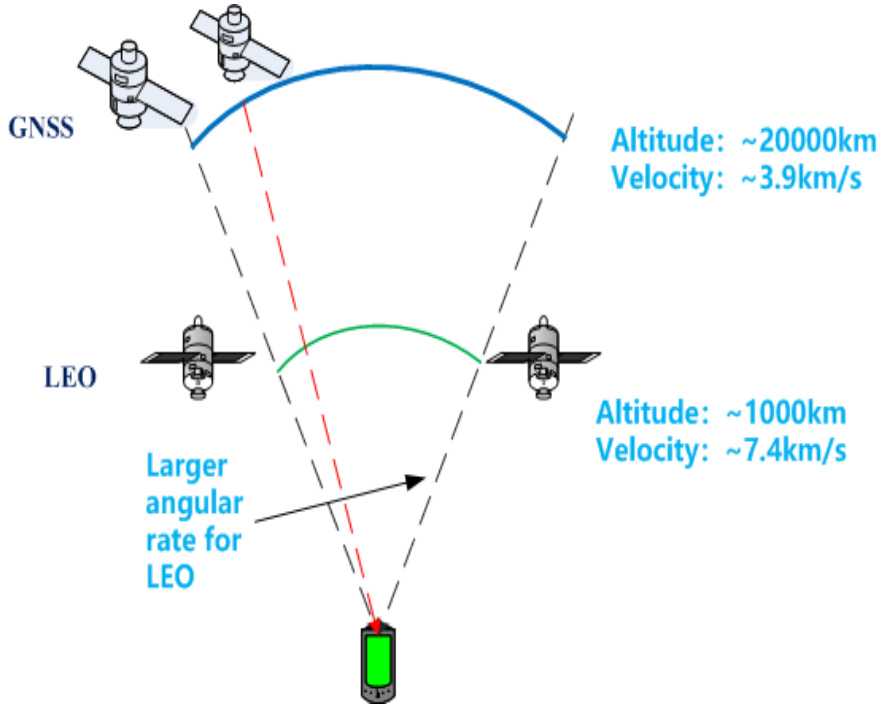
Precise Point Positioning Technique

- **Accuracy： <10cm**
- **Convergence time： ~20min**

1min

+ LEO satellites

02 Working Principle

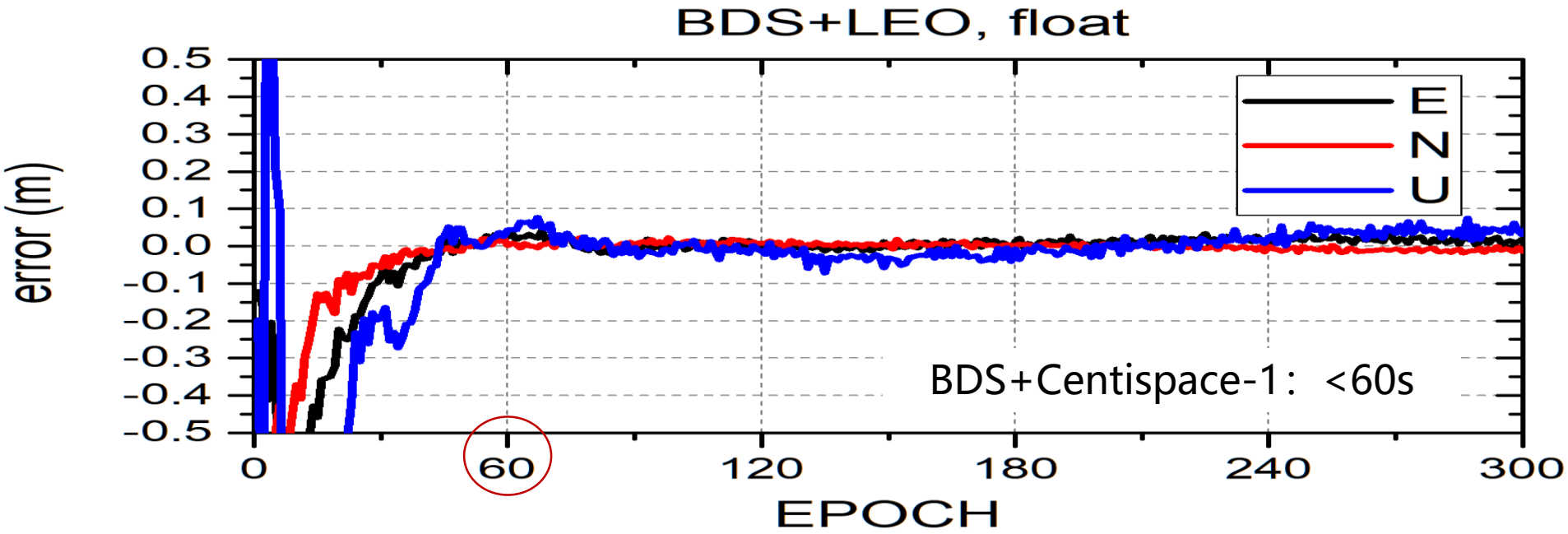


Orbit type and Altitude	Convergence Time
LEO（1000km）	1 min
MEO（10000km）	7 min
MEO（20000km）	20 min
BDS IGSO（36000km）	2 hour
BDS GEO（36000km）	+∞

Different orbit altitude

Different convergence time for PPP

02 Working Principle

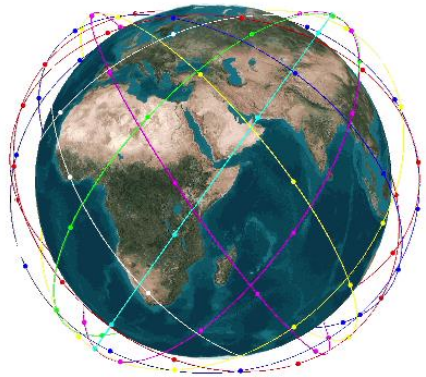


Simulations

02 Working Principle

GNSS constellation
More visible satellites

+



LEO constellation
Rapid movement

=

Fast convergence
&High accuracy

02 Working Principle

- Fast convergence and high accuracy
- Interoperability and compatibility
- Low cost and low power consumption

03

Development Plan

03 Development Plan

Second stage：2021-2023

Launch of 10-20 satellites in 2021；

Launch of 100-110 satellites from 2022 to 2023;

Construction of ground segment;

System final test.

First stage：2016-2020

Launch of 1 experimental satellite in 2018；

Launch of 5 experimental satellite in 2020 ；

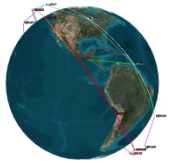
Construction of ground segment;

User segment researchment.

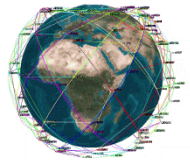
Found of company
2017

Launch of the first experimental satellite
2018

Launch of another 5 experimental satellites
2019-2020



Launch of 10-20 satellites
2021



Complete the project construction and test
2023

Verification and Demonstration of the system performance on orbit

Verification and Validation of key technologies

03 Development Plan

- One carrier rocket with single or double satellites in the experimental stage (S1 experimental satellite has been launched on 28th Sep. 2018)
- One carrier rocket with 10-12 satellites in the construction stage

Small carrier rocket

Large carrier rocket

03 Development Plan

Second stag
Launch of
Launch of
Construct
System fir

First stage：2016
Launch of 1 expe
satellite in 2018
Launch of 5 exp
satellite in 2020；
Construction of gr
segment;
User segment researchment.

Verification and Validation of key technologies

03 Development Plan

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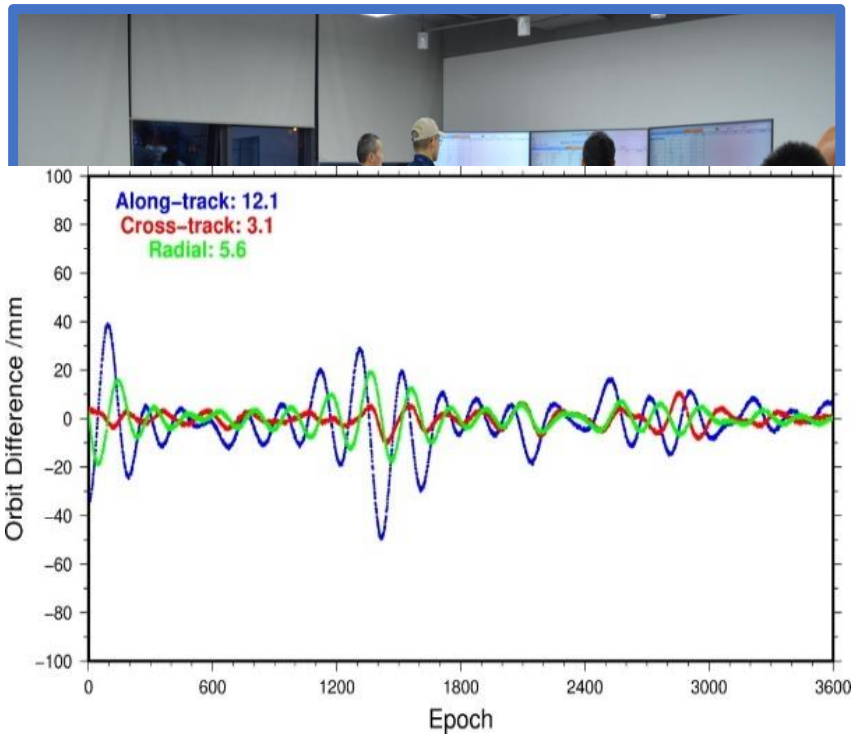
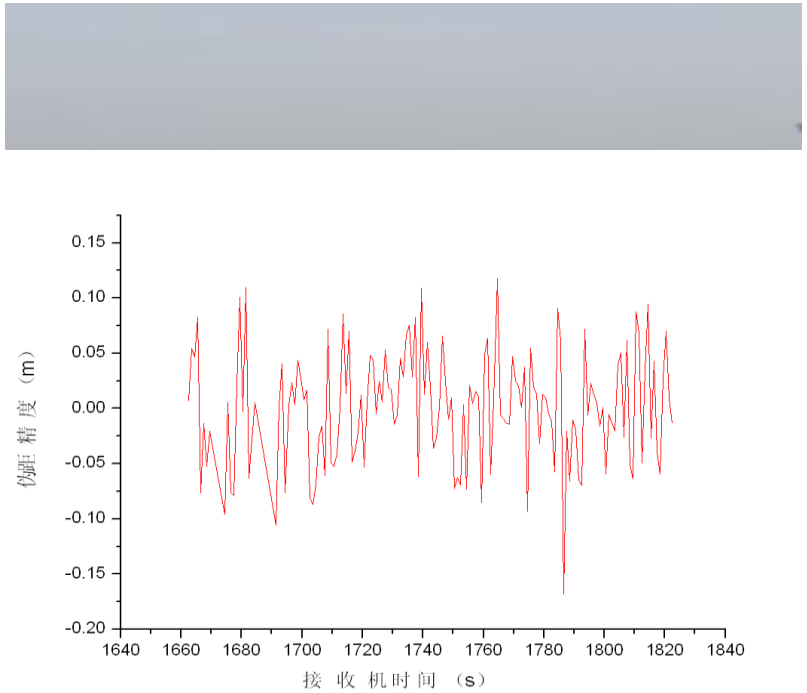


LEO satellite orbits

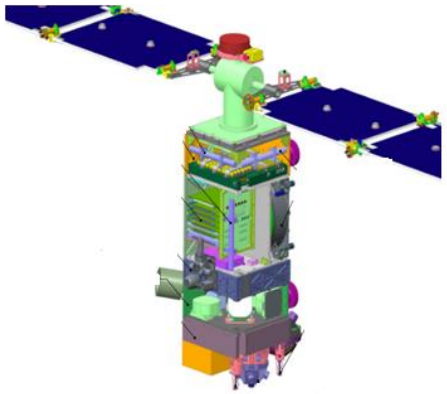


LEO satellite ranging signal

Verification and Validation of key technologies

03 Development Plan

- In 2020，other 5 experimental satellite will be launched.



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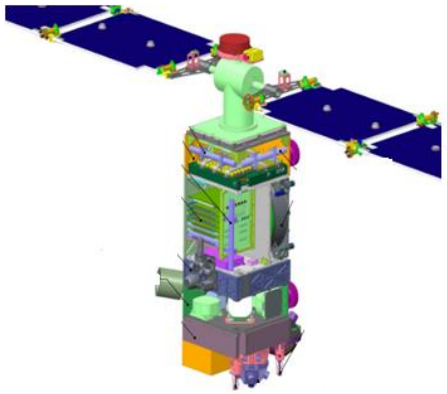

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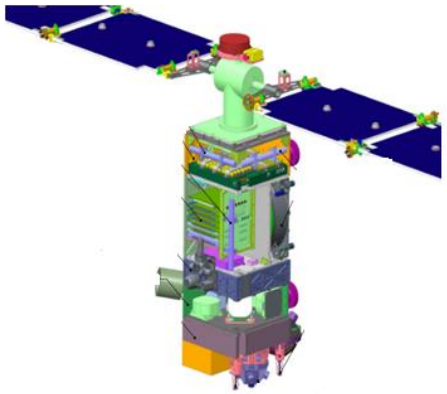

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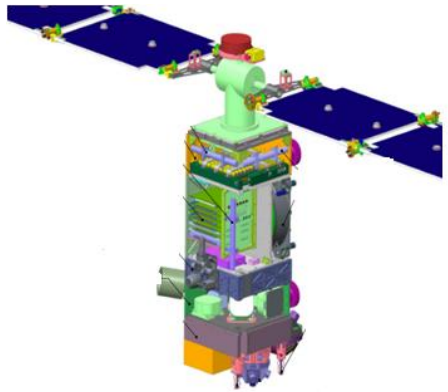

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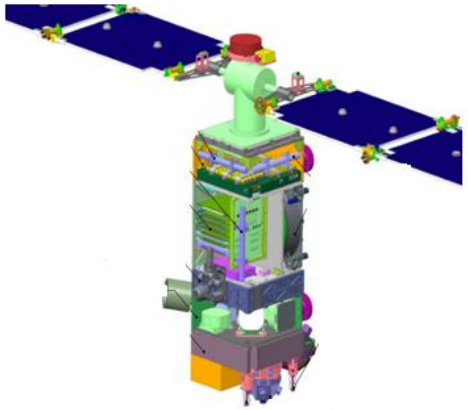

6

Conclusion

- A LEO satellite-based augmentation system
- Fast convergence, high accuracy, low cost, low power, global
- Have a good start, progress smoothly
- Welcome International cooperation

Thanks for your attention and support!

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