清華大學 Tsinghua University

13th Stanford PNT Symposium

Overview of the BDS III Signals

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Outline

1. Introduction
   - The Three-step Development Plan
   - A Brief History of BDS Development
   - The Evolution of BDS Signals
   - Current Status
2. Brief Description of BDS III
3. New Signals of BDS III
4. Conclusion

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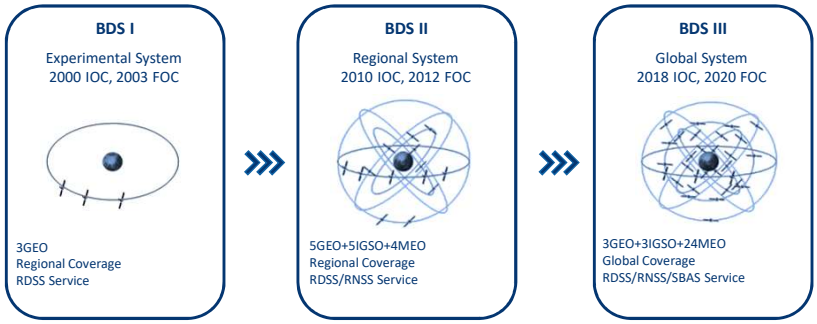
The Three-step Development Plan

- BDS program began in the 1990s. In order to overcome various difficulties, China formulated the following three-step development plan for BDS, from active to passive, from regional to global.



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The Three-step Development Plan

Step 3 (BDS III)

Start the development of the BDS Global System (BDS III) in 2013 to achieve global passive PNT capability by approximately 2020.

Step 2 (BDS II)

Start the development of the BDS Regional System (BDS II, also known as BD-II in earlier times) in 2004 to achieve regional passive PNT capability by 2012.

Step 1 (BDS I)

Start the development of the BDS Experimental System (BDS I, also known as BD-I in earlier times) in 1994 to achieve regional active PNT capability by 2000.

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A Brief History of BDS Development

- **The Early Active System**

BDS I——BDS Experimental System

BDS I

Experimental System
2000 IOC, 2003 FOC

3GEO
Regional Coverage
RDSS

BDS I was established in 2000 as the first generation of China's navigation satellite system. With 3 satellites (2+1 GEO), BDS I adopted a two-way active ranging scheme to provide RDSS for China and surrounding areas. Since then, China has been operating its own independent navigation satellite system and developed its own satellite navigation industry. After more than a decade of continuous operation, BDS I terminated its services at the end of 2012.

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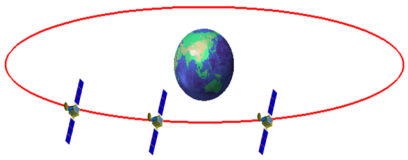
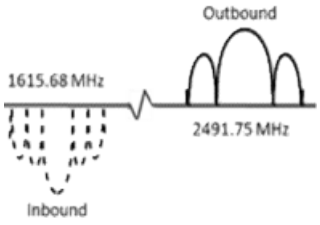
BDS I——BDS Experimental System

- Constellation: 3 GEO
- Frequencies/Signals:
  - Outbound: S Band/OQPSK
  - Inbound: L Band/BPSK



- Coverage: China and Surrounding Area
- Services: RDSS（positioning, timing, short message)

Signal	Carrier (MHZ)	Modulation	Chip Rate (Mcps)	Band Width (MHz)	Info Rate (Kbps)	Frame
Outbound	2491.75	OQPSK	4.08	8.16	16	Continuous
Inbound	1615.68	BPSK	4.08	8.16	8	Burst



A Brief History of BDS Development

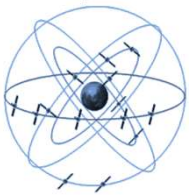
- **The Operational Regional System**

BDS II——BDS Regional System

BDS II

Regional System

2010 IOC, 2012 FOC



5GEO+5IGSO+4MEO

Regional Coverage

RDSS/RNSS

The second generation of China's navigation satellite system, BDS II, with a space segment of 14 operational satellites (5 GEO+5 IGSO+4 MEO), was established and began to provide services for the Asia-Pacific region at the end of 2012. In addition to providing RNSS services, BDS II also inherited the RDSS services from its predecessor BDS I. The completion of BDS II greatly expanded the applications of satellite navigation in China and further promoted the development of its satellite navigation industry.

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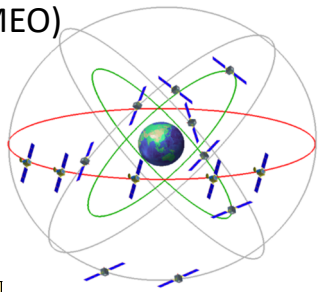
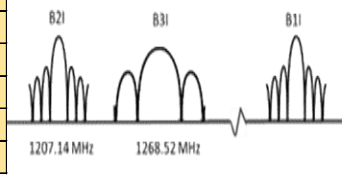
BDS II——BDS Regional System

- Constellation: 14(5GEO/5IGSO/4MEO)
- Frequencies: B1, B2, B3
- Signals: B1I/Q, B3I/Q, B3I/Q
- Coverage: Asia-Pacific Area
- Services: RDSS/RNSS



Signal Component	Carrier (MHz)	Chip Rate (Mcps)	Bandwidth (MHz)	Modulation Scheme	Service Type
B1I	1561.098	2.046	4.092	QPSK	OS
B1Q		2.046			AS
B2I	1207.14	2.046	20.46	QPSK	OS
B2Q		10.23			AS
B3I	1268.52	10.23	2.46	QPSK	OS
B3Q		10.23			AS



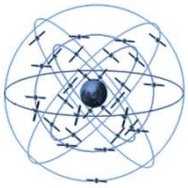
A Brief History of BDS Development

- **The Emerging Global System**

BDS III——BDS Global System

BDS III

Global System
2018 IOC, 2020 FOC



3GEO+3IGSO+24MEO
Global Coverage
RDSS/RNSS/SBAS

After the completion of BDS II deployment, China immediately started developing the global system BDS III in 2013. The *BeiDou Navigation Satellite System Signal in Space Interface Control Document of Open Service Signals B1C, B2a* was released on December 27, 2017. The first two BDS III MEO satellites were launched on November 5, 2017. It is expected that BDS III will complete its deployment and provide global services by approximately 2020.

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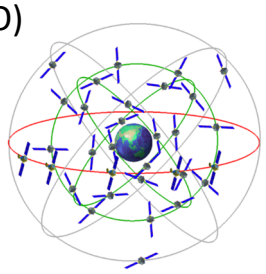
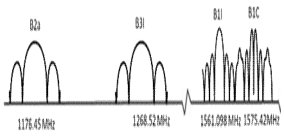
BDS III——BDS Global System

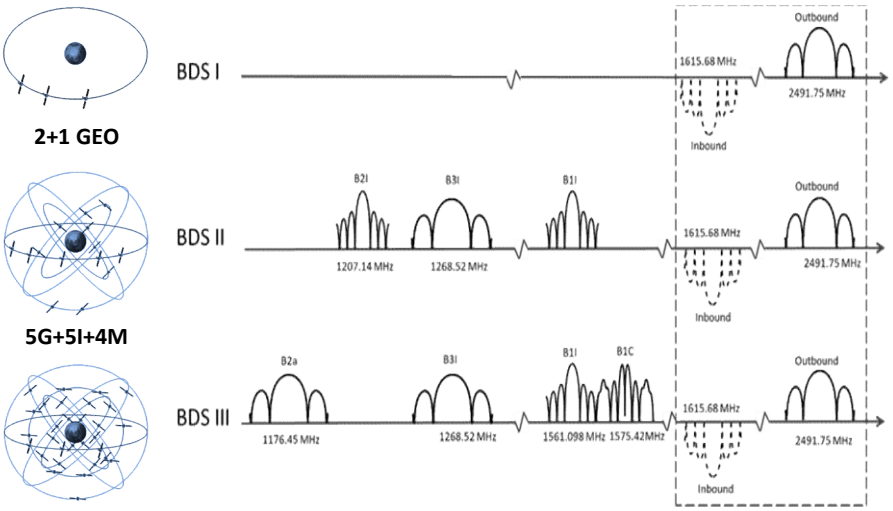
- Constellation: 30(3GEO/3IGSO/24MEO)
- Frequencies: B1(New), B2(New), B3
- Signals: B1C/B1I, B2a, B3I
- Coverage: Worldwide
- Services: RNSS/RDSS/SBAS/SAR



Signal	Carrier (MHz)	Component	Modulation		Symbol Rate (sps)	Phase Relationship	Power ratio
B1C	1575.42	$s_{B1C\_data}(t)$	BOC(1,1)		100	0	1/4
		$s_{B1C\_pilot\_a}(t)$	QMBOC (6,1,4/33)	BOC (1,1)	0	90	29/44
		$s_{B1C\_pilot\_b}(t)$		BOC (6,1)	0	0	1/11
B2a	1176.45	B2a_data	QPSK		200	0	1
		B2a_pilot			0	90	1



The Evolution of BDS Signals



Spectral Evolution Diagram of BDS OS Signals
(The RDSS signals is enclosed with dotted lines)

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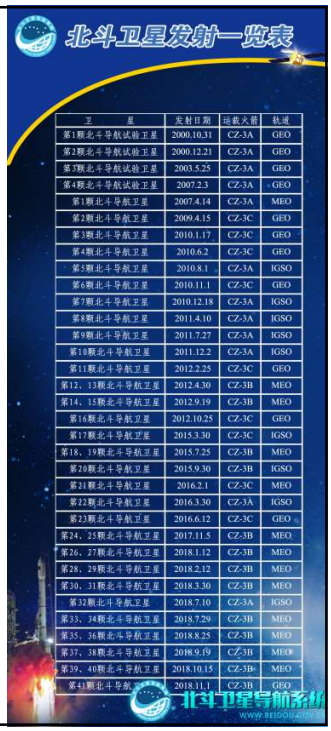
Current Status

BDS Launch Records

- Totally 45 BDS satellites with 34 launches from 2000.10~2018.11, where
  - 4 GEO satellites of BDS I;
  - 19 (7GEO+7IGSO+5MEO) satellites of BDSII;
  - 5 (2IGSO+3MEO) experimental satellites and 17 (1GEO+16MEO) FOC satellites of BDS III.
- Additional 13 (2GEO+3IGSO+8MEO) FOC satellites to be launched in the end of this year and next 2 years.



卫星	发射日期	运载火箭	轨道
第1颗北斗导航试验卫星	2000.10.31	CZ-3A	GEO
第2颗北斗导航试验卫星	2000.12.21	CZ-3A	GEO
第3颗北斗导航试验卫星	2003.5.25	CZ-3A	GEO
第4颗北斗导航试验卫星	2007.2.3	CZ-3A	GEO
第1颗北斗导航卫星	2007.4.14	CZ-3A	MEO
第2颗北斗导航卫星	2009.4.15	CZ-3C	GEO
第3颗北斗导航卫星	2010.1.17	CZ-3C	GEO
第4颗北斗导航卫星	2010.6.2	CZ-3C	GEO
第5颗北斗导航卫星	2010.8.1	CZ-3A	IGSO
第6颗北斗导航卫星	2010.11.1	CZ-3C	GEO
第7颗北斗导航卫星	2010.12.18	CZ-3A	IGSO
第8颗北斗导航卫星	2011.4.10	CZ-3A	IGSO
第9颗北斗导航卫星	2011.7.27	CZ-3A	IGSO
第10颗北斗导航卫星	2011.12.2	CZ-3A	IGSO
第11颗北斗导航卫星	2012.2.25	CZ-3C	GEO
第12、13颗北斗导航卫星	2012.4.30	CZ-3B	MEO
第14、15颗北斗导航卫星	2012.9.19	CZ-3B	MEO
第16颗北斗导航卫星	2012.10.25	CZ-3C	GEO
第17颗北斗导航卫星	2015.3.30	CZ-3C	IGSO
第18、19颗北斗导航卫星	2015.7.25	CZ-3B	MEO
第20颗北斗导航卫星	2015.9.30	CZ-3B	IGSO
第21颗北斗导航卫星	2016.2.1	CZ-3C	MEO
第22颗北斗导航卫星	2016.3.30	CZ-3A	IGSO
第23颗北斗导航卫星	2016.6.12	CZ-3C	GEO
第24、25颗北斗导航卫星	2017.11.5	CZ-3B	MEO
第26、27颗北斗导航卫星	2018.1.12	CZ-3B	MEO
第28、29颗北斗导航卫星	2018.2.12	CZ-3B	MEO
第30、31颗北斗导航卫星	2018.3.30	CZ-3B	MEO
第32颗北斗导航卫星	2018.7.10	CZ-3A	IGSO
第33、34颗北斗导航卫星	2018.7.29	CZ-3B	MEO
第35、36颗北斗导航卫星	2018.8.25	CZ-3B	MEO
第37、38颗北斗导航卫星	2018.9.19	CZ-3B	MEO
第39、40颗北斗导航卫星	2018.10.15	CZ-3B	MEO
第41颗北斗导航	2018.11.1	CZ-3B	GEO

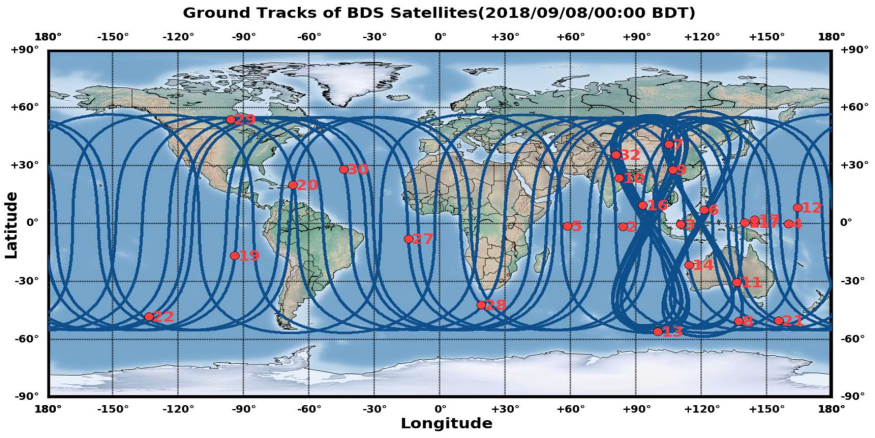
Current Status

BDS System Status

- **BDS I, decommissioned**——The early active regional system, was decommissioned in December 2012, after more than 10 years' continues operation (the RDSS continues to be provided by BDS II).
- **BDS II, operational**——The current regional system with 14 operational satellites (5GEO+5IGSO+4MEO) has been operational for more than 6 years since 2012.
- **BDS III, deploying**——The future global system is still under construction, and will provide IOC and FOC around 2018 and 2020, respectively.

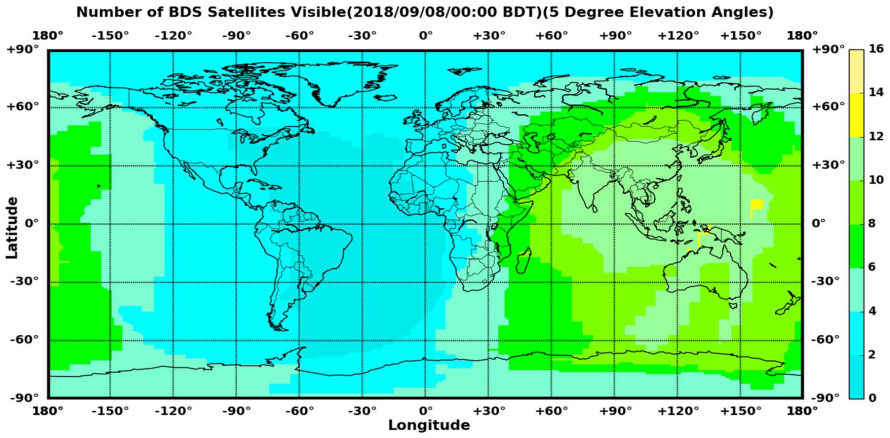
Current Status

The status of the Operational BDS II



Current Status

The status of the Operational BDS II



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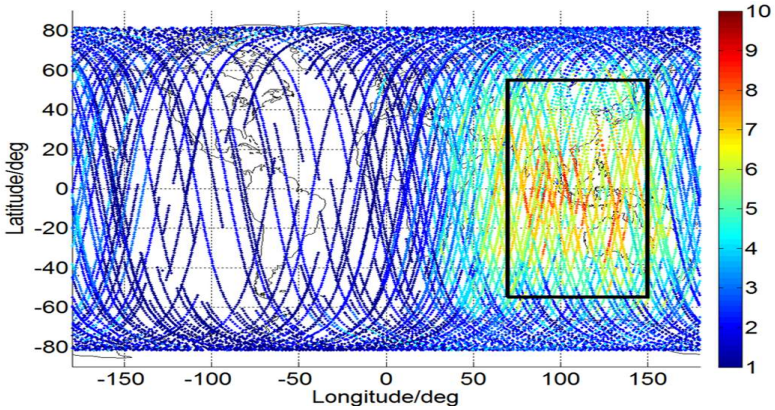
Current Status

The status of the Operational BDS II

(Measured by Tsinghua Smart Satellite)



Global tracking BDS II satellite results of Smart Satellite borne receivers
(Up to 9, Min. 1, average 5.7)

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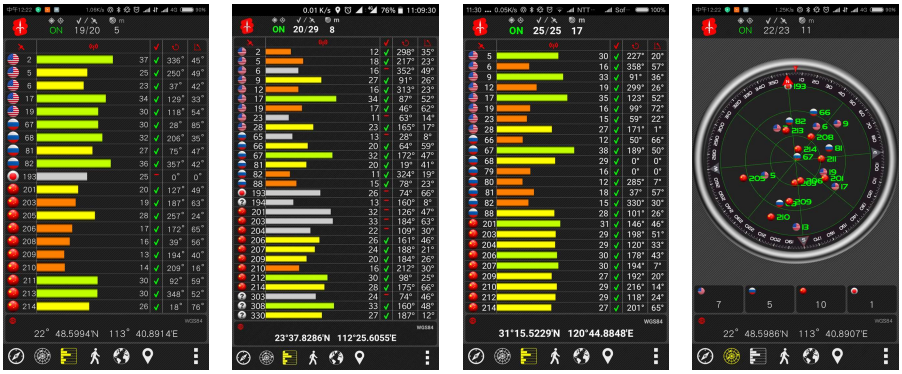
Current Status

The status of the Operational BDS II

(Real experience from various mobile phone users)



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Current Status

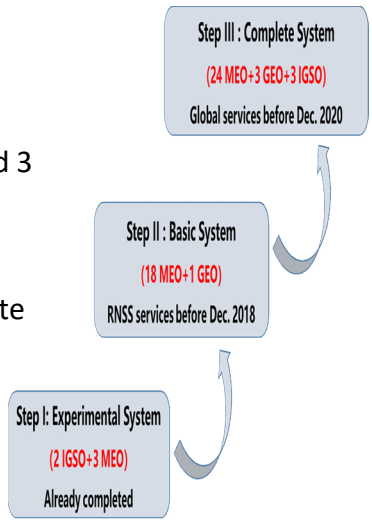
The status of the Emerging BDS III

- **The Development Plan**

The development plan of BDS III is also consisting of three steps.

- The first stage, the BDS III Experimental System of 2 IGSO and 3 MEO, has completed.
- The second step, the BDS III Basic System of 18 MEO and 1 GEO satellites , will completed in 2018.
- The third stage, the BDS III complete System, with additional 6 MEO, 3 IGSO, and 2 GEO satellites, will be completed around 2020.

It is expected that BDS III will provide initial service by the end of 2018, and will provide full service worldwide around 2020, respectively.



Current Status

The status of the Emerging BDS III

- After the new ICD (Test Version) for B1C and B2a was released in September 2017, the first pair of BDS III MEO satellites was successfully launched in November 2017. Currently, a total of 16 MEO and 1 GEO satellites have been successfully launched.
- The first GEO satellite of BDS III, launched in Nov. 01, is equipped with improved RDSS and new SAR payloads.
- The launch record of BDS III satellites by November 8, 2018 as the left table.

Satellite	Date of Launch	Orbit
1 / 2	Nov 05, 2017	MEO
3 / 4	Jan 12, 2018	MEO
5 / 6	Feb 12, 2018	MEO
7 / 8	Mar 30, 2018	MEO
9 / 10	Jul 29, 2018	MEO
11 / 12	Aug 25,2018	MEO
13 / 14	Sep 20, 2018	MEO
15/16	Oct 10, 2018	MEO
17	Nov 01, 2018	GEO

Current Status

The status of the Emerging BDS III

- **Compatibility and Interoperability between BDS an GPS**

In December 2017, China Satellite Navigation Office and the Office of Space and Advanced Technology, U.S. Department of State, signed the *Joint Statement on Civil Signal Compatibility and Interoperability Between the Global Positioning System (GPS) and the BeiDou Navigation Satellite System (BDS).*

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Outline

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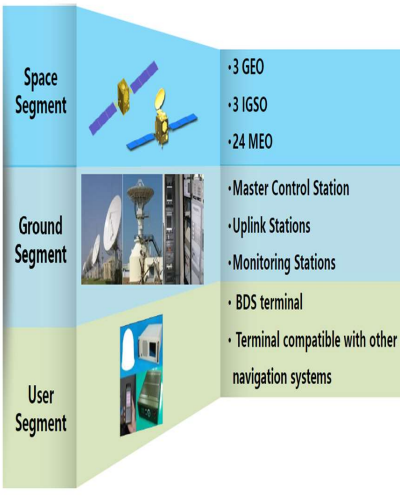
BDS III——The third Generation of BDS

- BDS III is the third generation of the BDS.
- Similar to other GNSSs, BDS is comprised of three segments: the space segment, the ground control segment, and the user segment.
- BDS provides all-weather and all-day positioning, navigation and timing (PNT) and other services to global or regional users.



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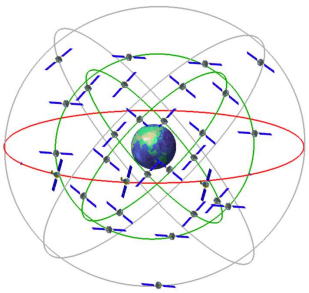
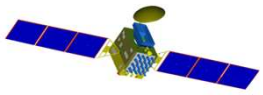
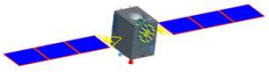
BDS III Space Segment

- BDS III constellation consists of 3 GEO, 3 IGSO, 24 MEO satellites, and possibly some spare satellites.
  - The 3 GEO satellites are positioned at 80°E, 110.5°E, and 140°E, respectively.
  - The 3 IGSO satellites are evenly distributed in 3 orbital planes at 35,786 km altitude with an orbital plane inclination of 55°.
  - The 24 MEO satellites evenly distributed in 3 orbital planes at 21,528 km altitude, constituting a classic Walker 24/3/1 constellation.
- The MEO satellites provide global coverage, while the GEO and IGSO satellites provide enhanced coverage for China and the Asia-Pacific region.





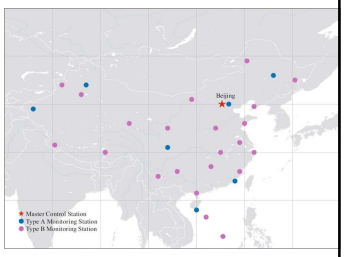
BDS GEO Satellites

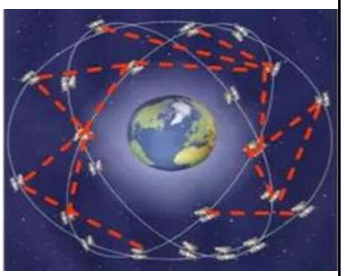


BDS-IGSO/MEO Satellites

BDS III Control Segment

- The BDS III Control Segment will be developed based on the BDS II control segment. Currently, it consists of 1 master control station, 7 Class-A monitor stations, 22 Class-B monitor stations, and 2 time synchronization/upload stations.
- The Inter-Satellite Links, one of the most important highlights of BDS III, will become a part of the Control Segment to improve the system's performance.





BDS III User Segment

- The BDS III user segment refers to all the BDS III and BDS III/GNSS compatible receivers for RNSS service, as well as BDS III RDSS/RNSS combined terminals for users' position reports and short message communications.

BDS III Signals

- BDS III will transmit at least 4 signals with 4 different frequencies for global open service, B1C, B2a and B1I and B3I.
- New Signals: B1C and B2a
  - Two new navigation signals, B1C and B2a, will be transmitted from the MEO satellites and IGSO satellites for global open service. Particularly, these two new signals will share two frequencies with GPS and Galileo, and some modern navigation signal features, such as BOC modulation, pilot and data orthogonal structure, will be adopted.
- Legacy Signals: B1I and B3I
  - Two legacy signals, B1I and B3I, will still be transmitted in BDS III.

BDS III Signal Characteristics

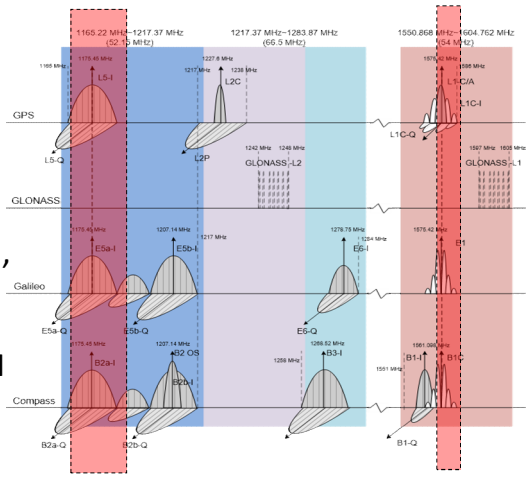
Signal Component	Carrier Frequency (MHz)	Code Rate (Mcps)	Modulation Scheme	Service Type
B1I	1561.098	2.046	BPSK	OS
B1C	1575.42	1.023	QMBOC	OS
B1A		N/A	N/A	AS
B2a	1176.45	10.23	ACE-BOC	OS
B2b	1207.14	10.23		OS
B3I	1268.52	10.23	BPSK	OS
B3Q		N/A	N/A	AS
B3A		N/A	N/A	AS

BDS III Services

- As a multiple function system, in addition to continuing to provide its iconic RDSS service and to expand the regional RNSS open service to the global open service by using new navigation signals, the SBAS and SAR services will also be integrated into the BDS III constellation.
  - RNSS——global service, provided by all satellites.
  - RDSS——the regional RDSS will provided by 3 GEO satellites, and the global RDSS will be provided by 14 MEO satellites distributed in three orbit planes.
  - SBAS——BDSBAS will serve users in the Asia-Pacific region with 3 GEO satellites via B1C and B2a signals. Two service modes will be provided: single frequency with dual constellations (SFDC) and dual-frequency with multiple constellations (DFMC).
  - SAR——SAR will be provided by 6 MEO satellites in 3 orbit planes.

Compatibility and Interoperability

- BDS III is designed to be compatible and interoperable with other global navigation satellite systems GNSSs.
- Specially, with the same frequency and bandwidth, similar modulation scheme and navigation message structure, BDS III signals B1 C and B2a are interoperable with GPS L1C and L5 signals.



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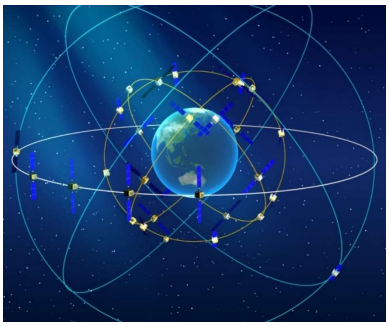
Main Characteristics of BDS III

- **Hybrid constellation**----Unique hybrid constellation structure, consist of
  - Geosynchronous Earth Orbit (GEO)
  - Inclined Geosynchronous Satellite Orbit (IGSO)
  - Medium Earth Orbit (MEO)
- **Multiple functions**----Multiple positioning and Location related functions, include
  - Radio Navigation Satellite Services (RNSS)
  - Radio Determination Satellite Services (RDSS)
  - Satellite-based Augmentation Systems(SBAS)
  - Search and Rescue (SAR)



Hybrid constellation of GEO, IGSO and MEO

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Main Characteristics of BDS

- **Regional focusing**----BDS-focused service area
  - In addition to 24 MEO satellites covering the world evenly, there are 3 GEO and 3 IGSO satellites covering the Asia-Pacific region, providing more services and better performance.
- **Passive and active combined positioning schemes** ---- Passive positioning for RNSS, active positioning for RDSS.
- **Inter-satellite links**---- Laser inter-satellite links will be used to overcome the limitation of ground based control segment.
- **Phased development process**---- Start with the simple BDS I, gradually expand to the regional BDS II and global BDS III.

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Outline

1. Introduction
2. Brief Description of BDS III
3. New Signals of BDS III
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   - B1C Signal
   - B2a Signal
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Planed BDS III Signals

- According to the most recent ICDs for B1C, B2a and B3I, BDS III will transmit at least 4 signals with 4 different frequencies for global open service
  - New signals: B1C and B2a
  - BDS II Legacy signals: B1I and B3I
- New Signals B1C and B2a are compatible and interoperable with GPS and Galileo
  - For B1C and B2a, they will share two frequencies with GPS and Galileo, and some modern navigation signal features, such as BOC modulation, pilot data and orthogonal structure, will be adopted.
- BDS II Legacy signals B1I and B3I will be continued to transmit
  - On the other side, the continued transmission of the B1I and B3I signals will ensure the smooth transition from BDS II to BDS III and provide high-performance triple-frequency open civil service as BDS II does, and thus, maximizes the benefits to receiver manufacturers and customers.

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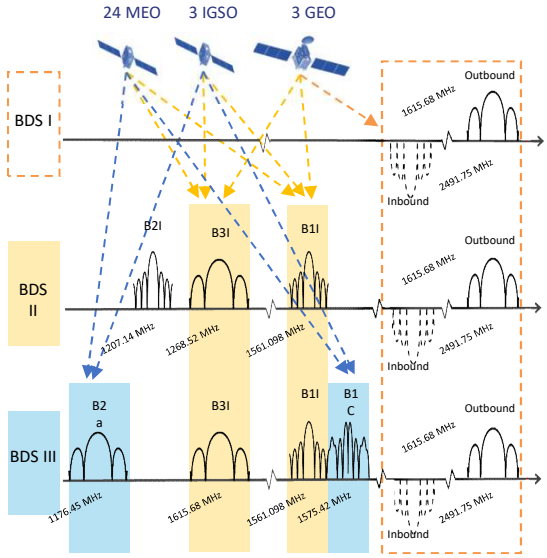
Planed BDS III Signals



- The two new navigation signals, B1C and B2a, will be transmitted by BDS III MEO and IGSO satellites.
- The legacy B1I and B3I signals will still be transmitted by all the BDS III satellites.
- The B2I signal originated in BDS II will be replaced by the new B2a signal.
- The enclosed part with dotted lines are the related signals of RDSS which are transmitted by GEO satellites only.

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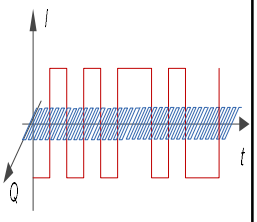
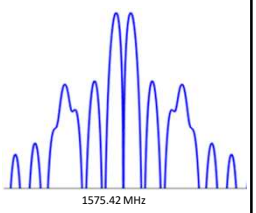
Modulation Schemes for New Signals

QMBOC (Quadrature Multiplexed Binary Offset Carrier) for B1C

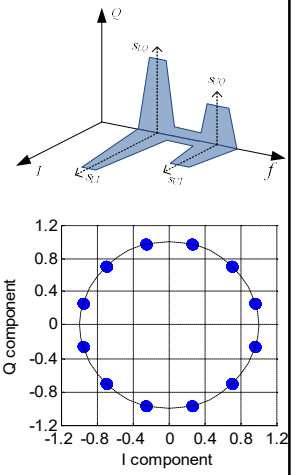
- The QMBOC modulation is a time-domain implementation of multiplexed binary offset carrier modulation (MBOC). It consists of two quadrature phase BOC modulations, BOC(1,1) and BOC(6,1).
- QMBOC has the same power spectrum as other MBOC implementations such as time-multiplexed BOC (TMBOC), which is used in the GPS L1C, and composite BOC (CBOC), which is used in the Galileo E1 OS.
- The QMBOC signal supports both a low complexity receiving mode and a high performance receiving mode.





Modulation Schemes for New Signals

- **ACE-BOC (Asymmetric constant envelope binary offset carrier) for B2**
  - The ACE-BOC modulation and multiplexing technique with its low complexity implementation form meets the B2 design requirement well. Therefore, ACE-BOC marries multi-carrier spread-spectrum modulation with constant envelope multiplexing.
  - It can combine four or fewer signals of arbitrary power ratio in phase quadrature onto two sidebands of a split-spectrum composite signal.
  - Moreover, the composite signals can either be received as two sets of QPSK signals located on two different bands respectively, or as a wideband signal.



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B1C Signal Characteristics

- B1C is the main signal of BDS III. All BDS users need to receive this signal. It is necessary to meet a large range of varied requirements, from location services and other consumer users (low cost), to high-precision measurement and other professional users (high-performance).

Signal	Carrier (MHz)	Component	Modulation	Symbol Rate (sps)	Phase	Power Ratio
B1C	1575.42	B1C_data	BOC(1, 1)	100	0	25%
		B1C_pilot	QMBOC(6,1,4/33)	0	90/0	75%

- The carrier frequency of B1C signal is identical with GPS L1 and Galileo E1 (1575.42 MHz), with bandwidth of 32.736 MHz;
- Orthogonal structure of data and pilot are adopted :
  - The data component B1C_data is generated by the subcarrier B1C_sc (t), the navigation message data B1C_D (t) and the ranging code B1C_C (t), by using sinusoidal BOC (1, 1) modulation;
  - The pilot component B1C_pilot is generated by the subcarrier B1C_sc (t) and the ranging code B1C_C (t), by using QMBOC (6, 1, 4/33) modulation.
- The power ratio of the data component to the pilot component is 1: 3.

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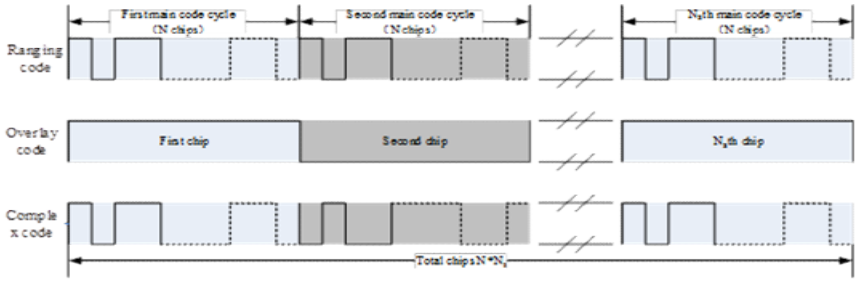
B1C Signal Characteristics

Structure of B1C (and B2a) PRN codes

- Hierarchical code structures are adopted for B1C (and B2a) PRN codes. The PRN codes on B1C (and B2a) are modulo-2 addition of a ranging code and an overlay code.
- Each MEO and IGSO satellite have a unique PRN code number to identify the corresponding satellite. Signals transmitted by the same satellites share a same PRN number.



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B1C Signal Characteristics

B1C Ranging Code

- The ranging codes for B1C are transmitted at a chipping rate of 1.023 Mbps for a total length of 10230 chips, which is obtained by truncating the Weil code with a length of 10,243 chips.
- A total of 126 B1C ranging codes are released (63 codes are for the data components and the other 63 codes are for the pilot components).

PRN code type and code length for B1C

Signal Component	Ranging code type	Ranging code length	Ranging code cycle (ms)	Overlay code length
B1C data component	Weil	10230	10	1
B1C pilot component	Weil	10230	10	1800

B1C Overlay Code

- The length of the B1C pilot component overlay code shall be 1800, which is obtained by truncating the Weil code with a length of 3607. The generation method is the same as the ranging code, and w ranges from 1 to 1803.

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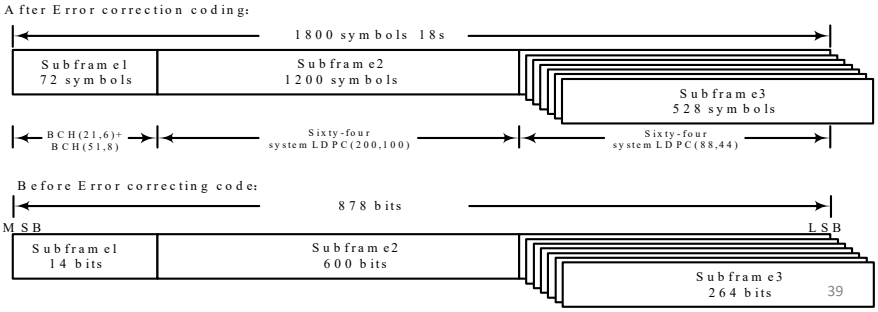
B1C Signal Characteristics

●B1C Navigation Message

- The navigation message broadcast by the B1C is named B-CNAV1, with CRC parity check (The length of the CRC code is k=24 bits).
- The B-CNAV1 message is modulated on the B1C data component. Each frame contains 1800 symbols with a symbol rate of 100 sps, where the broadcast period is 18 seconds. Each frame consists of three subframes. The basic frame structure as shown in following.



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B2a Signal Characteristics

● B2a is the second open service signal of BDS III, used to replace the B2I of BDS II, mainly for dual- or three-frequency receivers. B2a will mainly used for life safety service, high-precision measurement and other high-performance services, can also will be used for consumer applications with relative high performance requirements.

Signal	Carrier (MHz)	Component	Modulation	Symbol Rate (sps)	Phase	Power Ratio
B2a	1176.45	B2a_data	QPSK	200	0	1
		B2a_pilot		0	90	1

● The B2a carrier frequency is identical with GPS L5 and Galileo E5a (1176.45MHz), bandwidth of 20.46MHz;

● Orthogonal structure of data and pilot is adopted (QPSK):

- The data component B2a_data is modulated by the navigation message data B2a_D (t) and the ranging code B2a_C (t), using BPSK (10) modulation;
- The pilot component B2a_pilot includes only the ranging code B2a_C (t), using BPSK (10) modulation.

- The power ratio of the pilot component to the data component is 1: 1.

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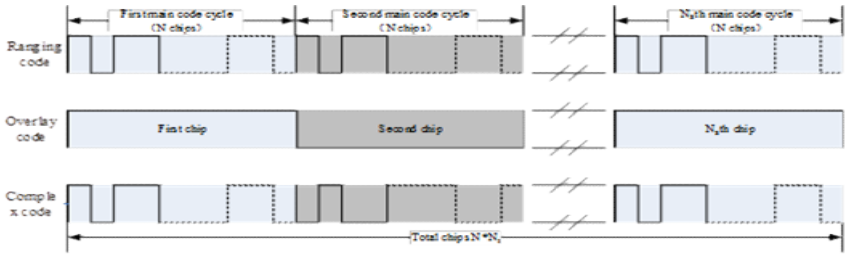
B2a Signal Characteristics

- Structure of B2a (and B1C) PRN codes.
  - Hierarchical code structures are adopted for B2a (and B1C) PRN codes. The PRN codes on B2a (and B1C) are modulo-2 addition of a ranging code and an overlay code.
  - Each MEO and IGSO satellite have a unique PRN code number (PRN number) to identify the corresponding satellite. Signals transmitted by the same satellites share a same PRN number.



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B2a Signal Characteristics

- B2a ranging codes
  - The ranging codes for B2a signals are transmitted at a chipping rate of 10.23 Mbps for a total length of 10230 chips.

PRN code type and code length for B2a

Signal Component	Ranging code type	Ranging code length	Ranging code cycle(ms)	Overlay code length
B2a data component	Gold	10230	1	5
B2a pilot component	Gold	10230	1	100

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B2a Signal Characteristics

- B2a overlay codes
  - All satellites are assigned the same B2a_data overlay code, whereas each of different satellites is assigned unique B2a_pilot overlay code.
  - B2a_data overlay codes: The length of a B2a_data overlay codes is 5, using a fixed 5-bit code sequence: 00010.
  - B2a_pilot overlay codes: The length of a B2a_pilot overlay codes is 100, which is obtained by truncating the Weil code with a length of 1021. The definition is same as the B1C ranging code.
  - Totally 63 B2a_pilot overlay codes are released.

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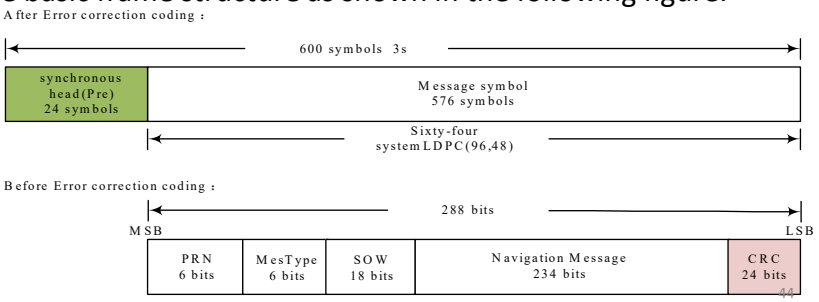
B2a Signal Characteristics

- B2a Navigation Message
- The navigation message broadcast by B2a is named B-CNAV2.
- The B-CNAV2 message is modulated on B2a data component.
- Each frame has a length of 600 symbols, with a symbol rate of 200 sps, where the broadcast period is 3 seconds. Each frame has three subframes.
- The basic frame structure as shown in the following figure.



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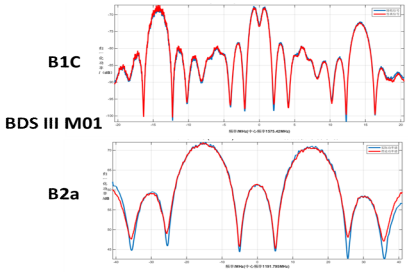
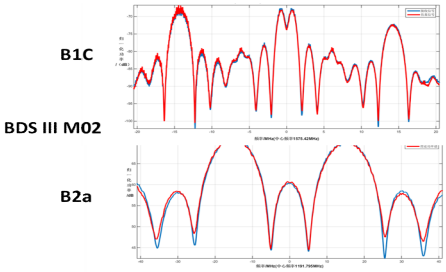
Initial Signal Quality Analysis

- The Spectra of the new signals B1C and B2a from the first two satellites (M01, M02) are measured by using a large antenna (40m diameter).
- The spectral plots show that the measured results of the B1C and B2a signals transmitted by the first pair satellites are highly consistent with the results of theoretical calculations.

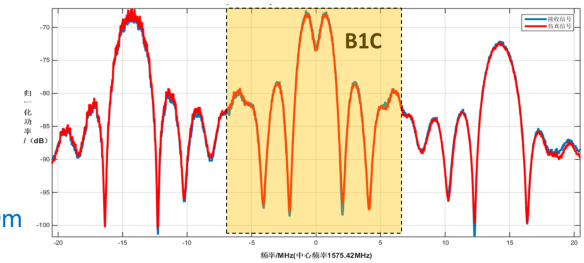




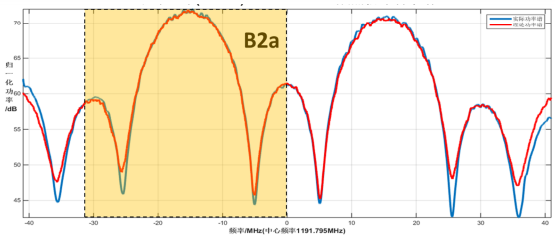
Initial Signal Quality Analysis

Spectrum of B1C (BDS III – M01)

------ measured by the 40m diameter antenna
------ simulated



Spectrum of B2a (BDS III – M01)



Plots of the B1C and B2a spectra, which is transmitted by the M01 satellite, measured by a 40 diameter antenna

enlarged figure of the B1C and B2a spectra

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Outline

1. Introduction
2. System Description of BDS III
3. New Signals of BDS III
4. Conclusion

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Conclusion

- BDS III is the third generation of the BDS, designed to be compatible and interoperable with other GNSSs, Including GPS, GLONASS and Galileo.
- BDS III will transmit at least 4 signals with 4 different frequencies for global open service, new signals B1C, B2a and legacy signals B1I and B3I.
- The two new signals, B1C and B2a, will be transmitted from the MEO satellites and IGSO satellites for global open service. Particularly, these two new signals will share two frequencies L1/E1 and L5/E5a with GPS and Galileo, and some modern navigation signal features, such as BOC modulation, pilot and data orthogonal structure, will be adopted.

Conclusion

- Currently, a total of 16 MEO and 1 GEO satellites have been successfully launched. According to the latest deployment plan at the time, 18 MEO and 1 GEO satellites will be in-orbit by the end of this year, while additional 6 MEO, 3 IGSO, and 2 GEO satellites will be launched from 2019 to 2020. It is expected that BDS III will provide initial service by the end of 2018, and will provide full service worldwide around 2020.
- For the international GNSS users, the most important and promised feature of BDS III is the compatibility and interoperability with other GNSSs. BDS III will become an important member of the international GNSS family, and serve all users together with other GNSSs.

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Thanks for your attentions!

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