



17th Meeting of the International Committee on  
Global Navigation Satellite Systems



# BDS Precise Point Positioning Service Status Update



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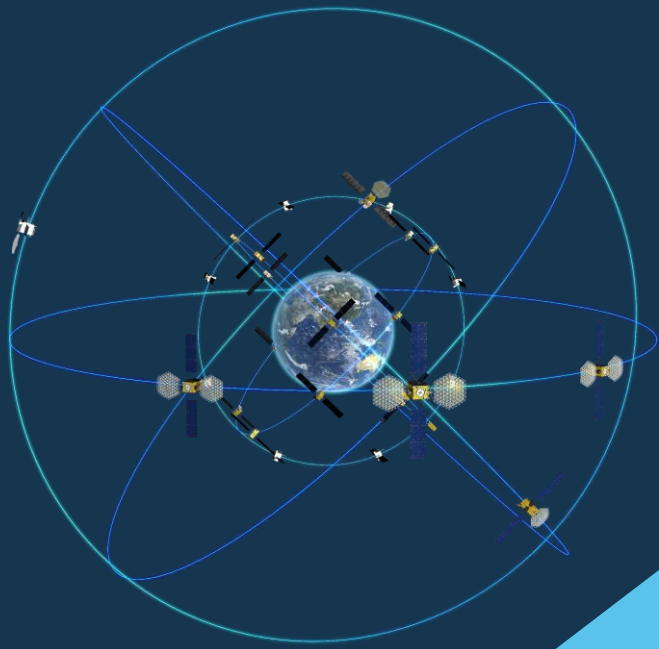
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Overview

01

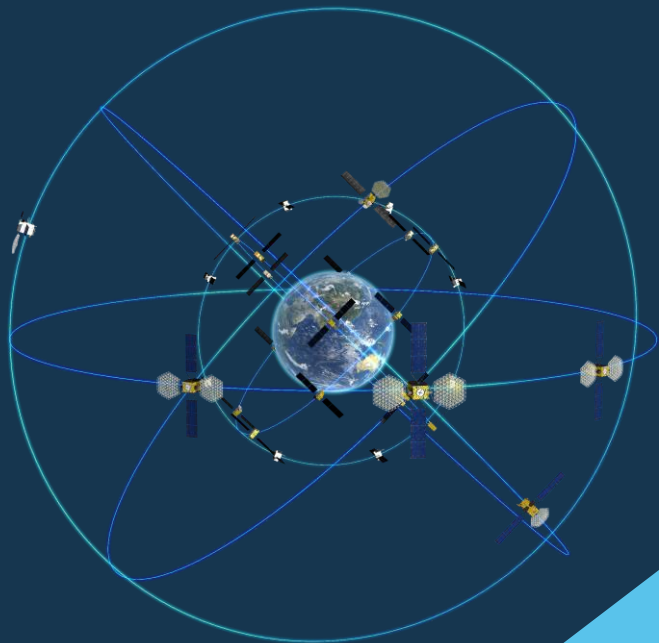
# OVERVIEW

The PPP service is provided through the PPP-B2b signal broadcasted by GEO satellites in the BDS-3 nominal constellation. And according to “the Application Service Architecture of BeiDou Navigation Satellite System (V1.0)”, the construction includes two phases.

- First phase: use the PPP-B2b I-components of the first three GEOs to provide a free and high-precision service for users in China and surrounding areas.
- Second phase: with the launch of subsequent satellites, expand the coverage, further improve the accuracy, reduce the convergence time, and better serve high-precision application fields.

Performance Characteristics	Performance Indicators	
	Phase I (Year 2020)	Phase II (After 2020)
Broadcast Data Rate	500bps	It will be extended to enhance multiple global navigation systems, to improve broadcast data rate, to expand satellite service area according to the situation, and to improve positioning accuracy and shorten convergence time.
Positioning Accuracy (95%)	Horizontal $\leq 0.3\text{m}$ Vertical $\leq 0.6\text{m}$	
Convergency Time	$\leq 30\text{min}$	





Design of BDS PPP Service

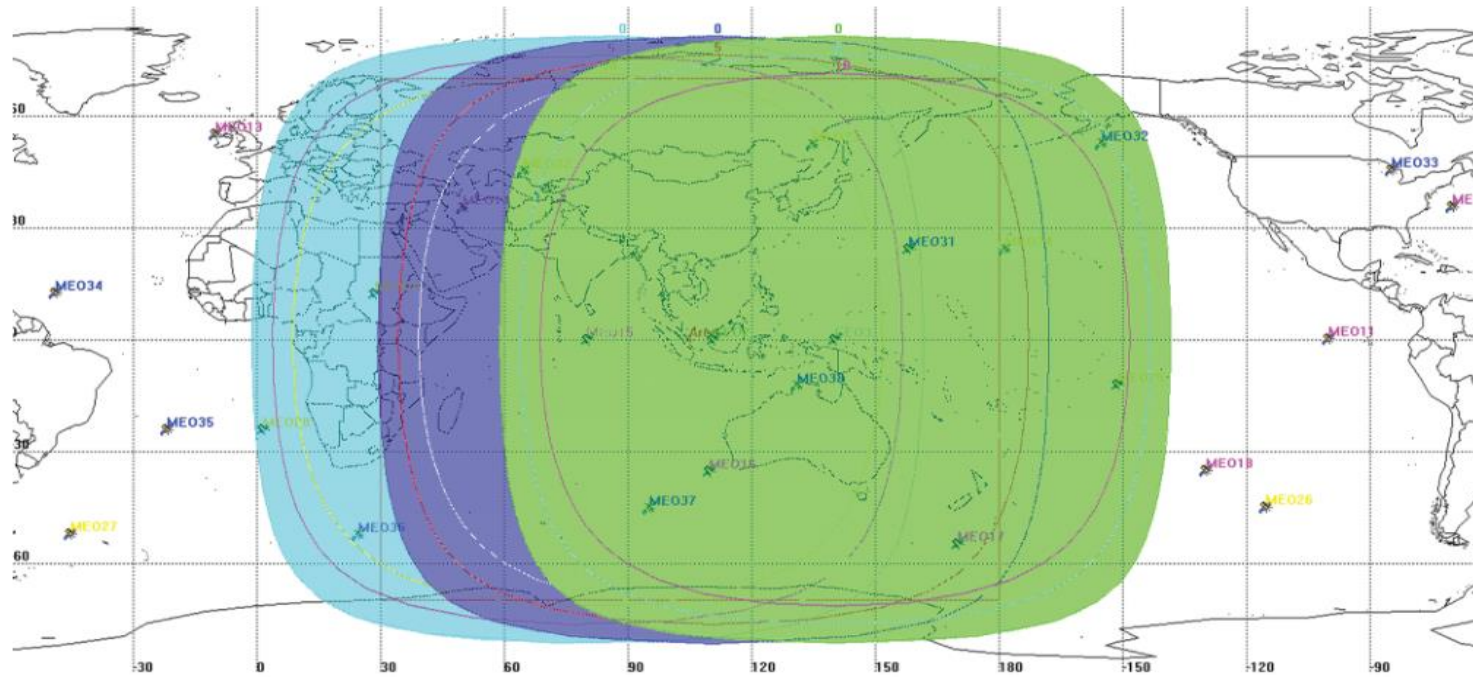
02



# Design of BDS PPP Service

## Service Volume

BDS can provide the PPP service to users in China and its surrounding areas in the scope of  $10^{\circ}\text{N}\sim 55^{\circ}\text{N}$ ,  $75^{\circ}\text{E}\sim 135^{\circ}\text{E}$ , on the surface of the earth and its near-earth areas extending within 1000 kilometers above the earth surface.

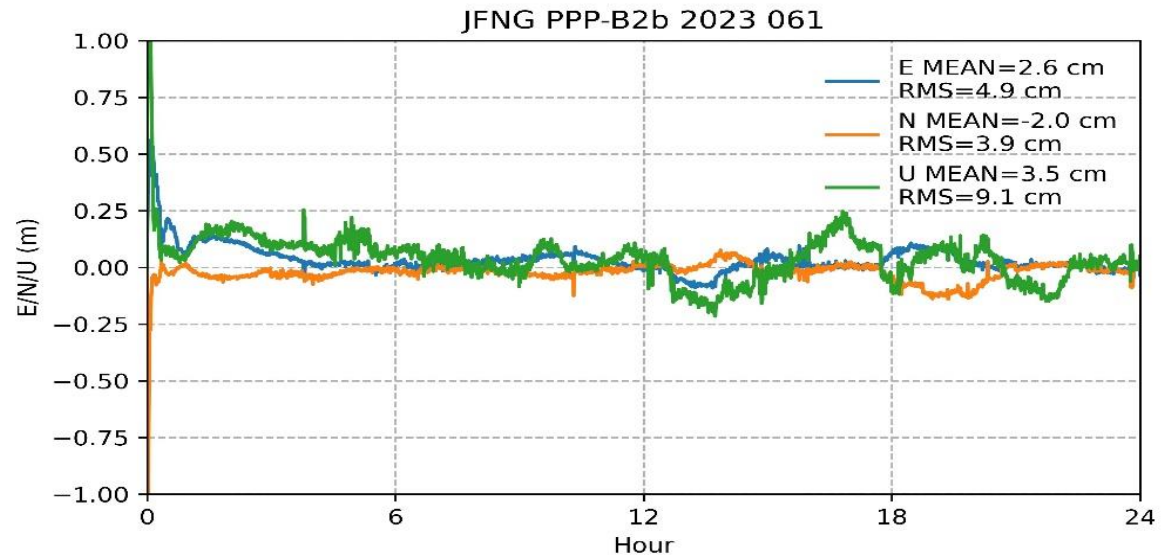




# Design of BDS PPP Service

## Performance Index

Characteristics		Performance Standard
BDS	Horizontal Positioning Accuracy(95%)	$\leq 0.3\text{m}$
	Vertical Positioning Accuracy(95%)	$\leq 0.6\text{m}$
	Convergence Time	$\leq 30\text{min}$
BDS + GPS	Horizontal Positioning Accuracy(95%)	$\leq 0.2\text{m}$
	Vertical Positioning Accuracy(95%)	$\leq 0.4\text{m}$
	Convergence Time	$\leq 20\text{min}$



The performance evaluation reveals that the positioning accuracy and the convergence time meets the open service performance standard.



# Design of BDS PPP Service

## SIS Characteristics

BDS PPP service has the same or similar center frequency as other PPP services.

Parameters		Japan		EU	Australia/ New Zealand	China	Russia	Korea
Session	Message Authentication	Yes (2024)	No	Yes (Phase 2, 2025)	No	TBD	No (TBC)	No TBC
	Bandwidth (per transmitting satellite)	2,000 bps	2,000 bps	448 bps	TBD bps	456 bps (TBC)	2,146 bps	TBD
	Efficiency <sup>6</sup>	8.5 bps/sat, 0.24 bps/sat/grid	8.5 bps/sat	24.4 bps/sat <sup>7</sup>	TBD	TBD	22.9 bps/sat	TBD bps/sat
	Extensibility <sup>8</sup>	Yes TBC	Yes TBC	Yes	-	Yes	No	Yes TBC
	Consistency Check for Ephemeris Update	Yes, using IOD-SSR	Yes, using IOD-SSR	Yes, using IOD Set ID	Yes	Yes	Yes, using IOD-SSR	Using IOD-SSR
	Satellite Grouping <sup>9</sup>	No	No	Yes	No	No	No	No
Transport	Framing Design	Preamble+payload+error correction	Preamble+payload+error correction	Preamble+payload+error correction	Preamble+payload+error correction	Preamble+payload+error correction	Preamble+payload+error correction	Preamble+payload+error correction
	Checksum and Error Correction	Reed-Solomon (255,223)	Reed-Solomon (255,223)	CRC and FEC (r=1/2) at 1 sec page level. HPVRS at message level.	TBD (16bits per word available)	Each message 486 bits, wherein the lowest 24 bits are CRC. After 64-ary LDPC(162, 81) encoding, the frame length shall be 972 symbols.	CRC-24Q Reed-Solomon (250,218)	TBD
	System Alert	Yes	Yes	-	No	TBD	No	Yes
	Generator ID <sup>10</sup>	Yes	Yes	No TBC	No	No	No	No
Network	Signal	L6D	L6E	E6-B	TBD	B2b	L3SVO	L6
	Data-link	Carrier Frequency	1278.75MHz		1278.75MHz	1207.14MHz (For early open service, 1176.45MHz)	1207.14MHz	1202.025MHz

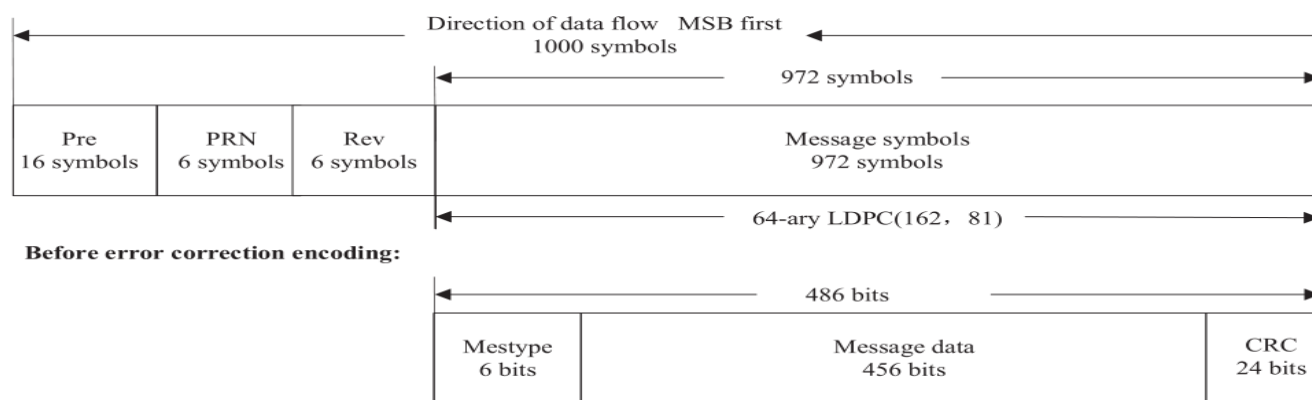




# Design of BDS PPP Service

## SIS Characteristics

Considering the downlink bandwidth and the performance requirement, the BDS PPP Service carried out a compression design based on the standard SSR and developed its customized message format.



Message type (in decimal)	Information content	Nominal validity time (s)
1	Satellite mask	-
2	Satellite orbit correction and URA	96
3	DCB	86400
4	Satellite clock correction	12
5	URA	96
6	Clock correction and orbit correction - combination 1	96
7	Clock correction and orbit correction - combination 2	96
8-61	Reserved	-
62	Reserved	-
63	Null message	-



# Design of BDS PPP Service

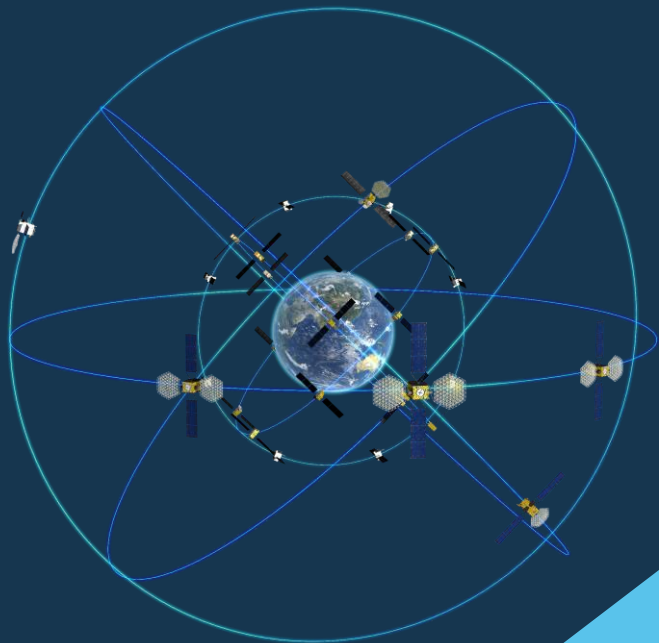
## SIS Characteristics

The navigation message of BDS PPP service contains information such as satellite mask of other systems, ID of signal and tracking modes, which provides the possibility to support interoperability at the message level.

### Definitions of signal and tracking modes

ID of signal and tracking mode	BDS	GPS	GLONASS	Galileo
0	B1I	L1 C/A	G1 C/A	Reserved
1	B1C(D)	L1 P	G1 P	E1 B
2	B1C(P)	Reserved	G2 C/A	E1 C
3	Reserved	Reserved	Reserved	Reserved
4	B2a(D)	L1C(P)	Reserved	E5a Q
5	B2a(P)	L1C(D+P)	Reserved	E5a I
6	Reserved	Reserved	Reserved	Reserved
7	B2b-I	L2C(L)	Reserved	E5b I
8	B2b-Q	L2C(M+L)	Reserved	E5b Q
9	Reserved	Reserved	Reserved	Reserved
10	Reserved	Reserved	Reserved	Reserved
11	Reserved	L5 I	Reserved	E6 C
12	B3 I	L5 Q	Reserved	Reserved
13	Reserved	L5 I+Q	Reserved	Reserved
14	Reserved	Reserved	Reserved	Reserved
15	Reserved	Reserved	Reserved	Reserved

Field	Name	Length (bit)	Scale factor	Range	Unit	Basic description
MesTypeID	Message type	6	1	0~63	--	See Table 6-1
Epoch	Epoch	17	1	0~86399	s	BDT seconds within a day
Reserved	Reserved	4	1	0~15	--	--
IOD SSR	IOD of SSR	2	1	0~3	--	Change as the system configuration changes.
IODP	IOD of PRN mask	4	1	0~15	--	Issue Of Data of PRN mask
BDS mask	Satellite slot 1	1	1	0~1	--	Broadcasting ID of the first satellite of BDS
	to slot 63	1	1	0~1	--	Broadcasting ID of the 63 <sup>rd</sup> satellite of BDS
GPS mask	Satellite slot 64	1	1	0~1	--	Broadcasting ID of the first satellite of GPS
	to slot 100	1	1	0~1	--	Broadcasting ID of the 37 <sup>th</sup> satellite of GPS
Galileo mask	Satellite slot 101	1	1	0~1	--	Broadcasting ID of the first satellite of Galileo
	to slot 137	1	1	0~1	--	Broadcasting ID of the 37 <sup>th</sup> satellite of Galileo
GLONASS mask	Satellite slot 138	1	1	0~1	--	Broadcasting ID of the first satellite of GLONASS
	to slot 174	1	1	0~1	--	Broadcasting ID of the 37 <sup>th</sup> satellite of GLONASS
Reserved mask	Satellite slot 175	1	1	0~1	--	Reserved
	to slot 255	1	1	0~1	--	Reserved
Reserved bits	Reserved bits	174	1	--	--	--
CRC	CRC bits	24	--	--	--	--



Work in Progress

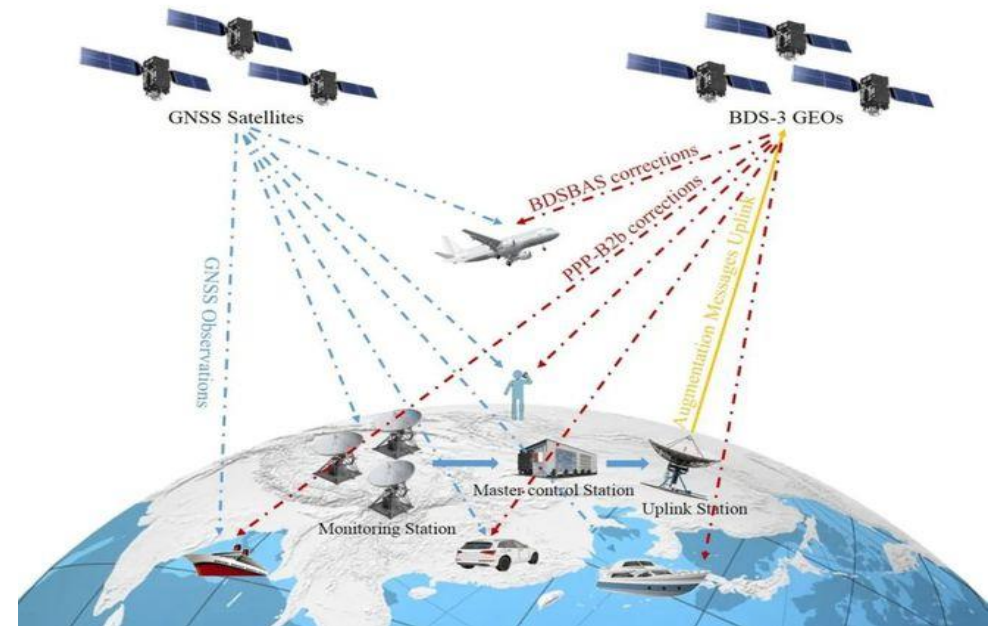
03



# Work in Progress

## Backup Satellite Launching

A new navigation satellite was launched on May 17, 2023. The satellite, designed to enter the geostationary earth orbit, is the first backup satellite for BDS-3. This satellite will also improve the robustness of PPP services. It will be connected to the BDS after it completes in-orbit tests.



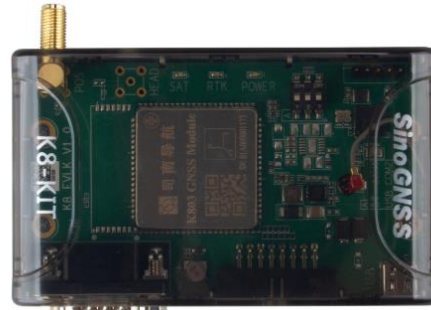




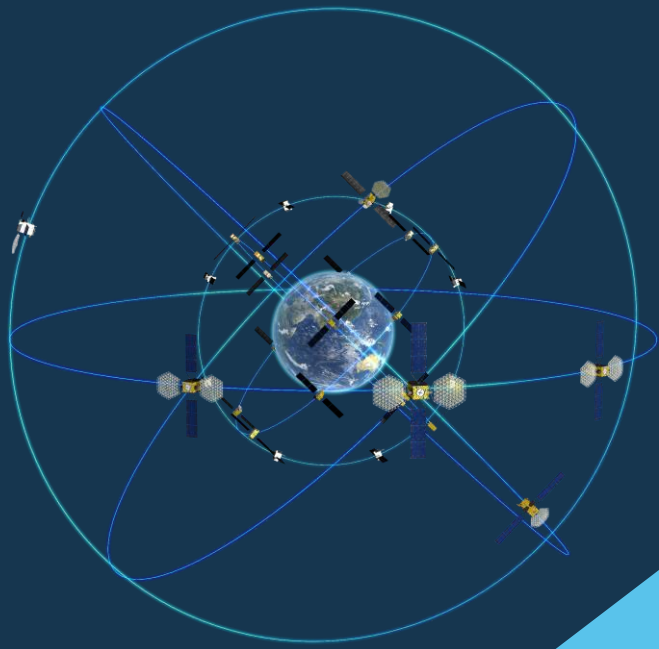
# Work in Progress

## Application

- Currently, a variety of boards and cards, as well as receivers, supporting BDS-PPP, have found extensive applications in precision agriculture, unmanned aerial vehicles, robots, and other fields.
- In the field of personal consumption, mobile phones supporting BDS-PPP are now available.







Conclusions

04



# Conclusions

- The performance evaluation reveals that the positioning accuracy and the convergence time of BDS PPP meets the open service performance standard.
- BDS PPP service has the possibility of interoperability with other systems at the signal, message and other levels.
- BDS will continue to promote system construction, improve service performance, and participate in PPP interoperability.

2019. 12:

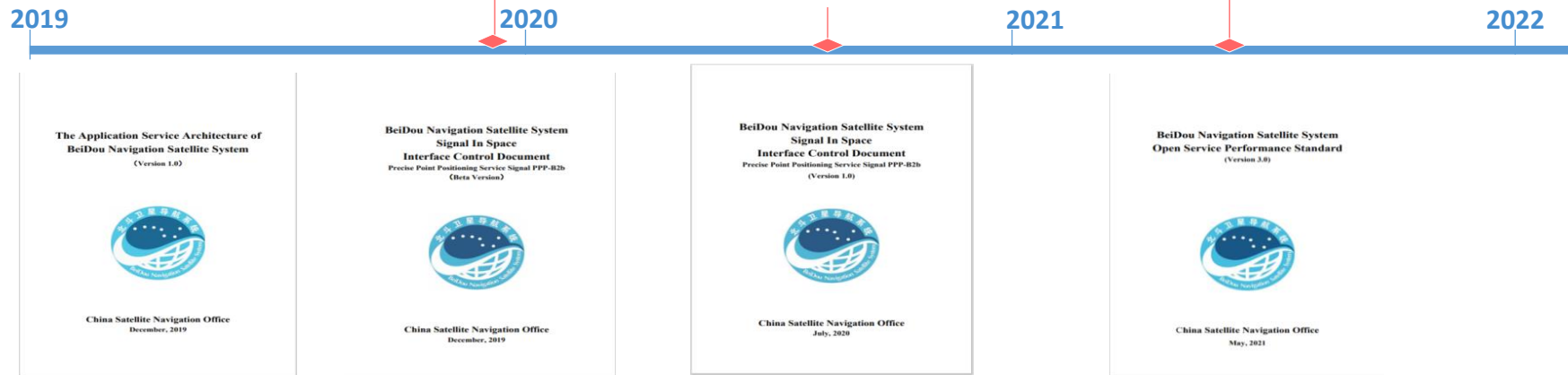
Announced provision of PPP service  
Published BDS SIS ICD PPP-B2b (Beta Version)

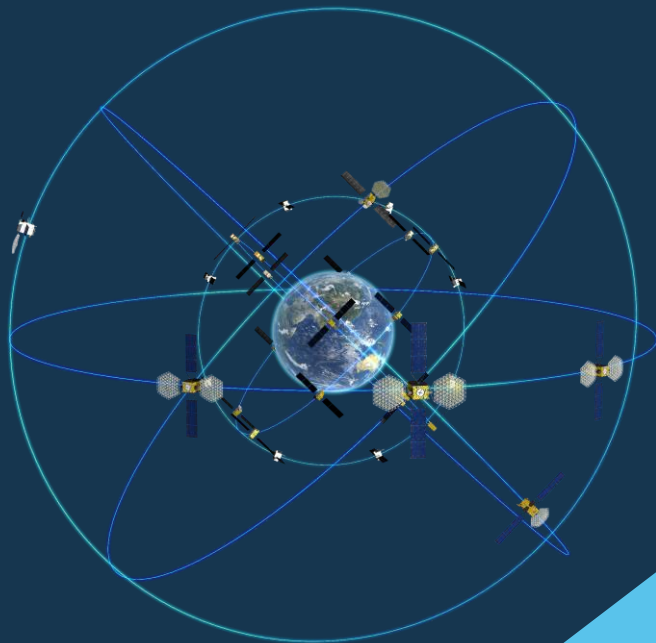
2021. 5:

Published BDS Open Service Performance Standard (V1.0)

2020. 8:

Published BDS SIS ICD PPP-B2b (V1.0)





Thank you for your attention

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