



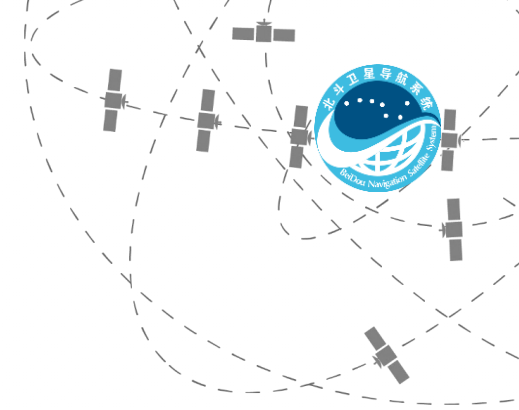
The Recent Status of BDT and the Plan of the Coming System Upgrade

13th Meeting of the International Committee on
Global Navigation Satellite Systems

Beijing Satellite Navigation Centre
Lin Zhang, Zhiwu Cai, Chunhao Han

2018-11-7





| CONTENT |

01 The Recent Status of BDT

- The System Structure of BDT
- Time Offset Between BDT and UTC(BSNC)
- Time Offset Between BDT and UTC
- Frequency Stability of BDT

02 The Upgrade Plan of BDT (BDS-3)

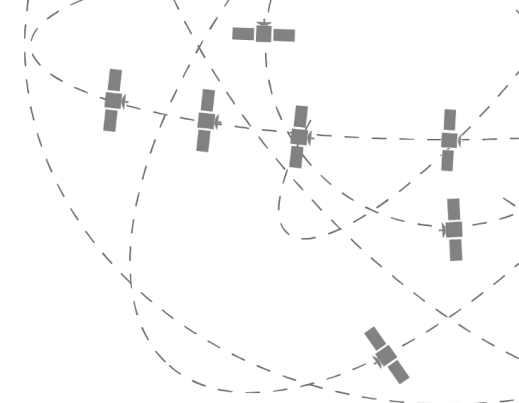
- The Development of Time-keeping Technology
- The Application of Optical Fiber Links in Ground Stations
- The New Monitor Links of BGTO Parameters

03 Summery

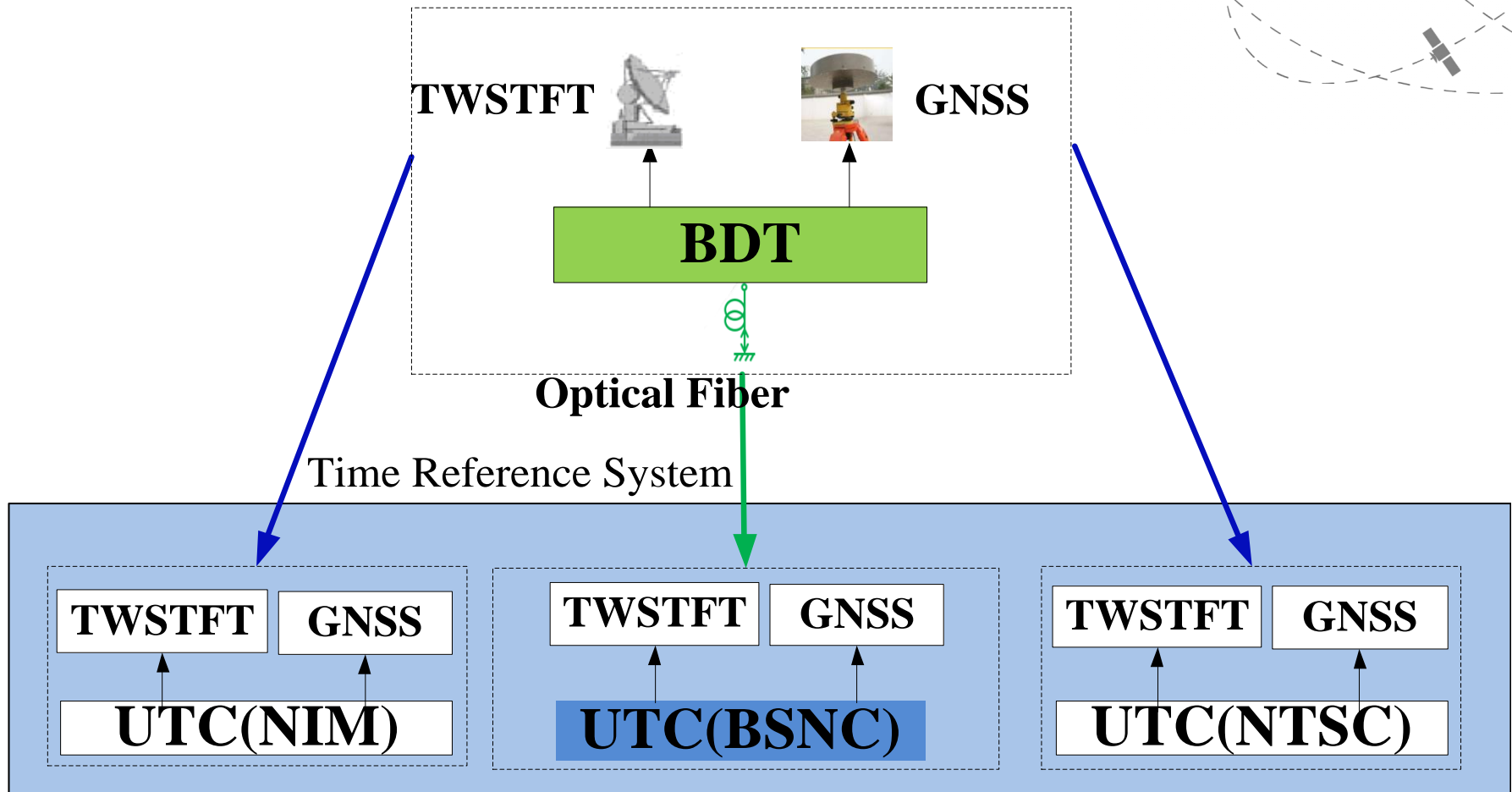
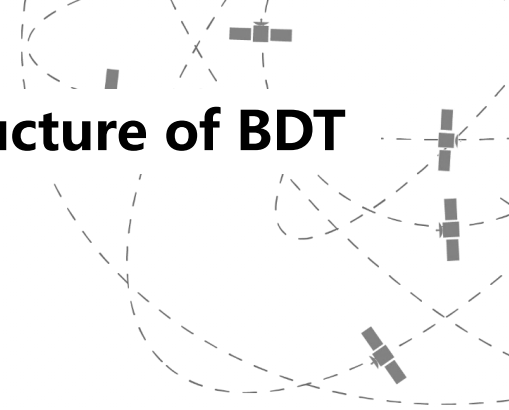
01

The Recent Status of BDT

- The System Structure of BDT
- Time Offset Between BDT and UTC(BSNC)
- Time Offset Between UTC(BSNC) and UTC
- Time Offset Between BDT and UTC
- Frequency Stability of BDT



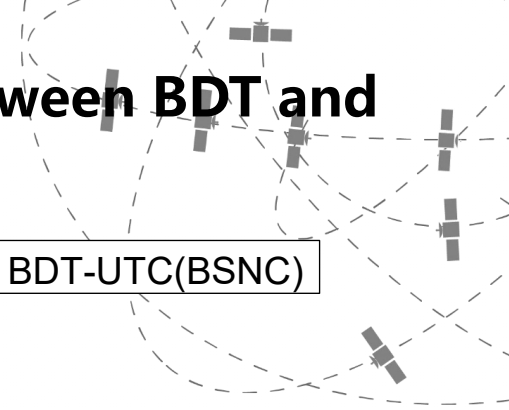
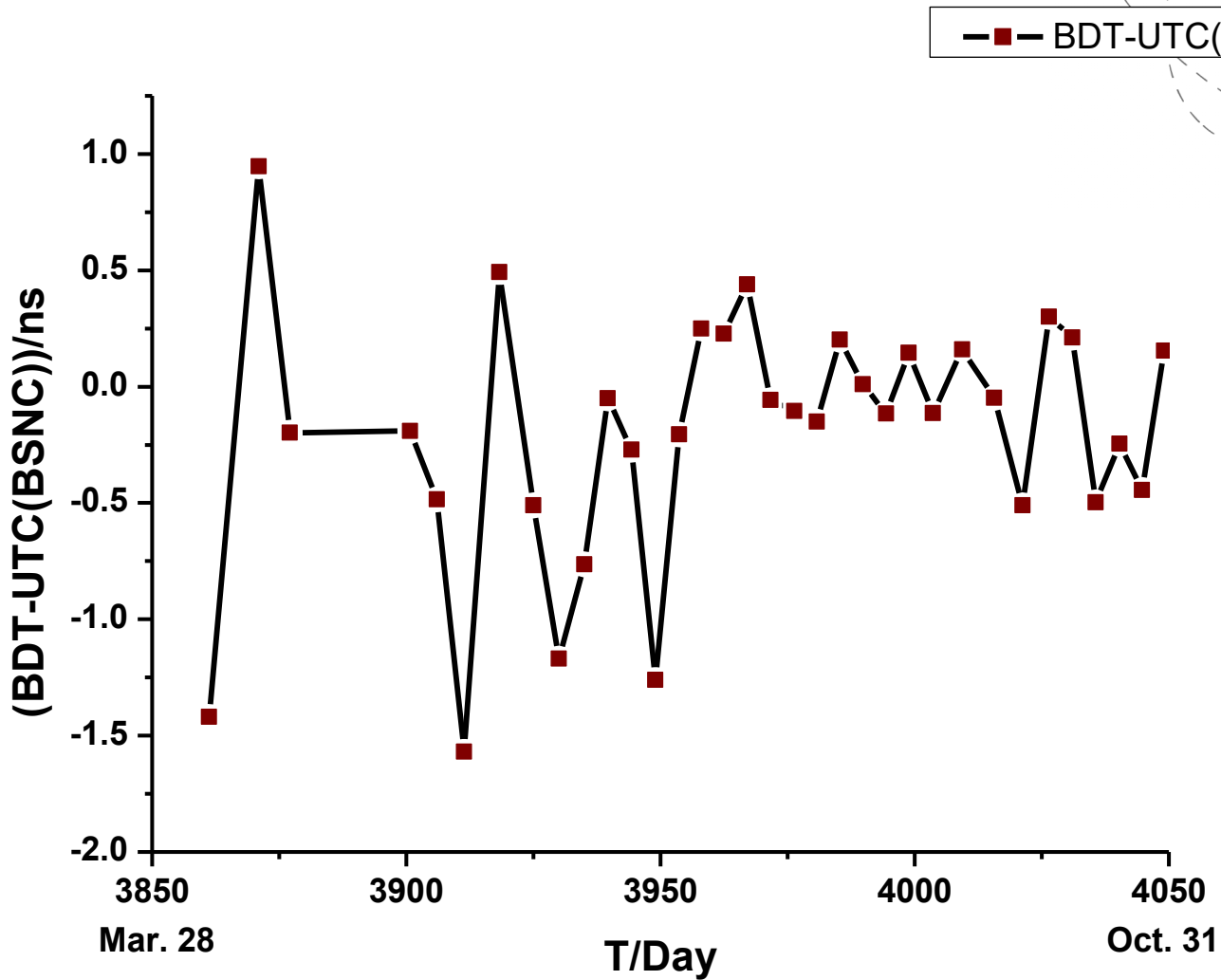
The Recent Status of BDT / The System Structure of BDT



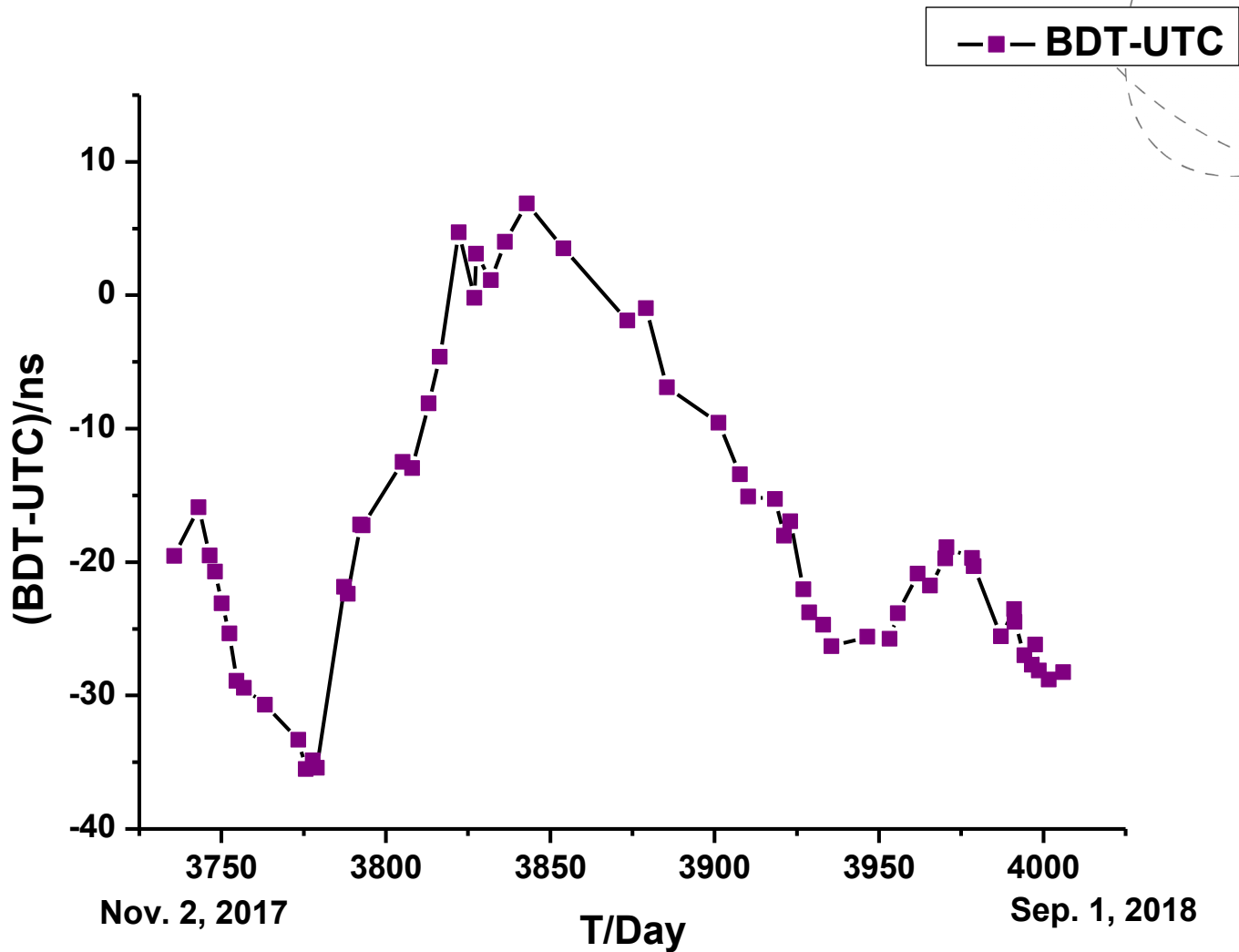


The Recent Status of BDT /

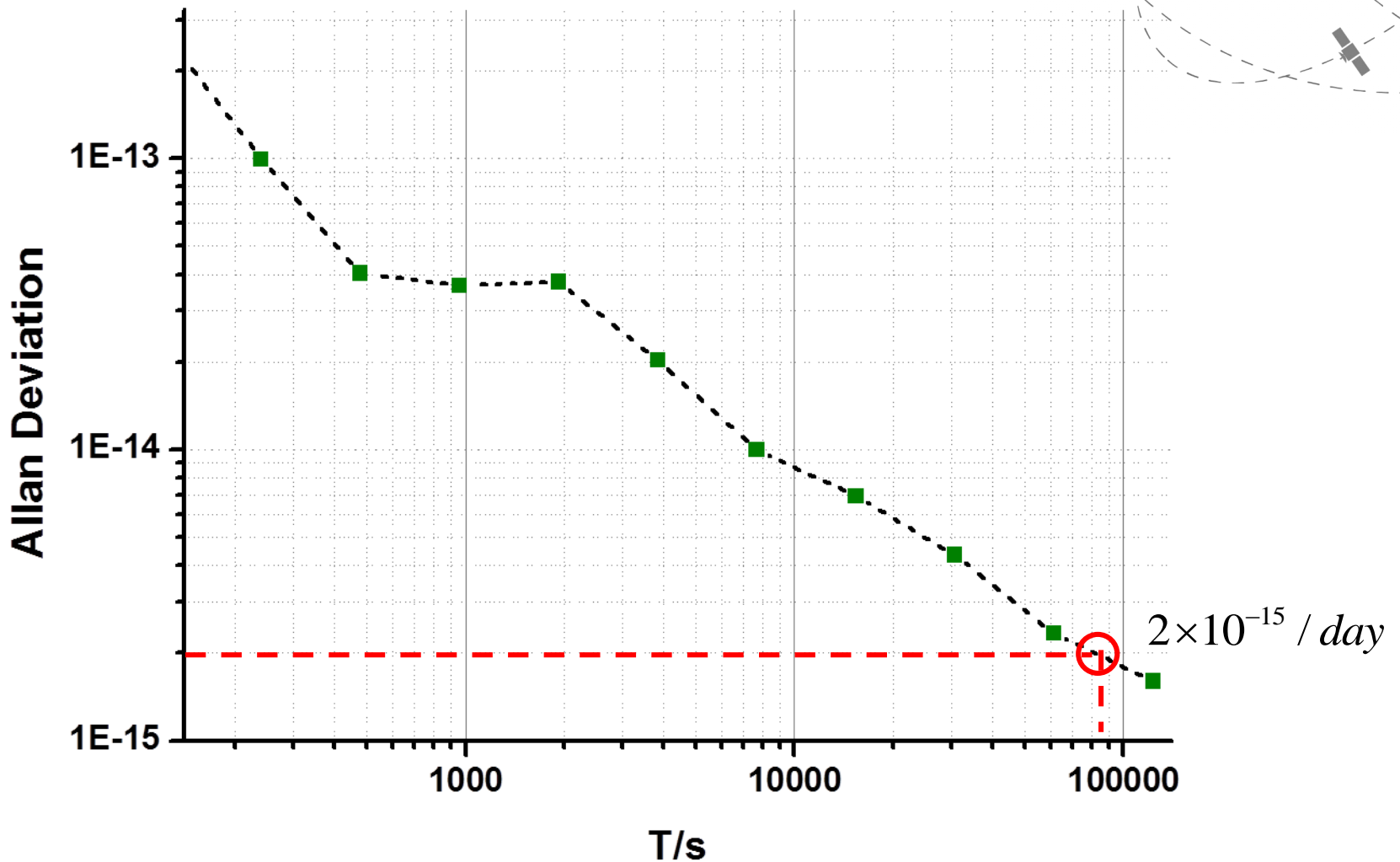
Time Offset Between BDT and UTC(BSNC)



The Recent Status of BDT / Time Offset Between BDT and UTC



--■-- Allan Deviation



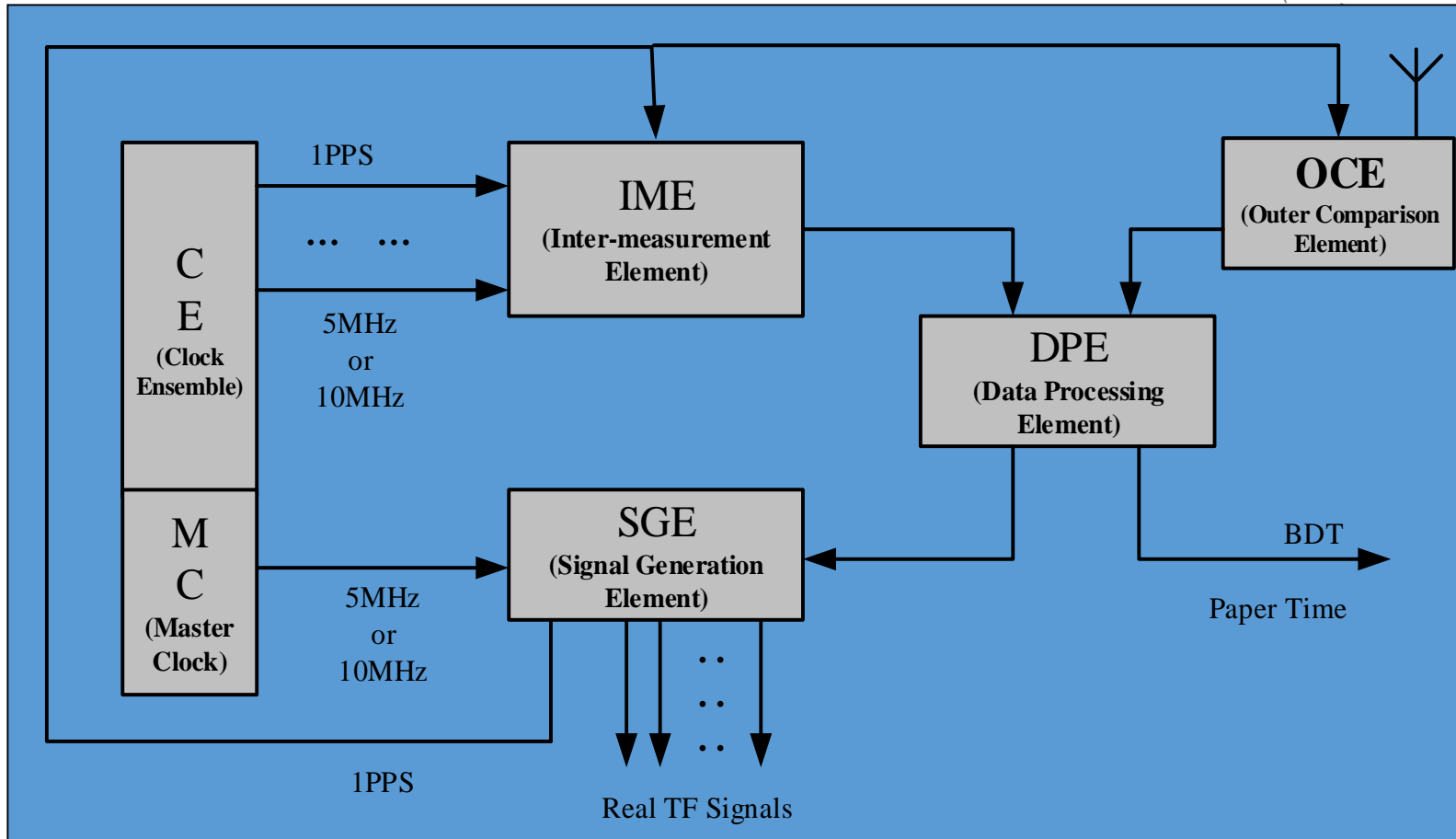


02

The Upgrade Plan of BDT (BDS-3)

- The Development of Time-keeping Technology
- The Application of Optical Fiber Links in Ground Stations
- The New Monitor Links of BGTO Parameters

Structure of TFS(Time and Frequency System)



Ensemble: More Clocks

- Hydrogen Clocks (Made in China)
- Cesium Clocks (Made in China)
- Clock Number ≥ 7

Algorithm: Optimized Models

- Weight Factors: Stability and Predictability
- Modify Frequency Drift

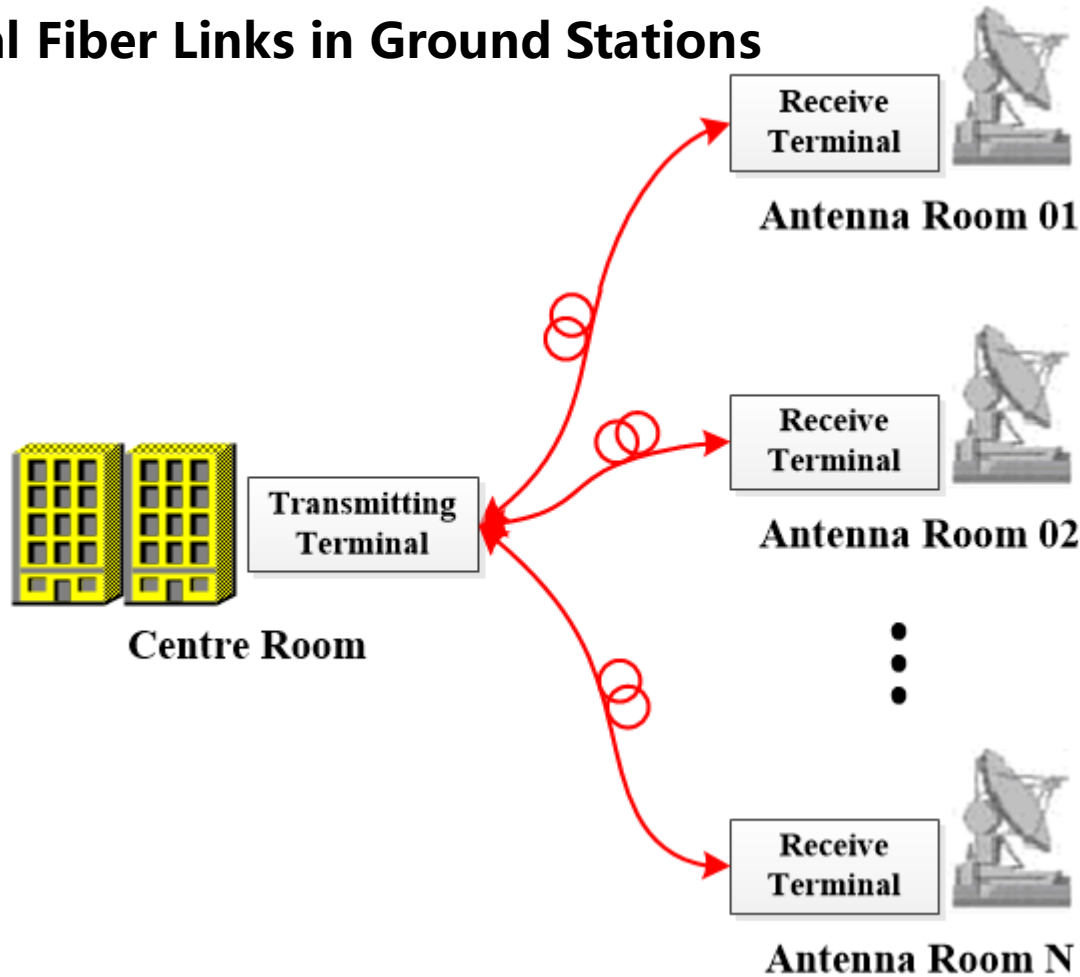




The Upgrade Plan of BDT (BDS-3)/

The Application of Optical Fiber Links in Ground Stations

➤ New Optical Fiber Links in Ground Stations

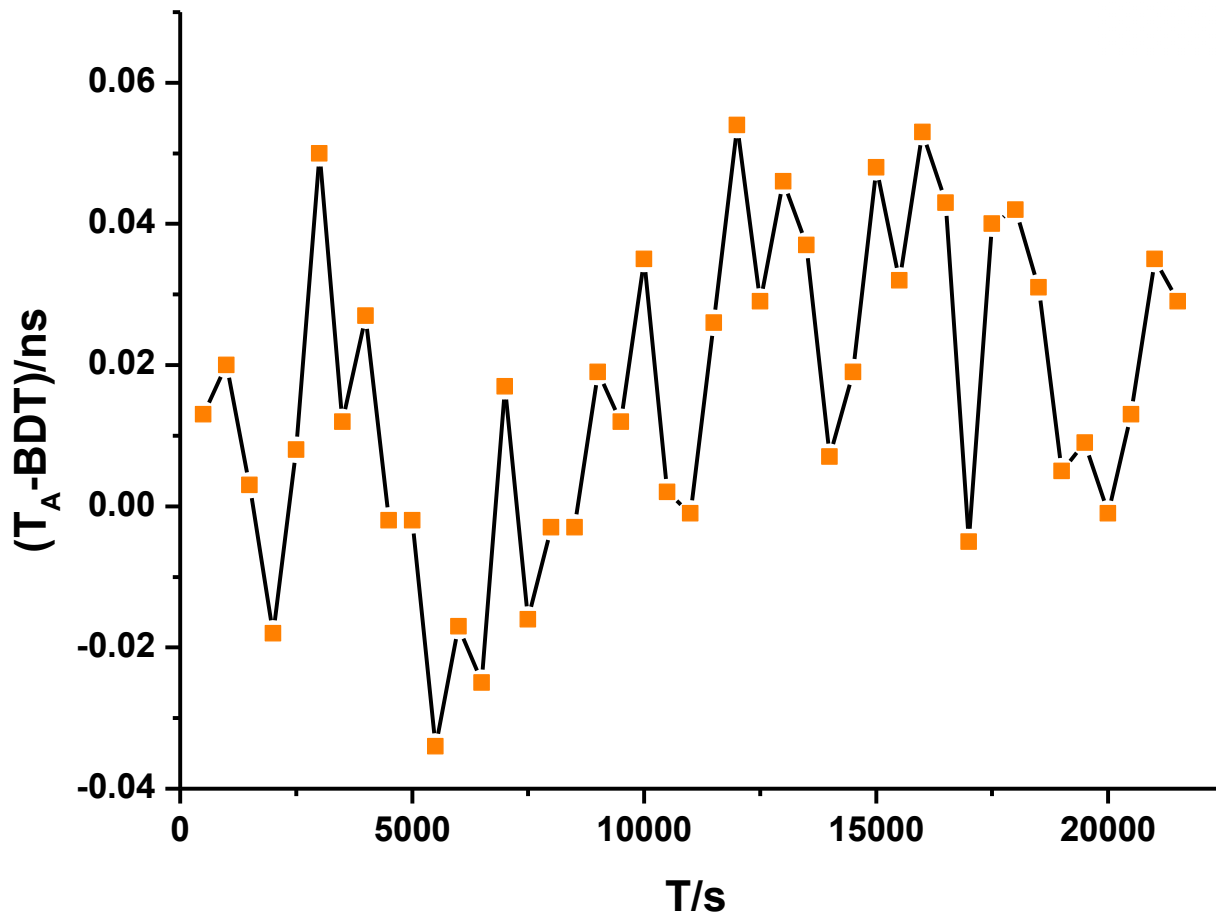
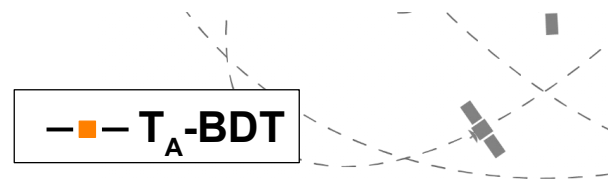




The Upgrade Plan of BDT (BDS-3)/

The Application of Optical Fiber Links in Ground Stations

➤ Time Offset Between T_A and BDT



BGTO: Time offset among BDT and Other
GNSST (GPST, GLNT, GST)

- The BGTO parameters will be broadcasted in BDS-3.
- The formation of BGTO parameters could be inquired in the ICD document of BDS.

ICD Document

BGTO Parameters

BeiDou Navigation Satellite System
Signal In Space
Interface Control Document
Open Service Signal (Version 2.1)



China Satellite Navigation Office
November 2016

5.2.4.18 Time Parameters relative to GPS time (A_{0GPS} , A_{1GPS})

These parameters indicate the relationship between BDT and GPS time as in Table 5-17. (Not broadcast temporarily)

Table 5-17 Time parameters relative to GPS time

Parameter	No. of Bits	Scale factor (LSB)	Units
A_{0GPS}	14*	0.1	ns
A_{1GPS}	16*	0.1	ns/s

* Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB.

A_{0GPS} : BDT clock bias relative to GPS time;

A_{1GPS} : BDT clock rate relative to GPS time.

The relationship between BDT and GPS time is as follows:

$$t_{GPS} = t_E - \Delta t_{GPS}$$

where, $\Delta t_{GPS} = A_{0GPS} + A_{1GPS} \times t_E$;

t_E is the SOW in BDT computed by user.

5.2.4.19 Time Parameters relative to Galileo time (A_{0Gal} , A_{1Gal})

These parameters indicate the relationship between BDT and Galileo

© 2016 China Satellite Navigation Office

time as in Table 5-18. (Not broadcast temporarily)

Table 5-18 Time parameters relative to Galileo time

Parameter	No. of Bits	Scale factor (LSB)	Units
A_{0Gal}	14*	0.1	ns
A_{1Gal}	16*	0.1	ns/s

* Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB.

A_{0Gal} : BDT clock bias relative to Galileo system time;

A_{1Gal} : BDT clock rate relative to Galileo system time.

Relationship between BDT and Galileo system time is as follows:

$$t_{Gal} = t_E - \Delta t_{Gal}$$

where $\Delta t_{Gal} = A_{0Gal} + A_{1Gal} \times t_E$;

t_E is the SOW in BDT computed by user.

5.2.4.20 Time Parameters relative to GLONASS time (A_{0GLO} , A_{1GLO})

These parameters indicate the relationship between BDT and GLONASS time as in Table 5-19. (Not broadcast temporarily)

Table 5-19 Time parameters relative to GLONASS time

Parameter	No. of Bits	Scale factor (LSB)	Units
A_{0GLO}	14*	0.1	ns
A_{1GLO}	16*	0.1	ns/s

* Parameters so indicated are two's complement, with the sign bit (+ or -) occupying the MSB.

A_{0GLO} : BDT clock bias relative to GLONASS time;

A_{1GLO} : BDT clock rate relative to GLONASS time.

Relationship between BDT and GLONASS time is as follows:

$$t_{GLO} = t_E - \Delta t_{GLO}$$

where $\Delta t_{GLO} = A_{0GLO} + A_{1GLO} \times t_E$;

t_E is the SOW in BDT computed by user.

42

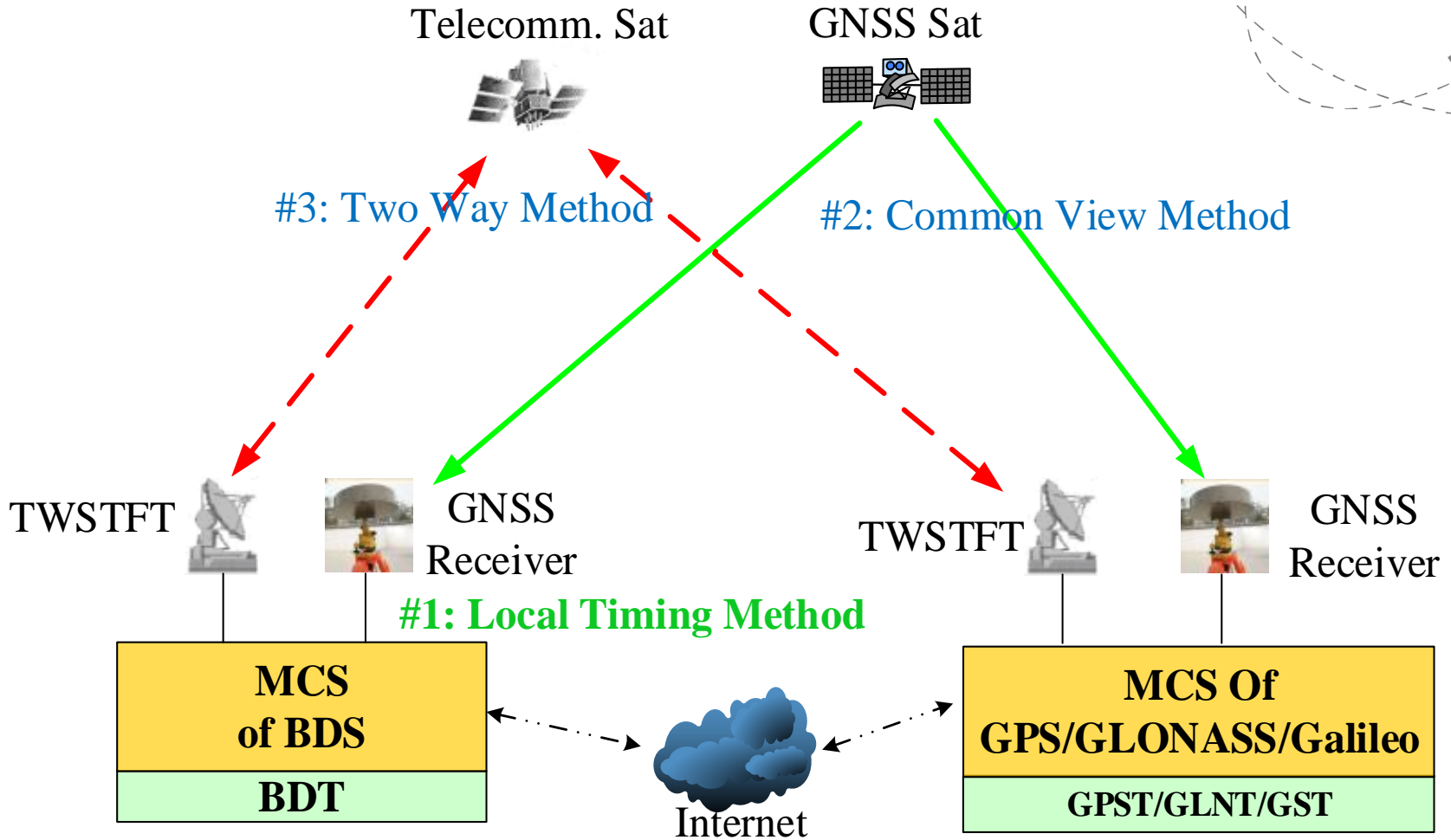
BDS-SIS-ICD-2.1
2016-11

43

BDS-SIS-ICD-2.1
2016-11

The Upgrade Plan of BDT (BDS-3)/

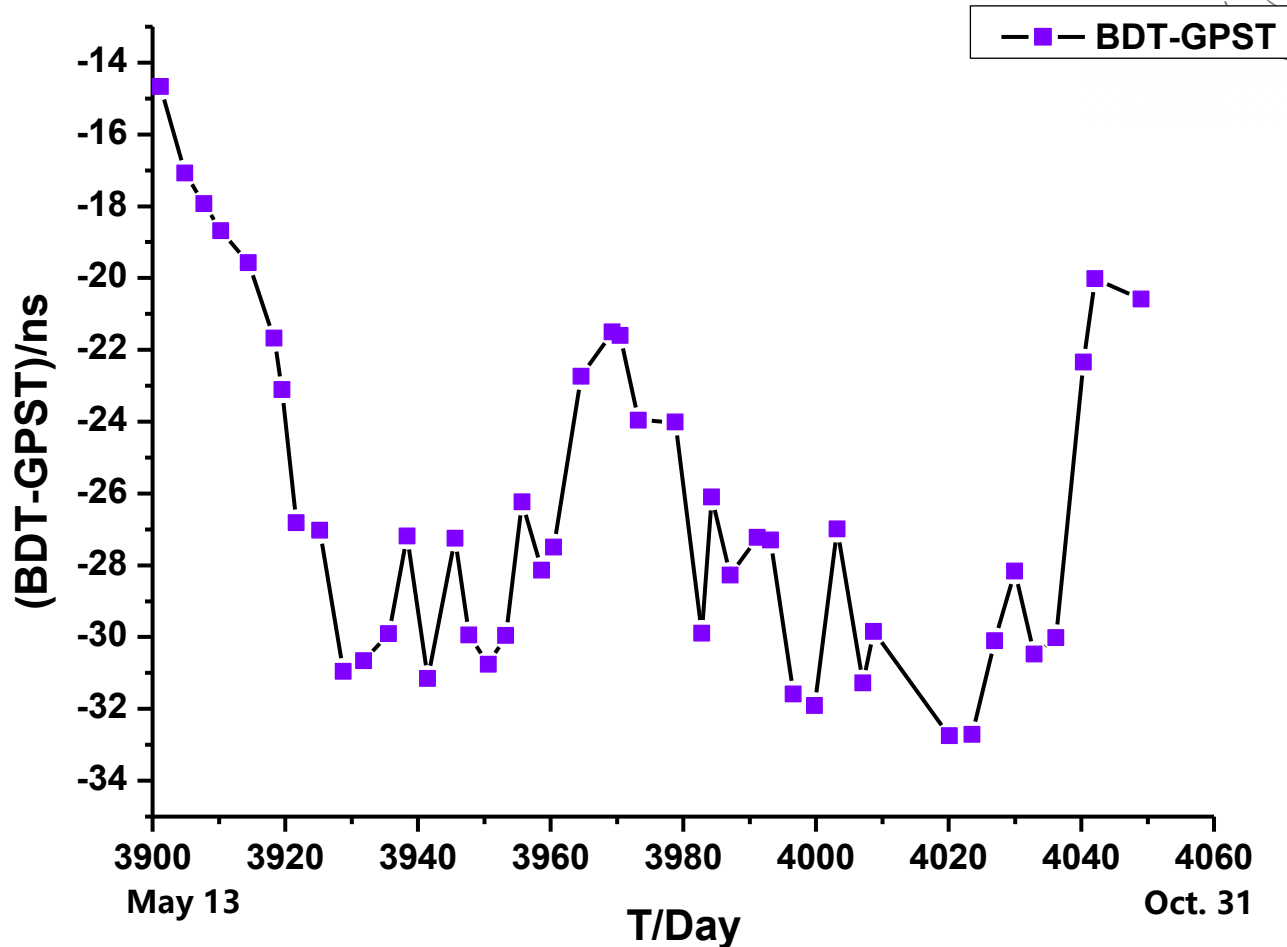
The New Monitor Links of BGTO Parameters

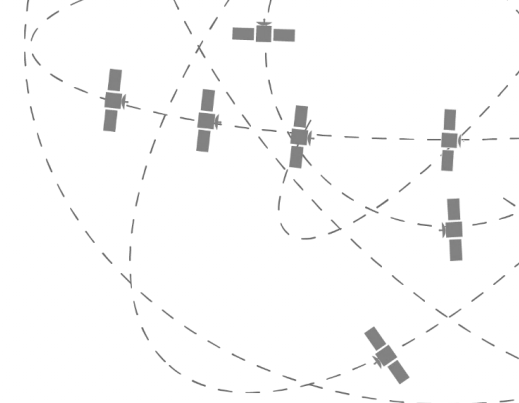


The Upgrade Plan of BDT (BDS-3)/

The New Monitor Links of BGTO Parameters

➤ Time Offset Between BDT and GPST (Local Timing Method)

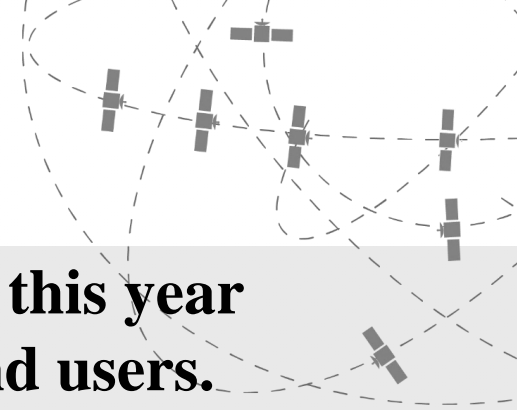




03

Summery

Summery



- **The BDT system runs stably and reliably in this year which provides stable time service for BDS and users.**
- **The time-keeping technology of BDT has been developed in BDS-3 by using more atomic clocks and better algorithm, which improves the performance of BDT both in time accuracy and stability.**
- **Due to the good performance of the optical fiber links, it has been widely used in BDS ground stations.**
- **The BGTO parameters will be broadcasted in BDS-3 which will support the compatibility and interoperability among GNSST.**

THANK YOU!

13th Meeting of the International Committee on
Global Navigation Satellite Systems

