CHINA SATELLITE NAVIGATION OFFICE

The 9th Meeting of International Committee on GNSS

Progress of BDT and its relationship with UTC/UTCr

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Contents

1. Operation status of BDT

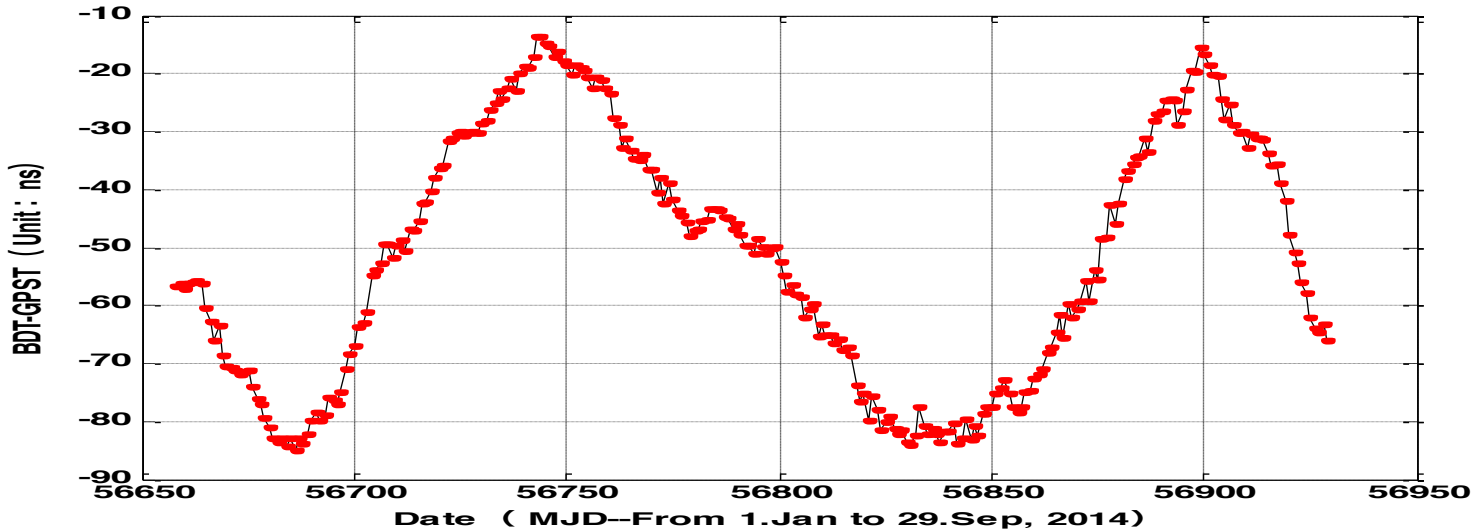
Definition of BDT

- The BeiDou system time (BDT) is an internal time scale, without leap second
- The largest unit used to stating BDT is one week, defined as 604,800 seconds
- BDT is counted with the week number (WN) and the second of week (SOW)
- The zero point is 1 January 2006（Sunday） UTC 00h 00m 00s

1. Operation status of BDT

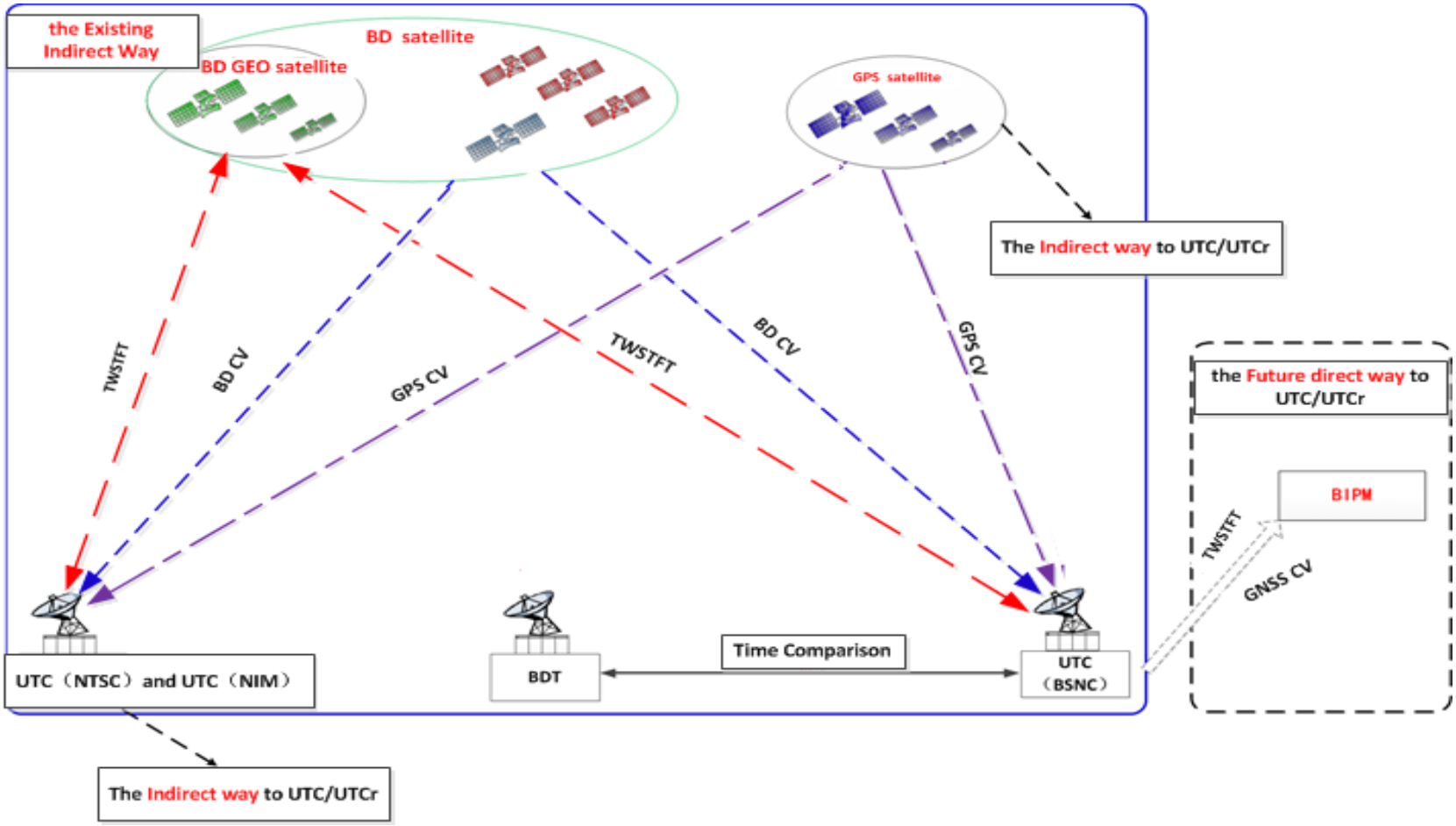
- **The Observed Time difference between BDT and GPST**

Item	Max/ns	Min/ns	Mean/ns	Std/ns	RMS/ns
|BDT-GPST|	84.87	13.61	51.65	21.23	55.87



1. Operation status of BDT

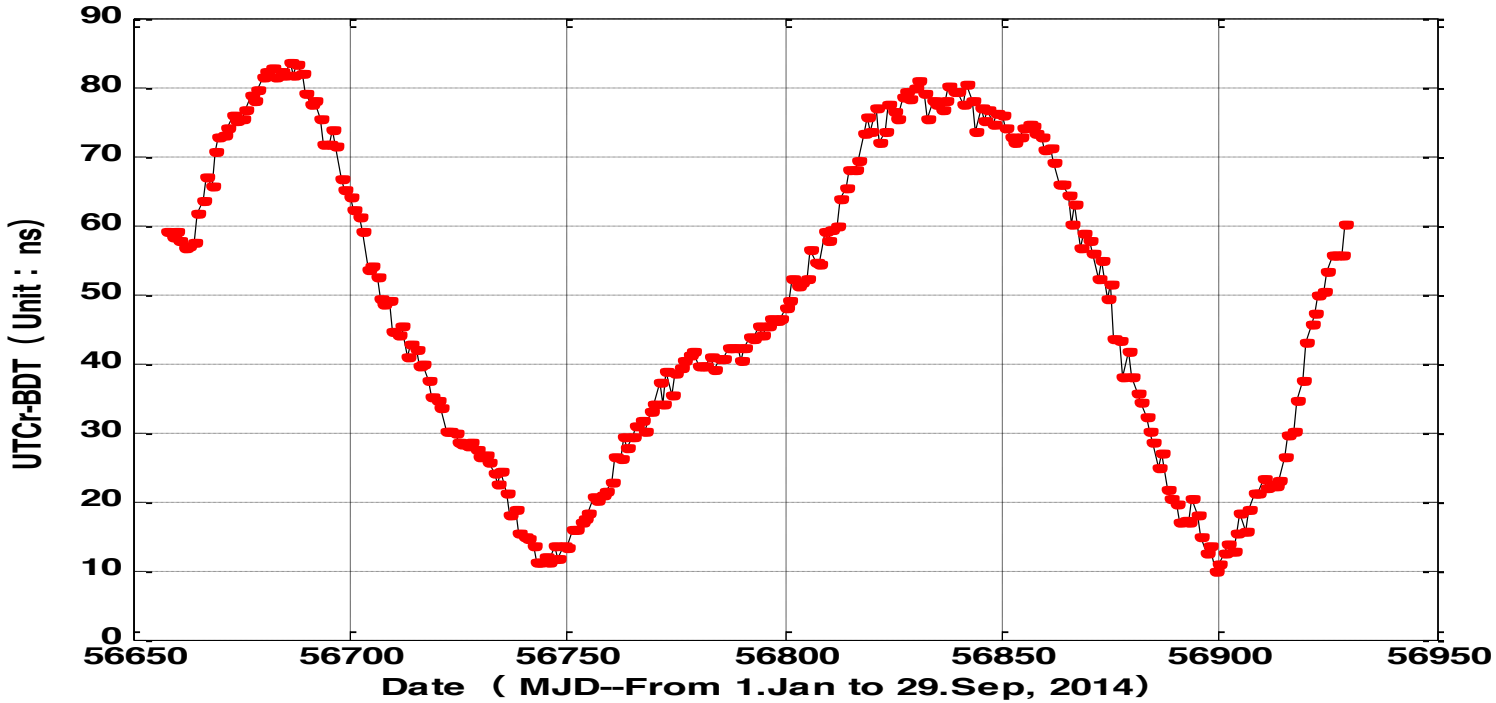
Time comparison links between BDT and UTC



1. Operation status of BDT

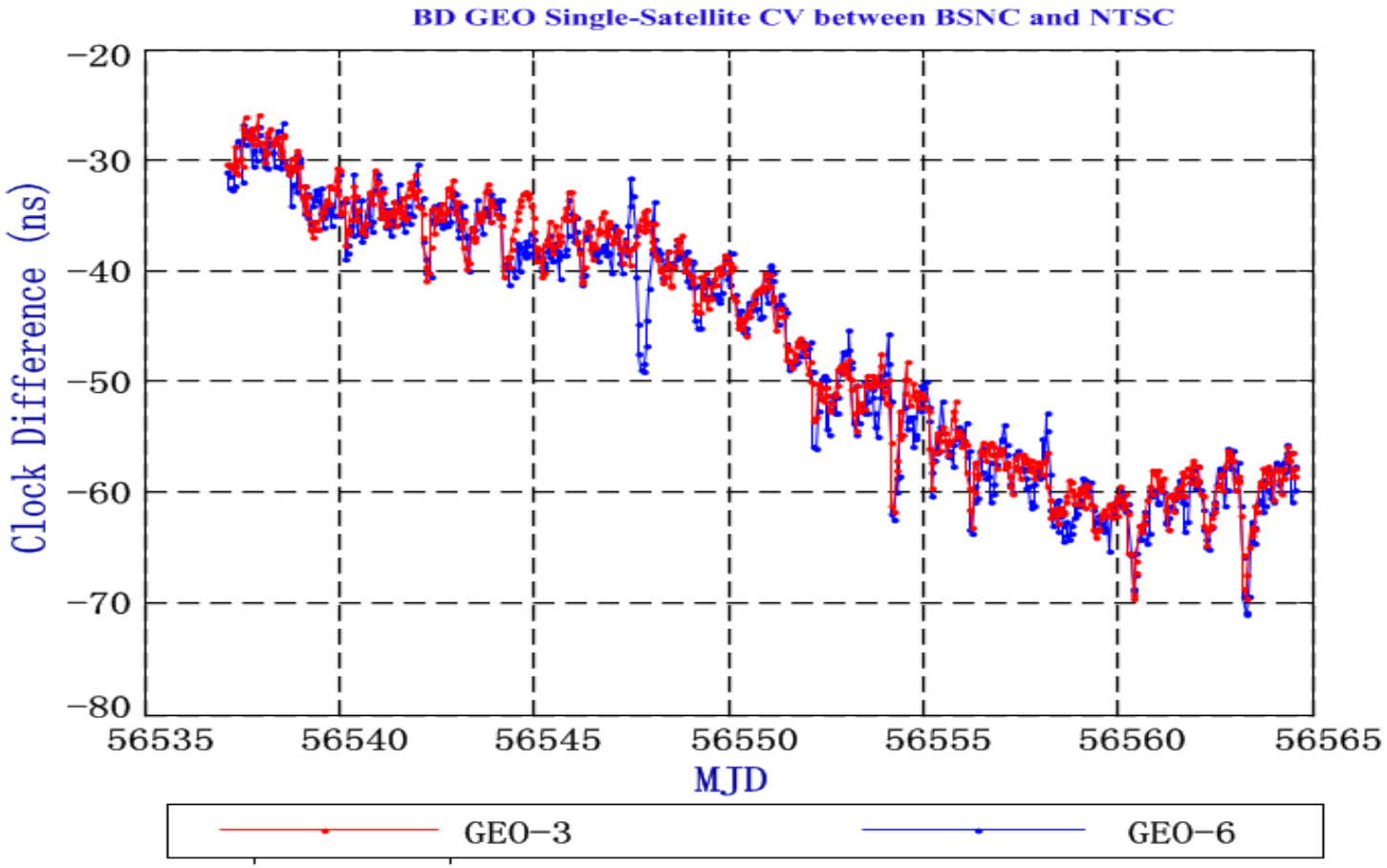
Time difference between BDT and UTCr

Item	Max/ns	Min/ns	Mean/ns	Std/ns	RMS/ns
|UTCr-BDT|	83.65	9.91	48.30	22.40	53.23



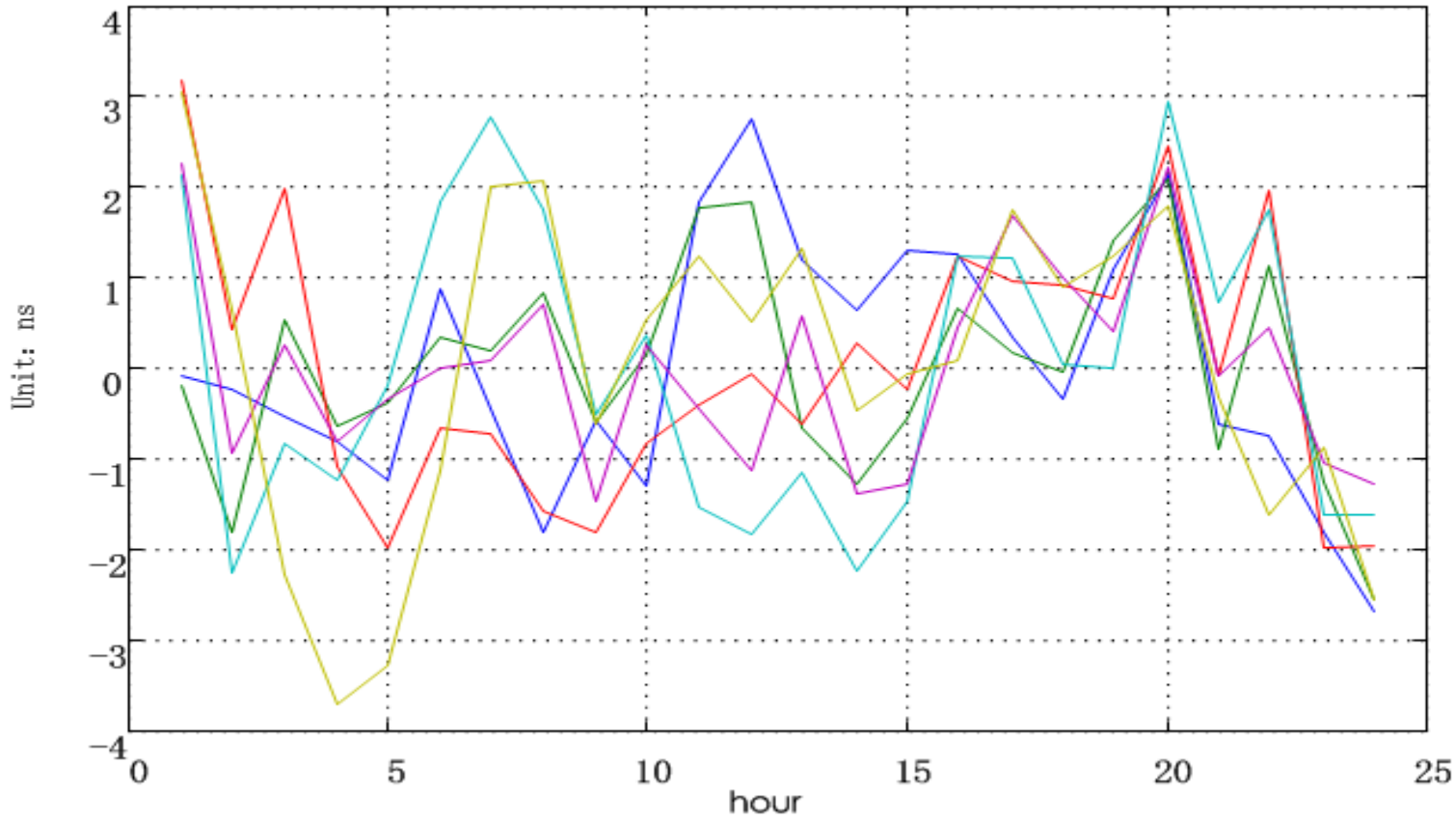
2. BDS time transfer

- **BDS CV based on single GEO satellite**



2. BDS time transfer

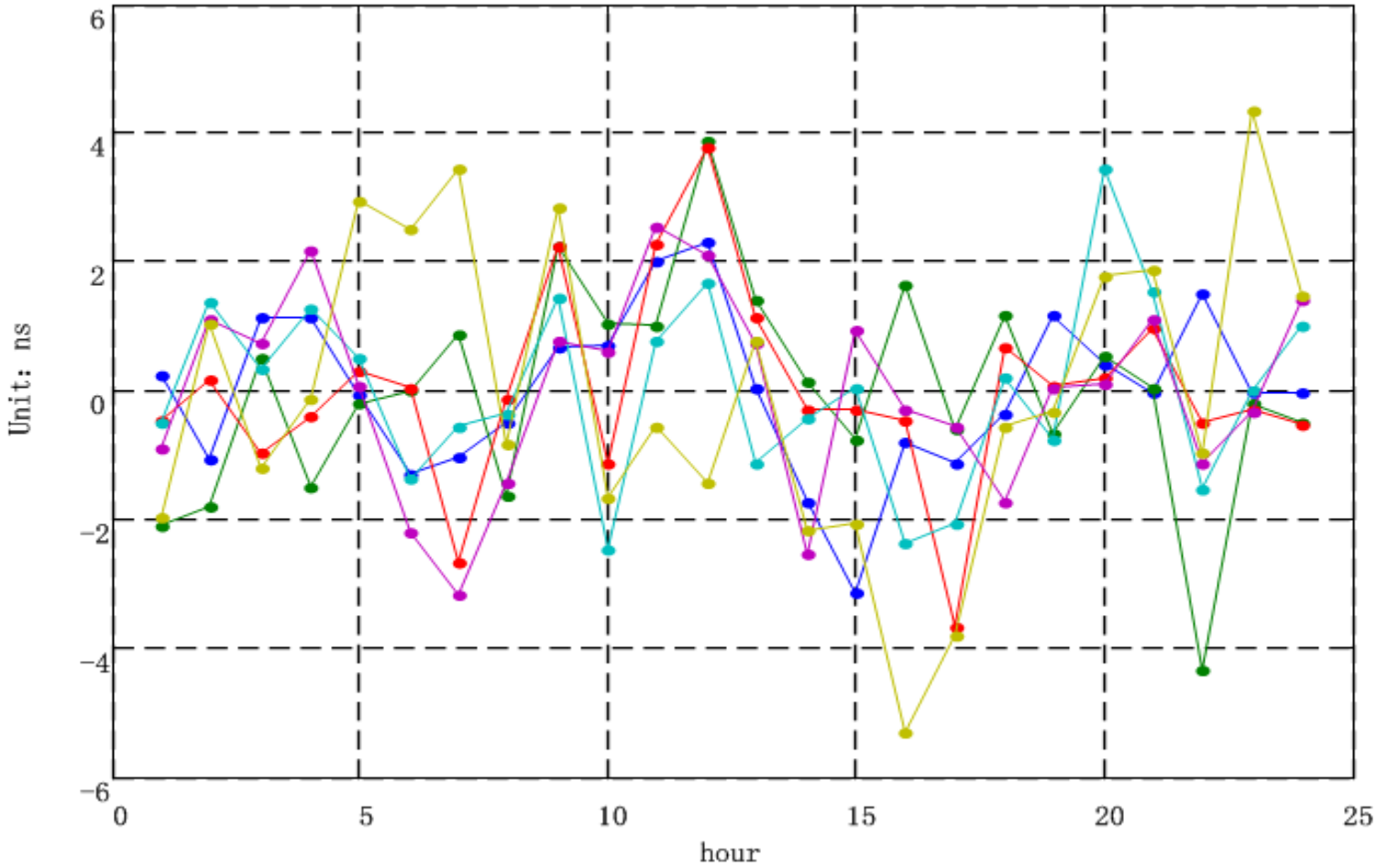
BDS CV based on single GEO satellite



Daily Residual Error of BD GEO3 Single-Satellite CV from MJD56538 to MJD56543

2. BDS time transfer

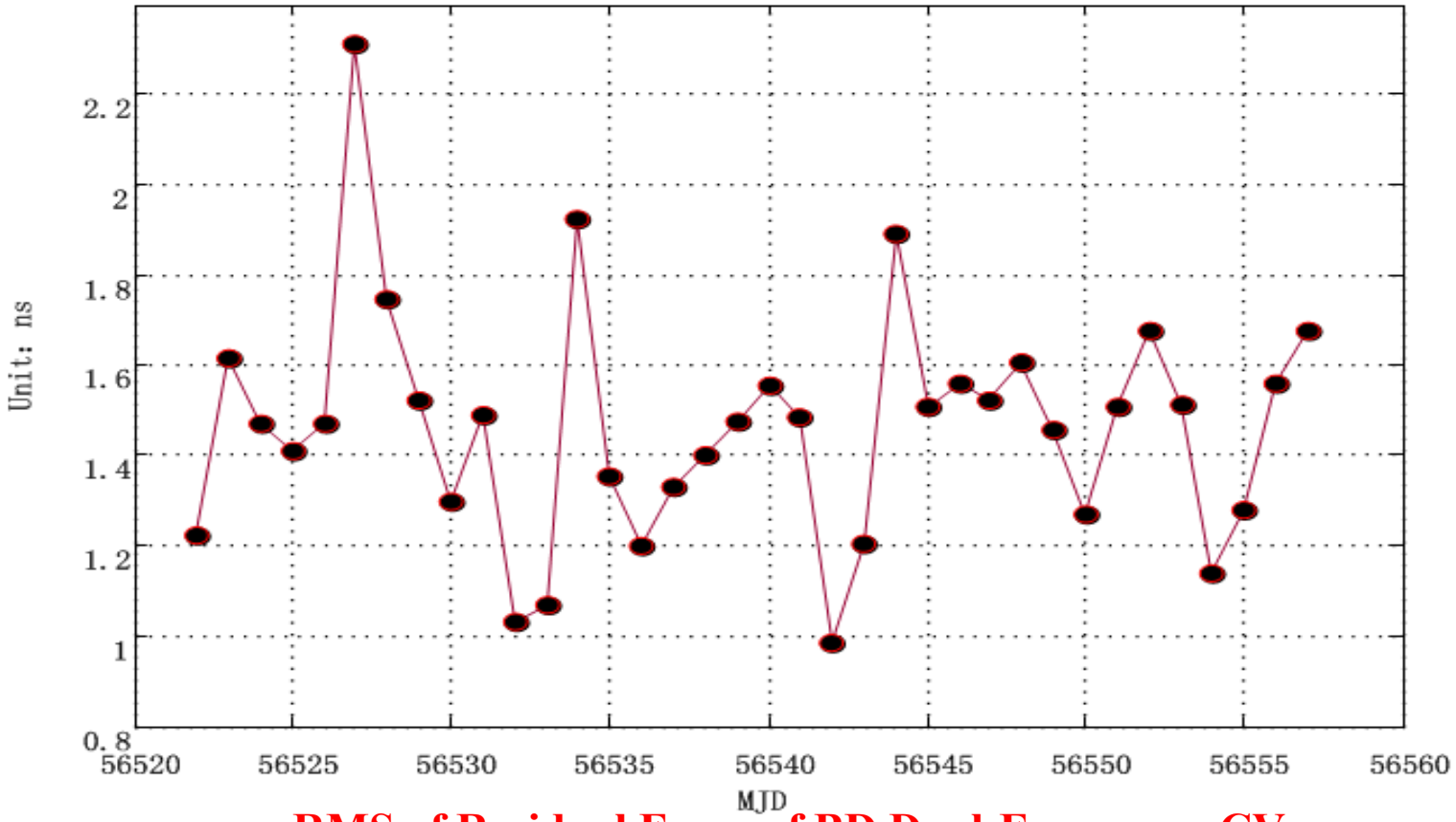
BDS dual-frequency CV



Daily Residual Error of BD Dual-Frequency CV from MJD56522 to MJD56527

2. BDS time transfer

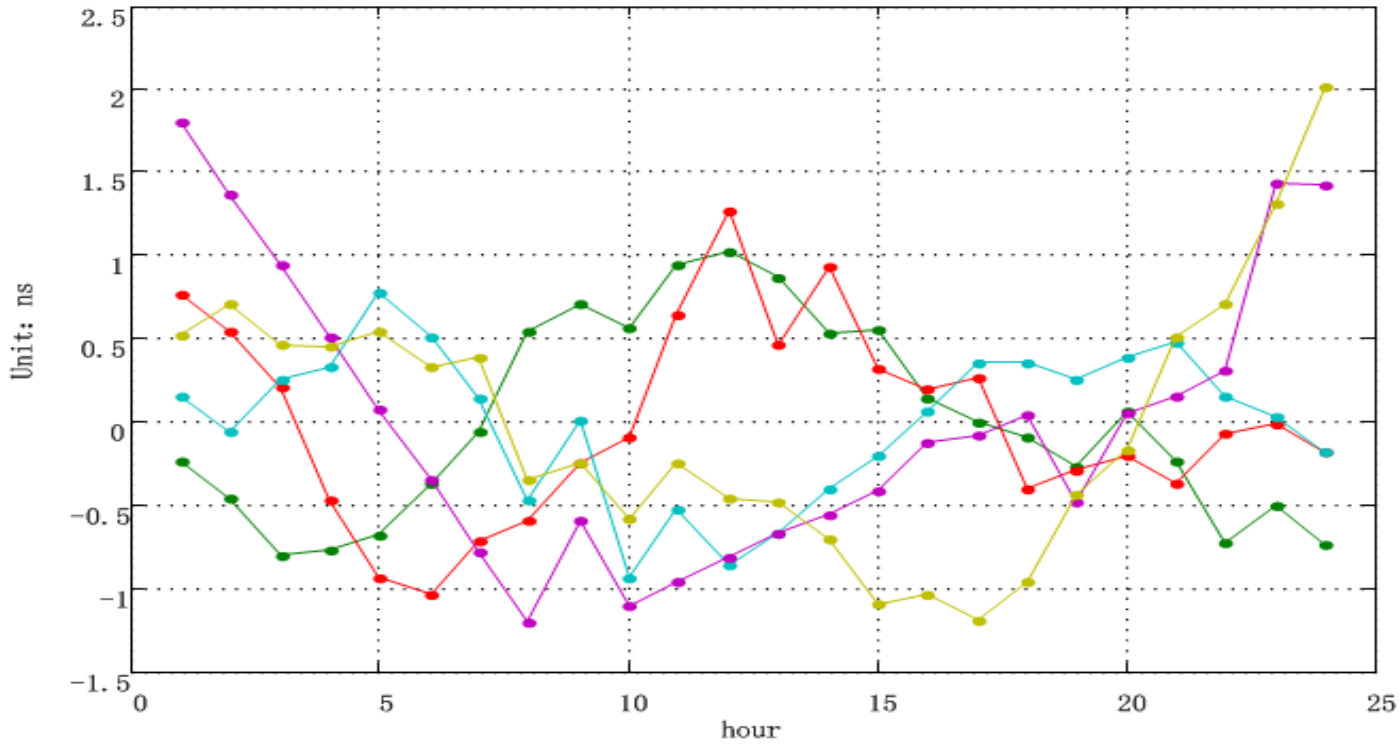
- **BDS dual-frequency CV**



RMS of Residual Error of BD Dual-Frequency CV

2. BDS time transfer

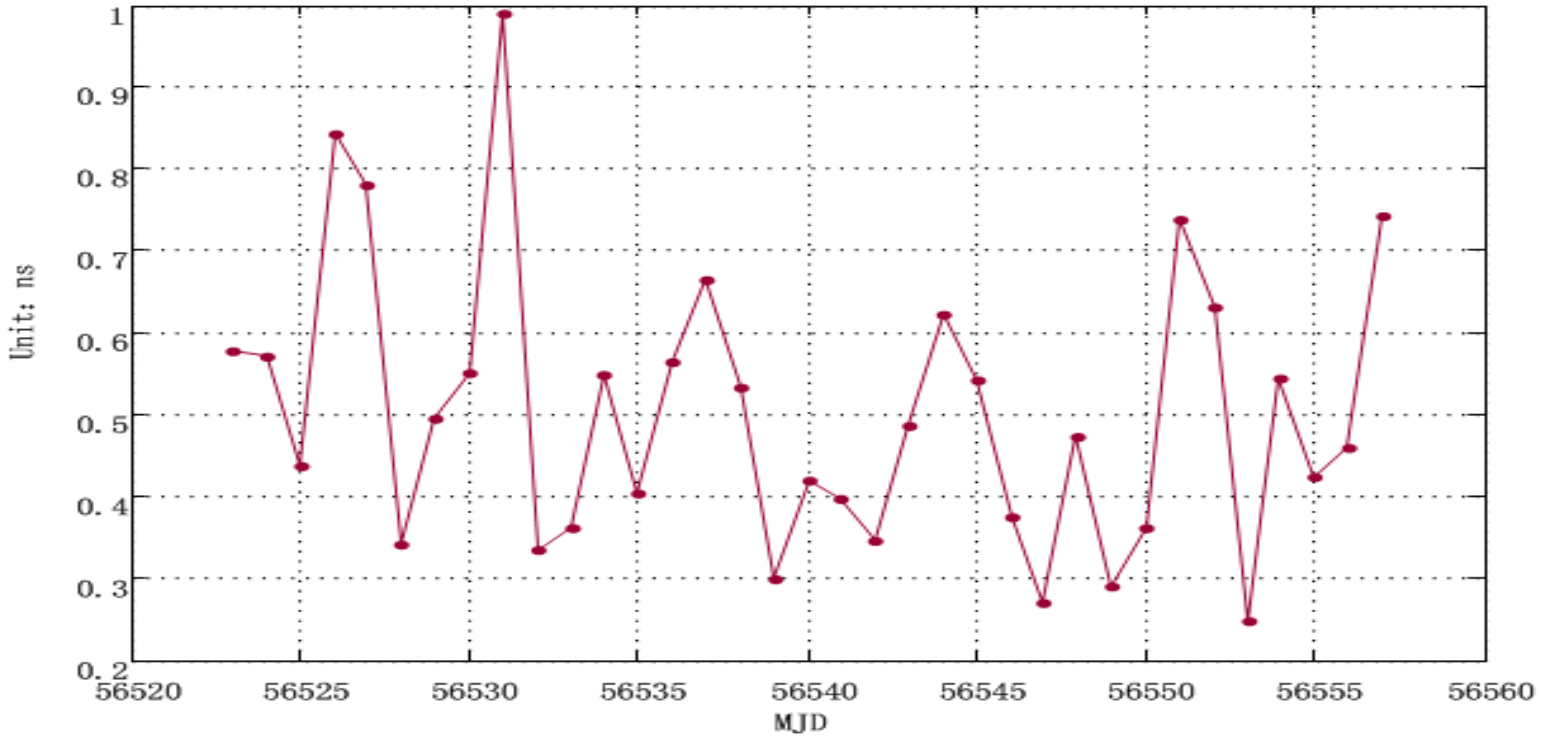
- **BDS C band TWSTFT based on GEO satellite**



Daily Residual Error of BD C Band TWSTFT from MJD56522 to MJD56527

2. BDS time transfer

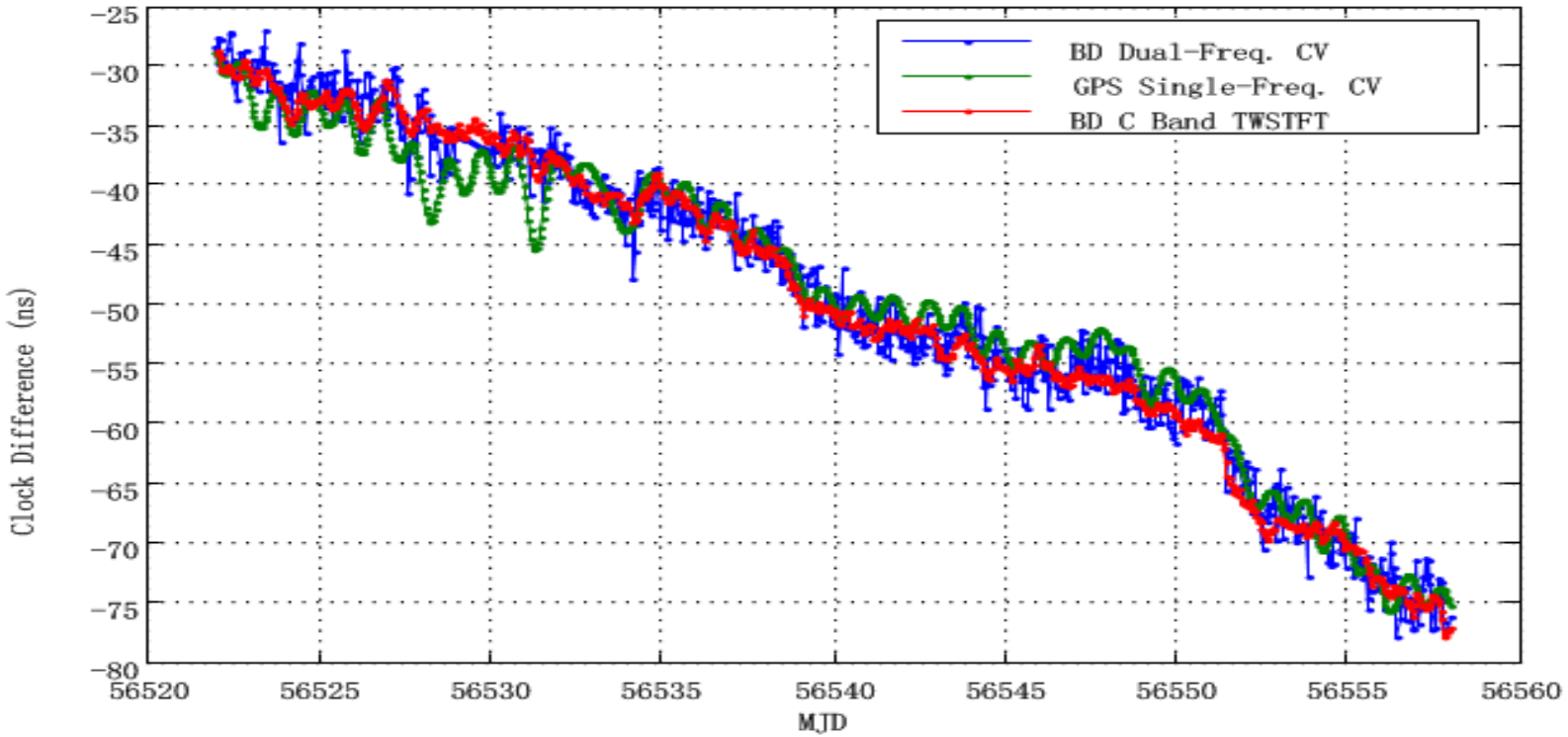
- **BDS C band TWSTFT based on GEO satellite**



RMS of Residual Error of BD C Band TWSTFT

2. BDS time transfer

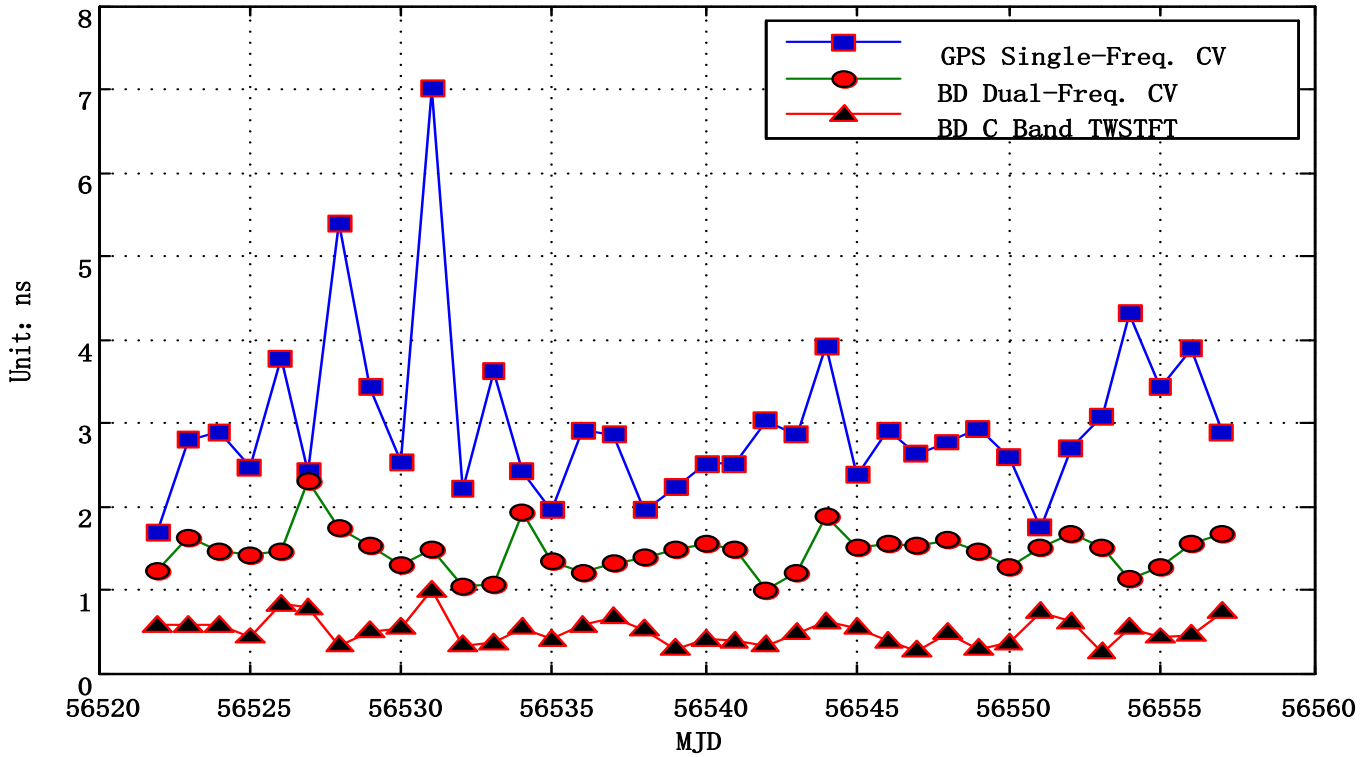
- **Different Time Transfer Modes between BSNC and NTSC**



Comparison of Different Time Transfer Modes

2. BDS time transfer

- **Different Time Transfer Modes between BSNC and NTSC**



RMS of different time transfer modes

3. On the future of UTC

Background:

WRC-15 Agenda Item 1.14:
to consider the feasibility of achieving a continuous reference time-scale, whether by the modification of coordinated universal time (UTC) or some other method, and take appropriate action, in accordance with Resolution 653 (WRC−12)

ITU-R WP7A is the responsible group for this agenda item is the responsible

3. On the future of UTC

Background:

At the latest WP7A meeting held in May 2014 in Geneva, Draft CPM text was agreed at WP7A and the following Methods are proposed:

Method A

- **Method A1:**
  - **-Stopping the insertion of leap seconds in UTC.**
  - **-To be effective no less than 5 years after the Final Acts**
  - **-The difference between UT1 and UTC will continue to be provided by IERS**
  - **-The name of UTC will be retained.**
- **Method A2:**
  - **- Similar to Method A1**
  - **-Change the name of UTC.**

Method B

-Retain UTC as currently defined

-Introduce a continuous reference atomic time-scale based on

TAI with an offset

-To be broadcast on an equal basis

Method C

- **Method C1:**

-No change in definition of UTC in order to avoid any confusion.

-Amend Recommendation ITU-R TF.460-6 to make clear that use of TAI is an acceptable alternative.

-TAI can be derived from UTC using a difference figure which is also broadcast.

- **Method C2:**

-Similar to Method C1

- except for Recommendation ITU-R TF.460-6

3. On the future of UTC

Preliminary Views：

- ✓ A continuous and uniform time scale is the basic goal of the eternal pursuit of science and technology.
- ✓ The irregular insertion of leap seconds in UTC is very inconvenient or troublesome for users that require continuous time scales.
- ✓ The definition of international standard time must keep some relation with the mean solar time or UT1, the base of civil time is always the sunrise and sunset.
- ✓ The dissemination of two “standard” time-scales might bring significant risks of confusion.

3. On the future of UTC

Preliminary Views：

- ✓ A continuous international reference time-scale can be achieved by stopping the insertion of leap seconds in UTC. And as the de facto international standard time, UTC should give up the role of the approximate EOP.
- ✓ As an approximation of UT1, UTC has wide applications in astronomy, geodesy and space science. If stop the leap seconds, hardware and software in some systems need some adaptive modifications. And this work will take time and money.
- ✓ GNSS should provide EOP service.

3. On the future of UTC

Preliminary Views：

- ✓ **Suppression of leap seconds reduces the risk of operator error and increases the reliability of systems that depend upon time. It has no negative impact on the normal operation of the Beidou system.**
- ✓ **Taking into account the long use history and wide application of UTC , the reform of UTC should be treated with caution and the implementation time need not to be rushed. The name and continuity of UTC should keep unchanged.**

Then the best choice is the Method A1

4. Summary

a) The time offset between BDT and UTC was kept within 100ns.

b) The precision of TWSTFT based on BDS GEO satellite(C band) is better than 1 ns. The precision of BDS CV is better than 2 ns.

c) The elimination of leap seconds have no negative impacts on the operation of BDS.

d) The best choice for the future of UTC is the Method A1.

Thank you!

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