

TL STATION REPORT

National Time and Frequency Standard Lab.
Telecommunication Laboratories, Taiwan

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**14th Meeting of the CCTF WG on TWSTFT
September 10-12, 2006
Paris Observatory, Paris, France**



Topics

- **Reference clocks**
- **Earth stations and Equipments**
- **Links**
- **Improvements at TL**
- **Future Works**



Reference clocks

➤ **Cesium clocks :**

Agilent 5071A high performance × 9

➤ **Active H-masers:**

CH1-75 × 2 (with CAT)

➤ **Time Scale:**

UTC(TL):

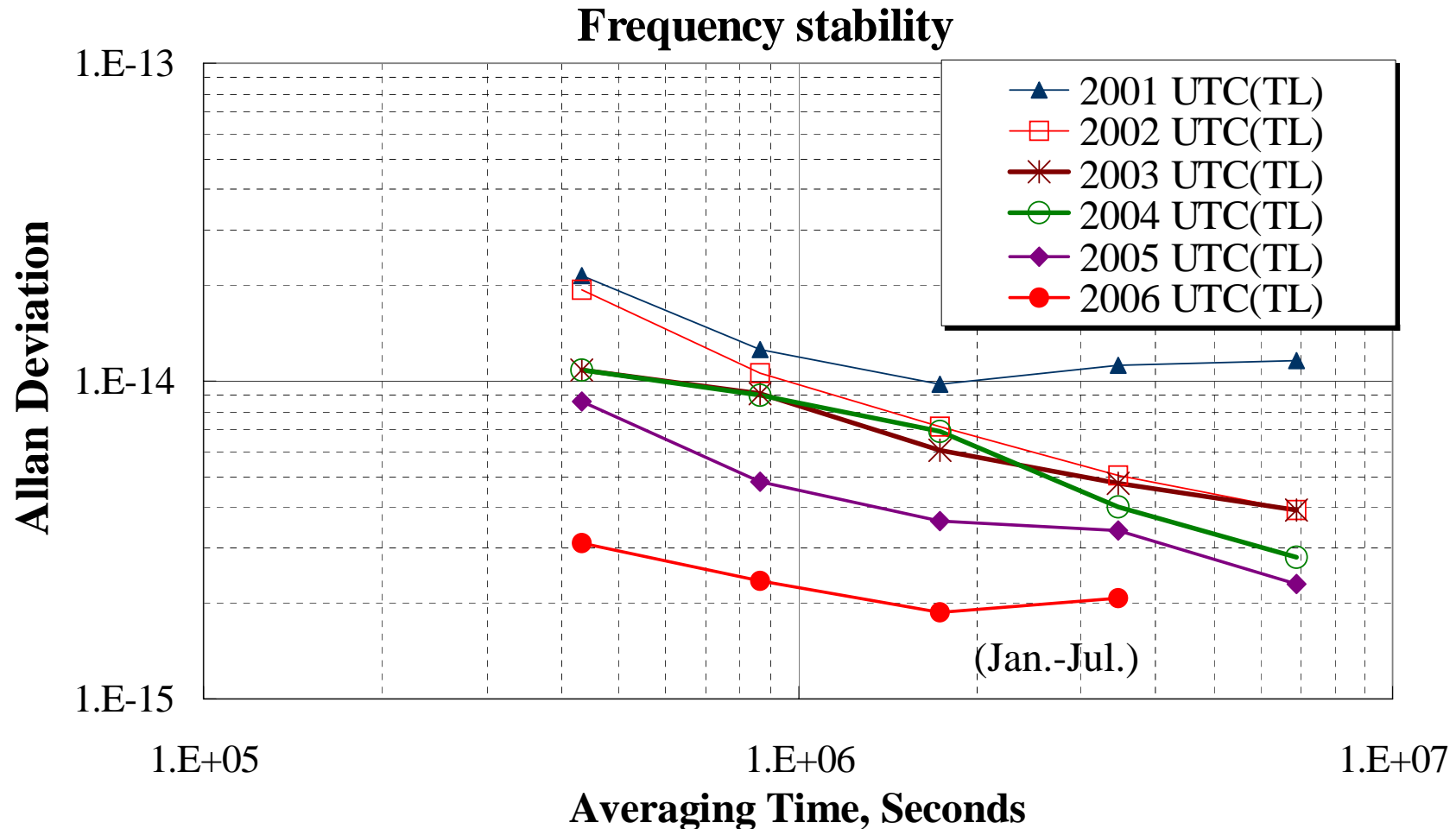
- **HM 76053 → Microphase stepper(AOG)→UTC(TL)**

TA(TL):

- **Agilent 5071A cesium clock ensemble**
- **Inversely exponential weighting**



Stability Plot

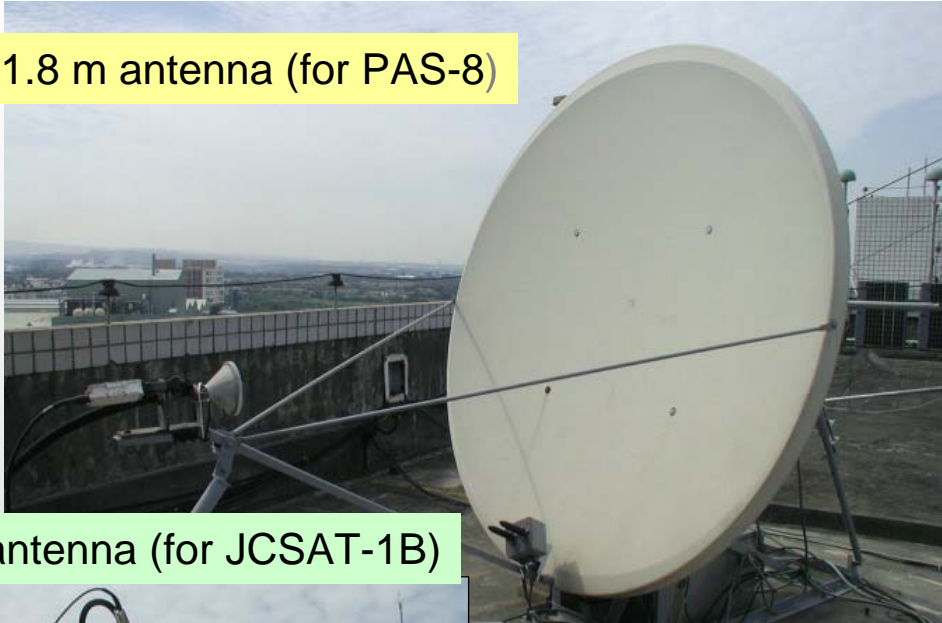


Earth stations (same as last year)

Earth Station	TL-01	TL-02	TL-03	TL-04
Labs to be linked	Test	NICT, KRISS, NTSC, NMIJ, SG	VSL	-
Satellite	PAS-8	JCSAT-1B	PAS-4	-
Band	Ku	Ku	Ku	C
Antenna	Prodelin-1194 1.8 m	Andrew 2.4 m	Andrew 2.4 m	Andrew 4.6 m
Modem	SATRE (073) S/W: 4.11.8	NICT muti- channel	SATRE (066) S/W: 4.11.8	SATRE(063)
UP/Down Converter	Codan 5900 (8W) (5908 SSPA, 5582 Power Supply Unit)	Codan 5900 (8W) (5908 SSPA, 5582 Power Supply Unit)	Codan 5900 (8W) (5908 SSPA, 5582 Power Supply Unit)	EFDData CST-5000 Satellite terminal
IF Cable	Andrew SFJ1-50A	Andrew SFJ1-50A	Andrew SFJ1-50A	Andrew SFJ1-50A
Counter	SATRE internal	NICT internal	SR-620	HP5370B
OP and Analyzing Software	-	Operated by NICT	Automation operating by TL	-
Others	SATSIM (Satellite simulator)	Power Splitter and 70 MHz BP filter	Power splitter and VHF switch	-

Antenna dishes (same as last year)

Prodelin 1.8 m antenna (for PAS-8)



2.4 m antenna (for PAS-4)



2.4 m antenna (for JCSAT-1B)

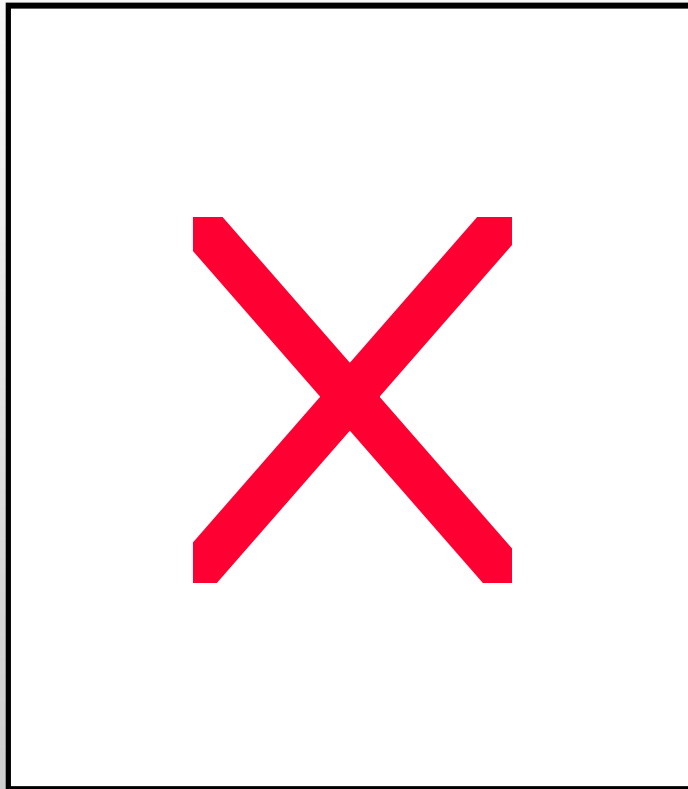


4.6 m antenna (for NSS-5)

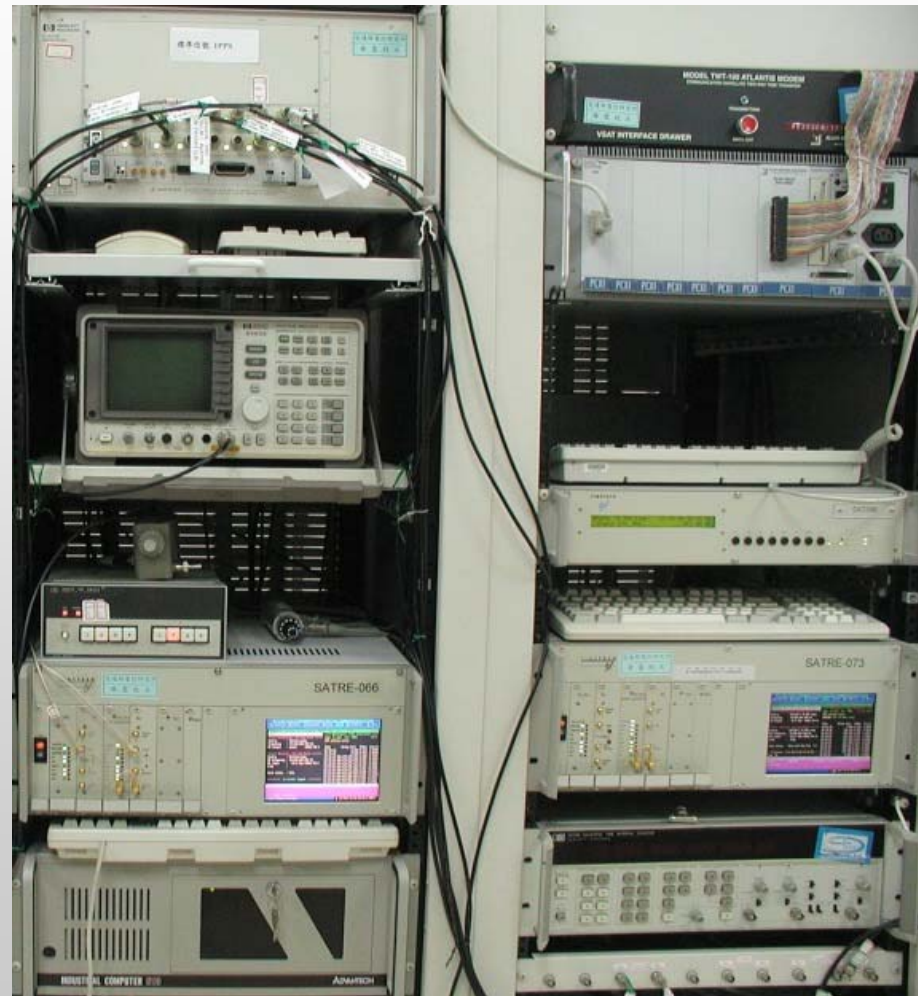
Standard Time and Frequency Lab

Modems (same as last year)

NICT modem (Provided by NICT)



SATRE modems (1 ch) x3



GPS Equipments

GPS MC	GPS P3, CP
Topcon EURO-80	Ashtech Z12T

TL's GPS MC data are put on TL's ftp site.

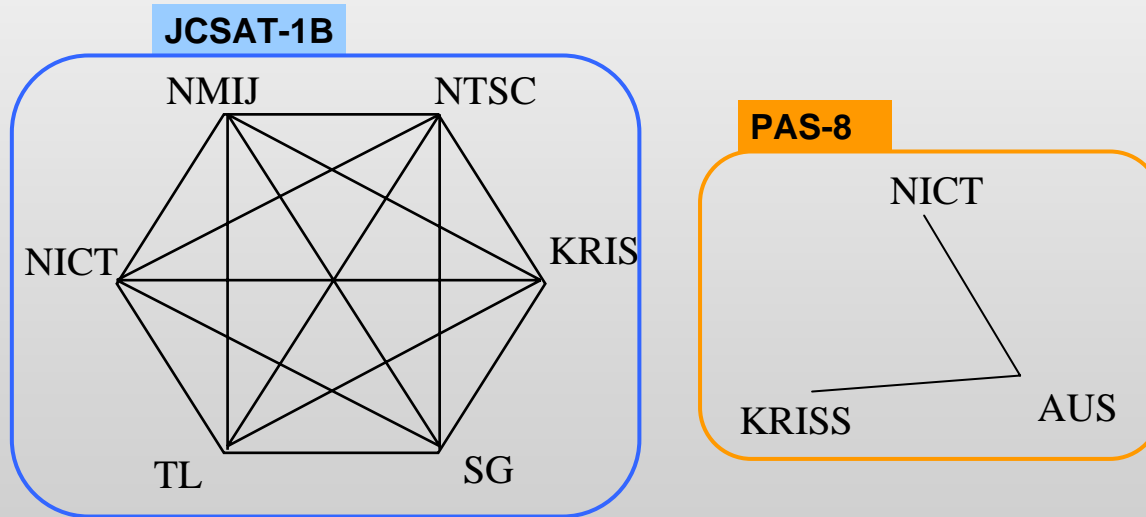
<ftp://ftp.stdtime.gov.tw/pub/gps/gpscvt/topcon>



A. Cooperation between NICT and TL

On TWSTFT

- ❑ From Mar. 2003, began the test of the NICT modem.
- ❑ From Feb. 2005, began the regular observations by using NICT modem
More than 24 points/day
Remote control by internet
To form a Asia TWSTFT networks of AUS, KRIS, NICT, NMIJ, NTSC , SG, and TL



- ❑ In 2006, first calibration of NICT-TL link by portable station

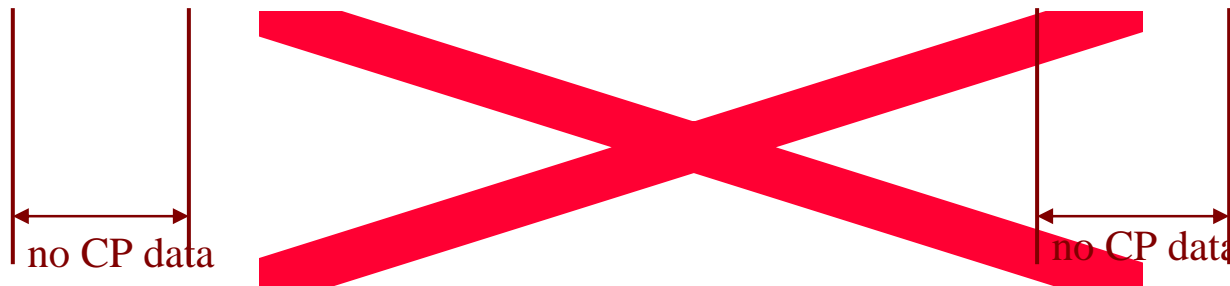


NICT-TL

(comparison between TW and GPS data)



Std. Dev. = 694 ps (only on that CP data are also available)

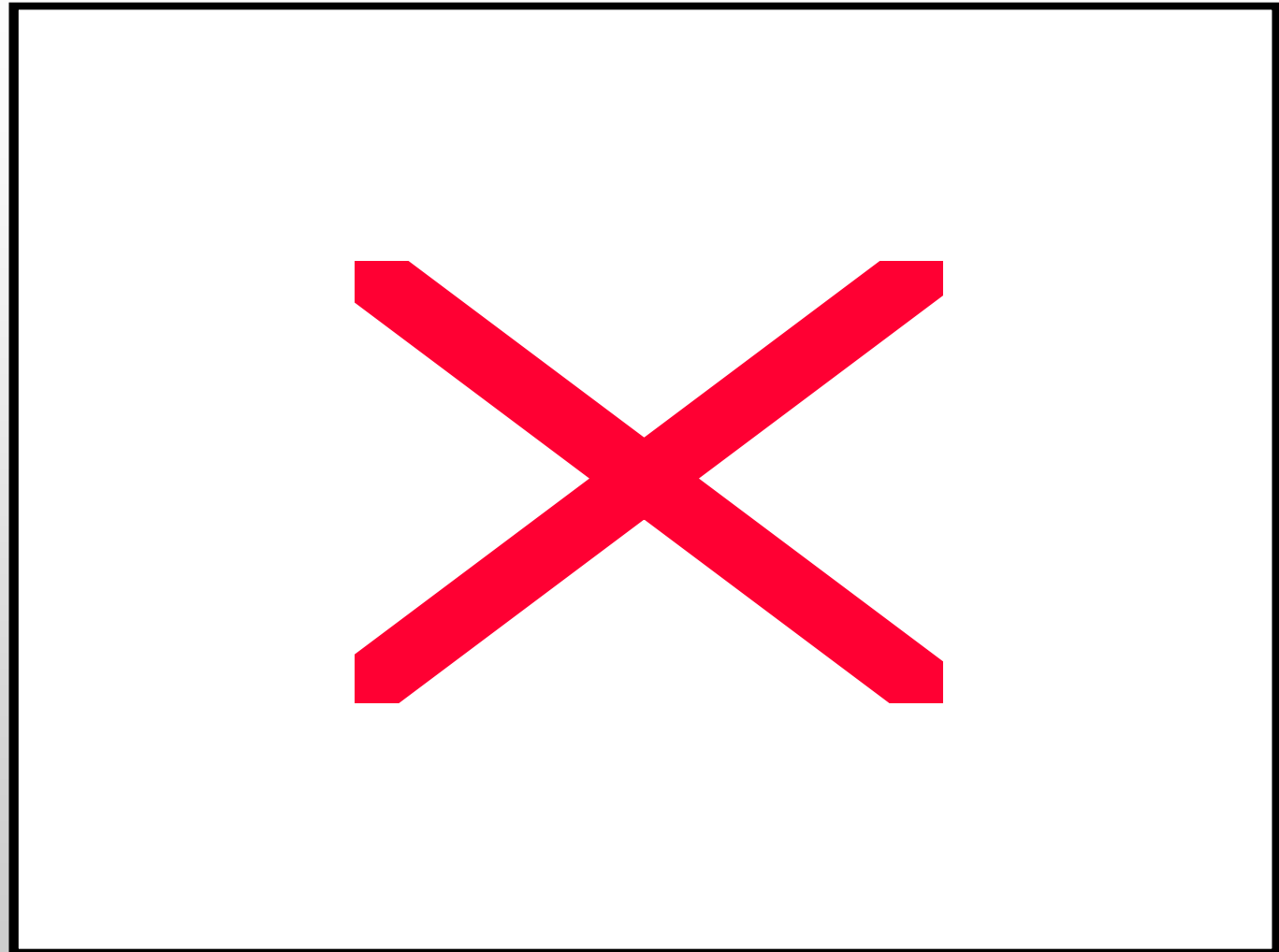


Calibration of NICT-TL link by portable station

2/17-2/20/2006:
Calibrate at NICT

2/26-3/4/2006:
Calibrate at TL

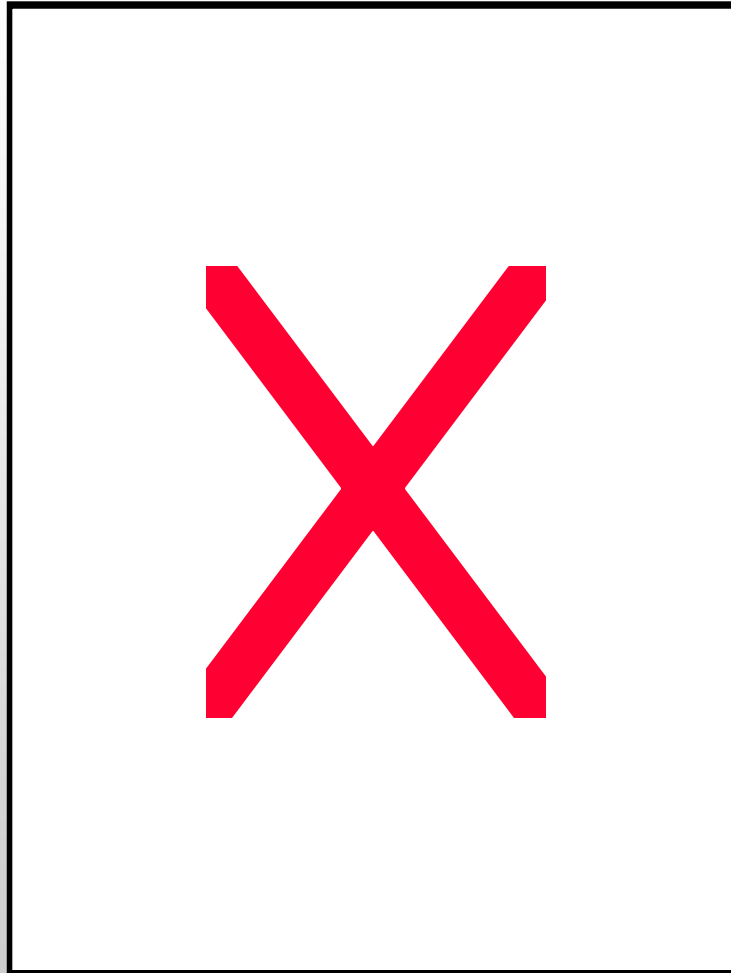
3/15-3/16/2006:
Return to NICT and
Calibrate again



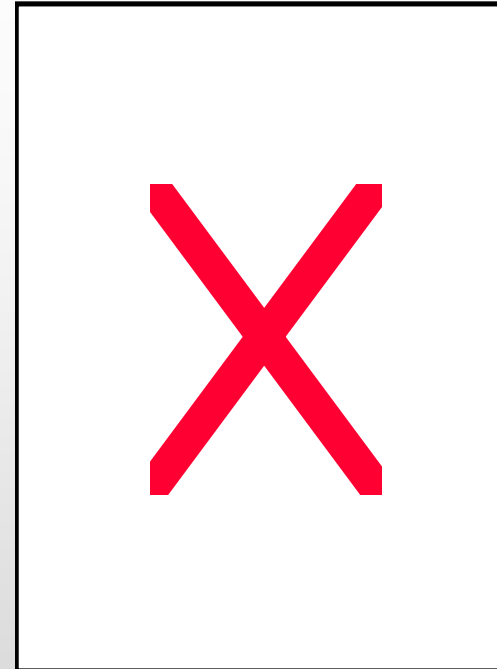
2006/3/2 at TL



Calibration of NICT-TL link by portable station



2 channel modem, up/down converter, counter and control PC



E/O and O/E converter for uplink & downlink signal via optical fiber



Calibration of NICT-TL link by portable station

For TL-NICT link

- Difference of earth station delays

$$0.5(d_{NICT} - d_{TL}) = 152.378 \text{ ns}$$

$$U = \boxed{\text{X}} = \boxed{\text{X}} = 1.148 \text{ ns}$$

- Sagnac effect = -63.090 ns

- CALR (TWSTFT) = 89.288 ns [2006] ($u_A = 0.26 \text{ ns}$, $u_B = 1.12 \text{ ns}$)

BIPM:

$$\text{CALR (GPS P3)} = 89.006 \text{ ns [2005]} (u_A = 0.7 \text{ ns}, u_B = 5 \text{ ns})$$



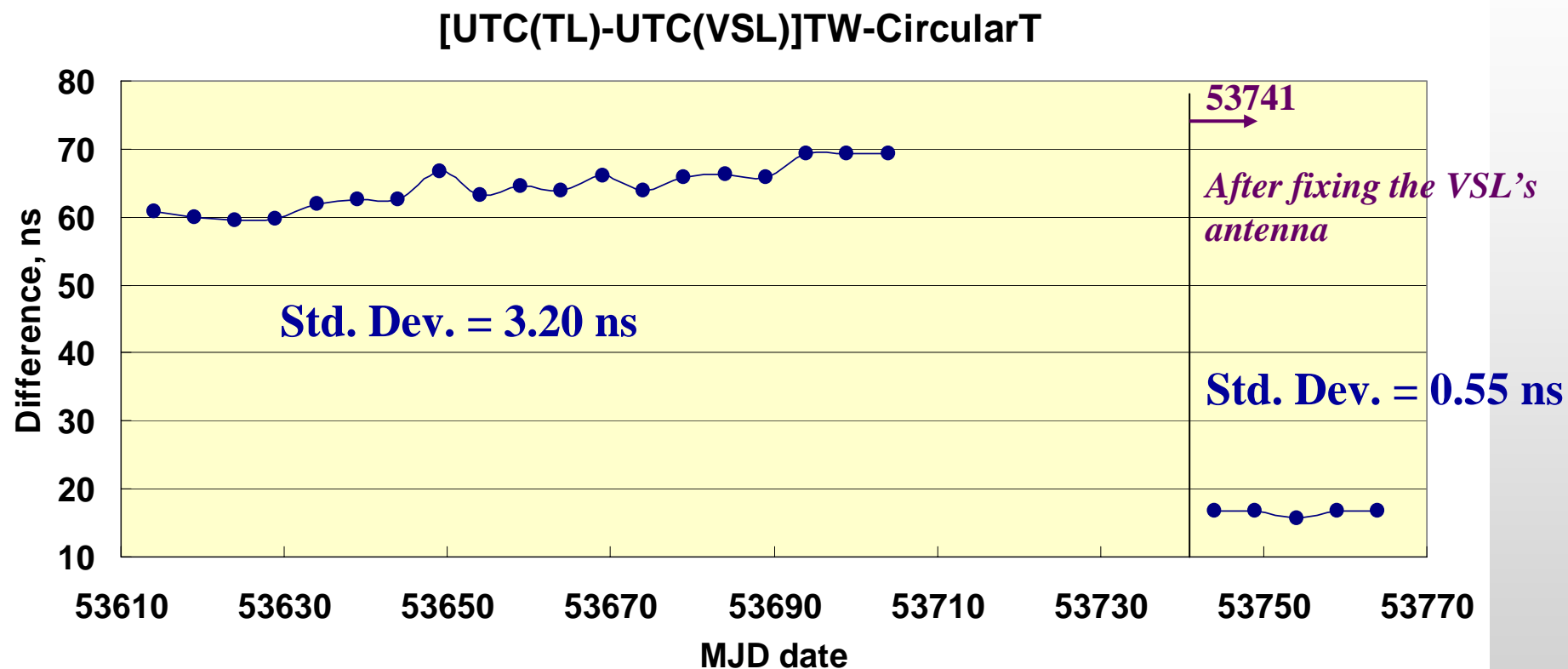
B. Recent Events for VSL-TL link

- ❑ From 2005/9/2 (MJD 53615): Automate the daily measurements and data processing
(3 sessions from 7:38 UTC to 7:48 UTC)
- ❑ 2005/12/4-2006/1/5 (MJD 53708-53740): Antenna of VSL was being repaired
- ❑ 2006/2/06- now (MJD 53772-now): **Transponder** of different polarizations for U/L and D/L at TL **is all occupied**
- ❑ Aug. 2006: TL upgraded OMT for solving the polarization problem
- ❑ Sep. 2006: Pretest for the VSL-TL link

(TL's ftp site [ftp.stdtime.gov.tw/pub/twstft](ftp://ftp.stdtime.gov.tw/pub/twstft))



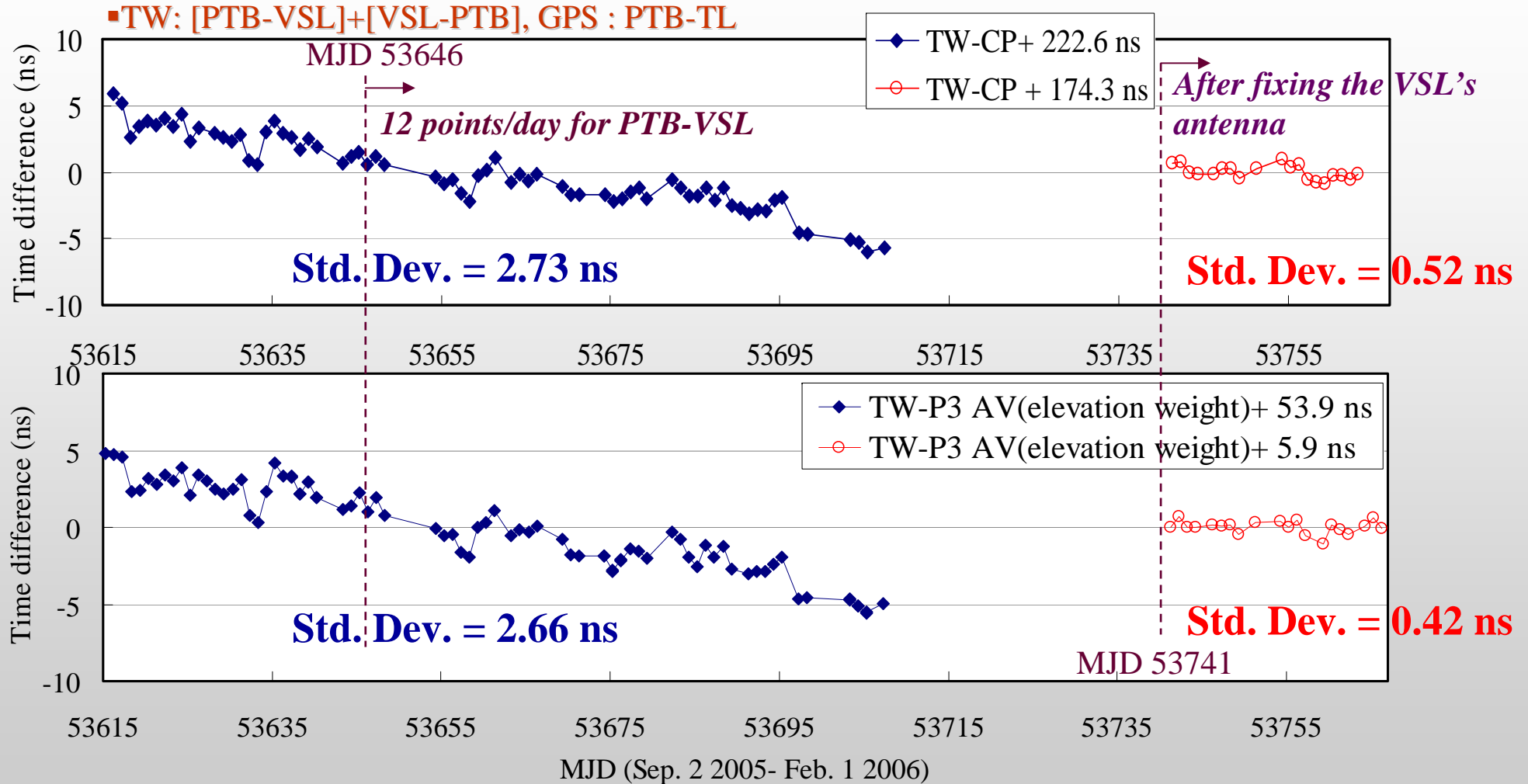
Recent results



- The computation TL/VSL TWSTFT link has not yet been calibrated by Circular T, but is corrected with EARTH ROT.CORR. (Sagnac effect = -273.89 ns).



PTB-VSL+VSL-TL



■ The VSL-PTB data is calculated by linear interpolation for the dates at MJD+0.3215



Improvements

- ❑ **Using TIC(SR620) to monitor UTC(TL) and 1PPSTX of NICT modem**
- ❑ Upgrading OMT for PAS-4 link
- ❑ Successful TX/RX test on SATRE modem by using 2.5MHz chip rate on 2.5MHz BW with a SAW filter provided by NICT



Future Works

- **Cooperate with NICT, USNO, NIST on Hawaii links**
 - **Transfer TWSTFT signal via Hawaii**
 - **USNO/NIST – Hawaii – NICT/TL links**
 - **Global TWSTFT links will be established in the near future**
- **Link With PTB, OP, IEN (planning)**
 - **Using SATRE modem**
 - **PAS-4 (sharing the transponder of NICT-PTB link, and using the SAW filter for the 2.5 MHz Bandwidth)**
- **Use SATSIM to measure the earth Station delay**
 - **The SATSIM system will be applied to the VSL-TL TWSTFT link for calibrating the delay variations of their earth stations.**



More interesting topics

- To analyze the closure loop for TWSTFT networks
- TWSTFT based on carrier phase

