Introduction to National Standard Time and Frequency Lab., TL

Shinn-Yan Lin

Associate Researchers, TL

■ Clocks and Time scales

- ➢ **Cesium clocks :**

  HP 5071A high performance × 7,
  HP 5061B high performance × 1
  Cs300, Cs474, Cs160 are under fixing (tube change)

- ➢ **Active H-masers CH1-75 (Tuned) × 2Cs809 → Micro-stepper → UTC(TL).**

  ∗ From July 2000, new AOG 110 × 2

■ Time Transfer

- . GPS and Glonass Common-view

  TTR6 × 2, datd in CCDS format → BIPM
  3S GPS/Glonass multi-channel receiver
  Ashtech Z-survery × 2, Z-12T × 1

- GPS Carrier Phase Freq and Time Trans
  with NML

- Two-way Satellite Time Transfer

  NIST modem × 2,
  SATRE modem × 2,
  AOA modem ×1,

Ku band station × 2,	1.8m with CRL
	2.4m (Sep., 2000, with USNO)
C band station ´ 1	4.6m April 2000, with NML

※1.8 m earth station was damaged by Bilis Typhoon

- Time transfer using optical fiber

  Short-term stability 260ps through 5m single mode fiber

The Influence of Different TWSTT Receive and Transmitter Codes

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Abstract

Two Satre modems (Satre modem 063 and 066) were used in testing different TWSTT standard transfer and receiver codes. Two modems use the same reference clock (5 MHz and 1 pps input come from UTC (TL)). The moderated signal did not pass through any earth station and satellite but replaced by a 50-ohm BNC cable, attenuator, and filter. We find that the different receiver code did make different delay; the largest difference is about 150 ps. Similar test used NIST modem also done to compare with Satre modem. The result is similar, but the largest difference between different codes combination is 1 ns.

Block Diagram

We used NIST modems and Satre modems to measure the difference. The 2 sets of modems were connected by BNC cables, Attenuator and filter directly. So that we avoid all the influences come from satellite and earth station, the only term can change the result is the combination of different transmitter and receiver codes. The block diagrams were shown in figure 1.

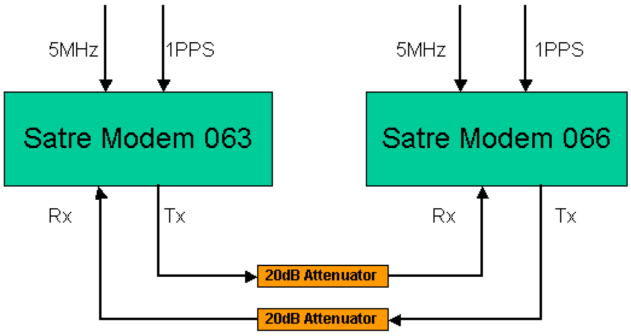

Figure 1

The temperature change during this experiment was about 2~5 degree C and all the lengths of cables were shorter than 2 meters. We could believe that the path delays are fixed or the variances were very small. The only term we changed was different set of Rx and Tx codes.

We repeated the test but the NIST modems were replaced by Satre modems, The block diagrams were shown in figure 2.

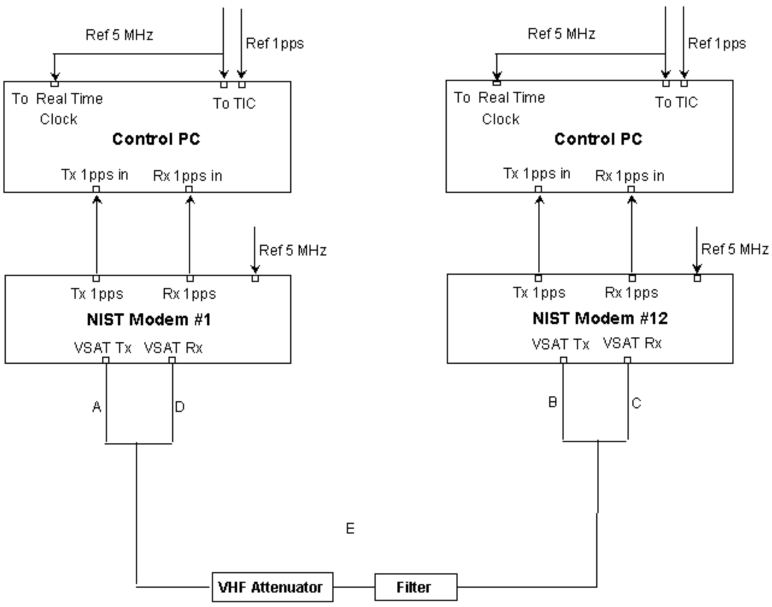

Figure 2

Result:

We recorded the TIC reading directly and plotted in figure 3 and 4. Rx codes were presented as x-axis and the delay y-axis. Both test showed the different Rx code did make different delay; the delay is the smallest when using Rx code 5 and is the largest when using Rx code 2. The difference of delay between code 5 and code 2 is about 1 ns (NIST modem) and 150 ps (Satre modem).

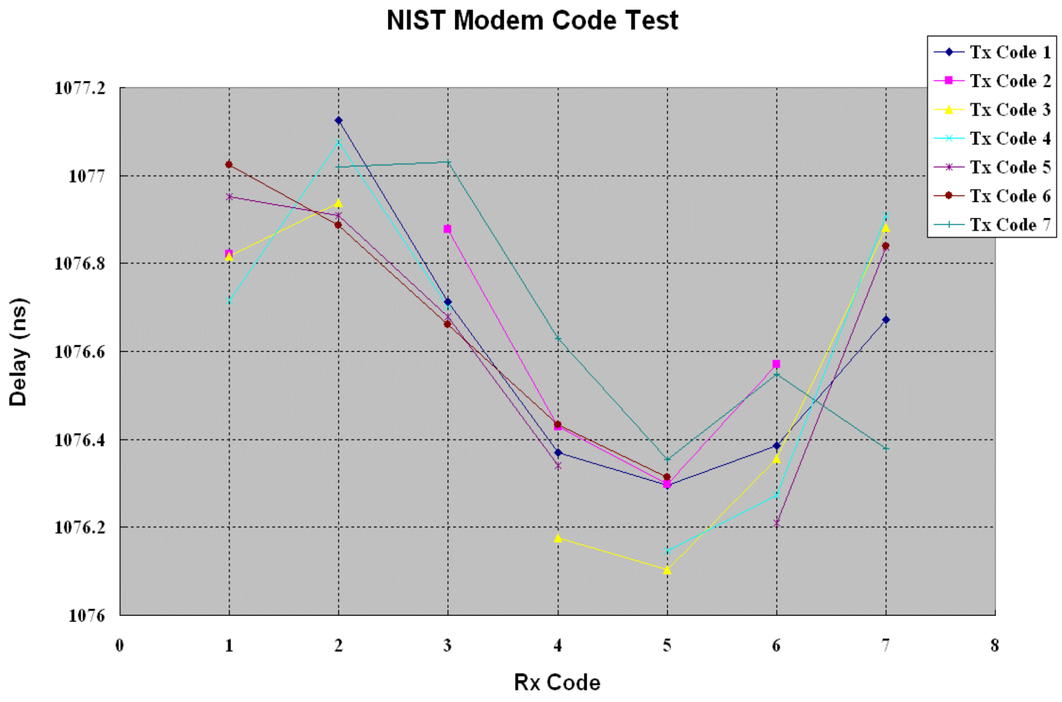

Figure 3

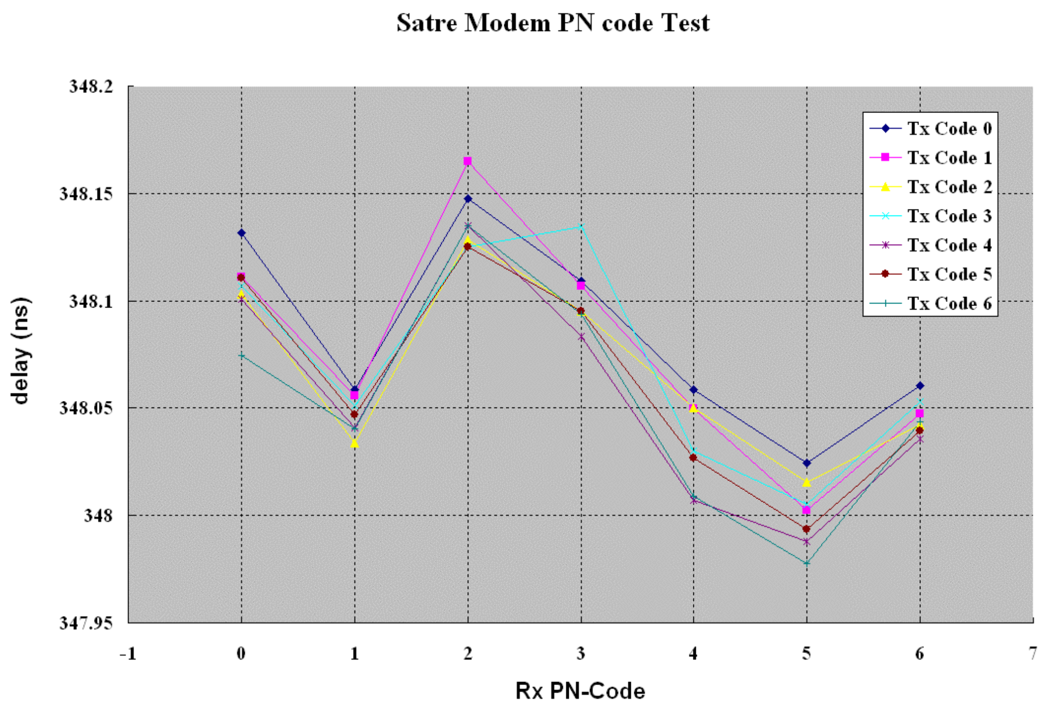

Figure 4

Conclusion

The uncertainty of long base line TWSTT experiment is about several ns, every term will cause more than 100 ps uncertainty should be concerned about. Although We find that the different set of transmitter and receiver code did make different measurement result and the NIST modem and Satre modem showed the same profile of sketch; but we still cannot explain that.

Acknowledgement

We very much appreciate Mr. Wayne Hanson and Mr. Victor Zhang who both work at NIST. Mr. Hanson lent us 2 sets of NIST modem; Mr. Zhang helped us to design the whole NIST modem test. This report cannot be finished without Mr. Hanson and Mr. Zhang.

Reference

[1] Ascarrunz, F. G., Jeffers, S. R., and Parker, T. E. (1997), "Earth Station Errors in Two-Way Time and Frequency Transfer", IEEE Transactions on Instrumentation and Measurement, Vol 46, pp.205-208.

[2] Kirchner, D. (1991). "Two-Way Time Transfer via Communication Satellites", IEEE Proceedings, Vol. 79, No. 7, July 1991, pp.983-990.