National Institute of Information and Communications Technology

NICT station report

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CCTF WG meeting on TWSTFT Sep. 5, 2012

Agenda

- Current status
- Interference problem in Rx frequency band of Eu-Asia link
- R&D status
  DPN
  Recent results by Carrier-phase TWSTFT

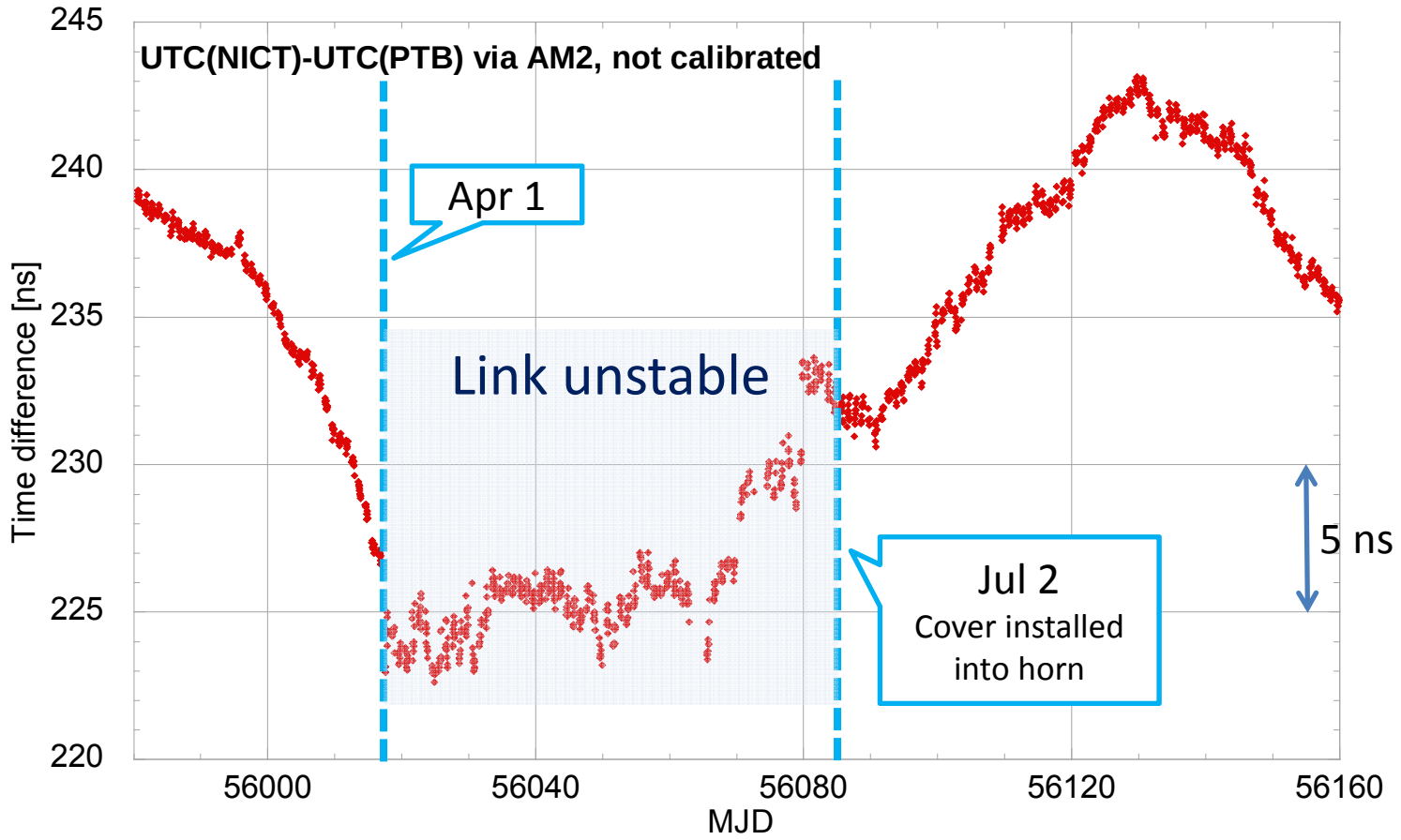
Current status

Same frequency

No.	Link	Satellite	BW [MHz]	Modem & Repetition	Objective	Participants
1	Asia	GE23	2.5	NICT, Once/hour	Monitor of clocks at LF stations (JJY40/60)	NICT, JJY40, JJY60, TL
2	Asia-Hawaii	GE23	2.5	SATRE, Once/hour	Connection with USNO	NICT, TL
3	R&D	GE23	0.2 x 2	AWG & sampler, Random	R&D using DPN, carrier-phase TWSTFT	NICT, domestic station, TL
4	Eu-Asia	AM2	2.5	SATRE, Once/hour (UTC 13-22h)	Contribution for TAI	NICT, NIM, NPLI, NTSC, PTB, SU, TL

AWG:
Arbitrary waveform generator

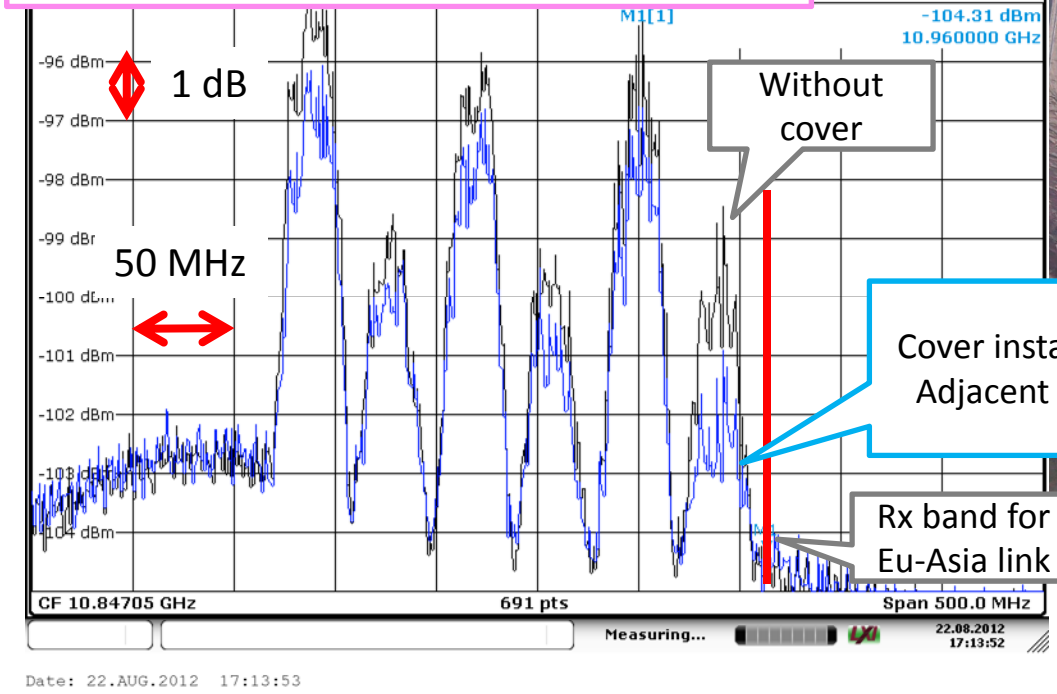
Interference problem for Rx band of Eu-Asia link at NICT

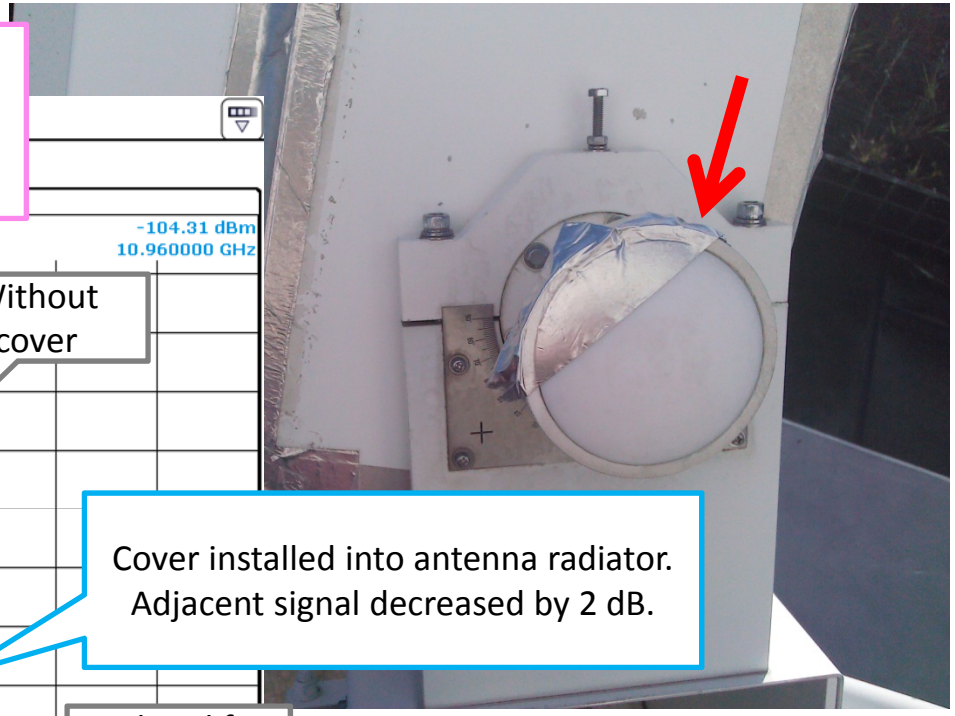


After April 1 in 2012, link stability at NICT degraded suddenly!

Interference problem for Rx band of Eu-Asia link at NICT

fc = 10.8475 GHz, span = 500 MHz
At 8:00 UTC; AM2 transponder was off.
Input signal of D/C





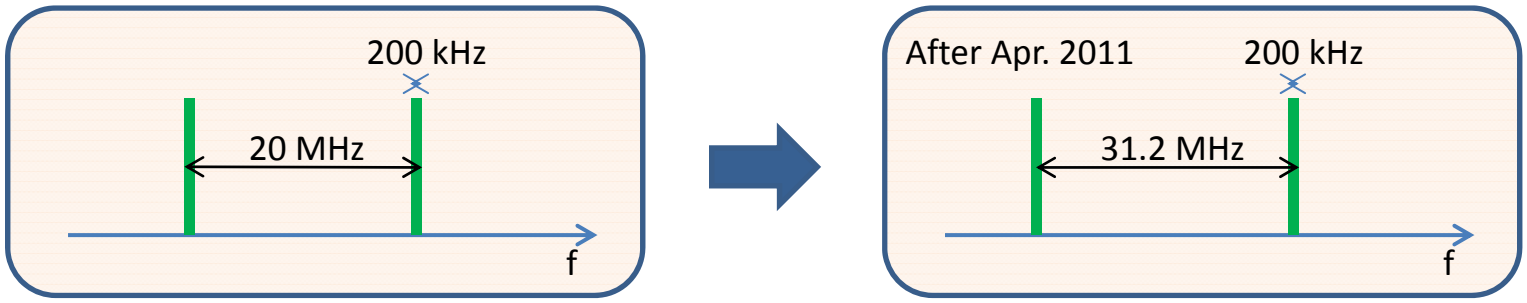
Cover installed into antenna radiator.
Adjacent signal decreased by 2 dB.

We found large signals in adjacent channels, which come from ground-ground communication for base stations of mobile phone.
Output power of LNA might be saturated.
Insertion of a BPF in front of LNA is planned.

R&D status - DPN-

DPN; Dual Pseudo random Noise

- DPN measurement via GE23 has been done
  in a newly allocated frequency band since April 2011.



σ: 20 ps　　σ: 12 ps

- The measurements with a domestic station or TL has been performed occasionally.
  Instability due to instrument will be compensated by additional measurement in internal calibration loop.
- Details will be presented by T. Gotoh in PTTI 2012.

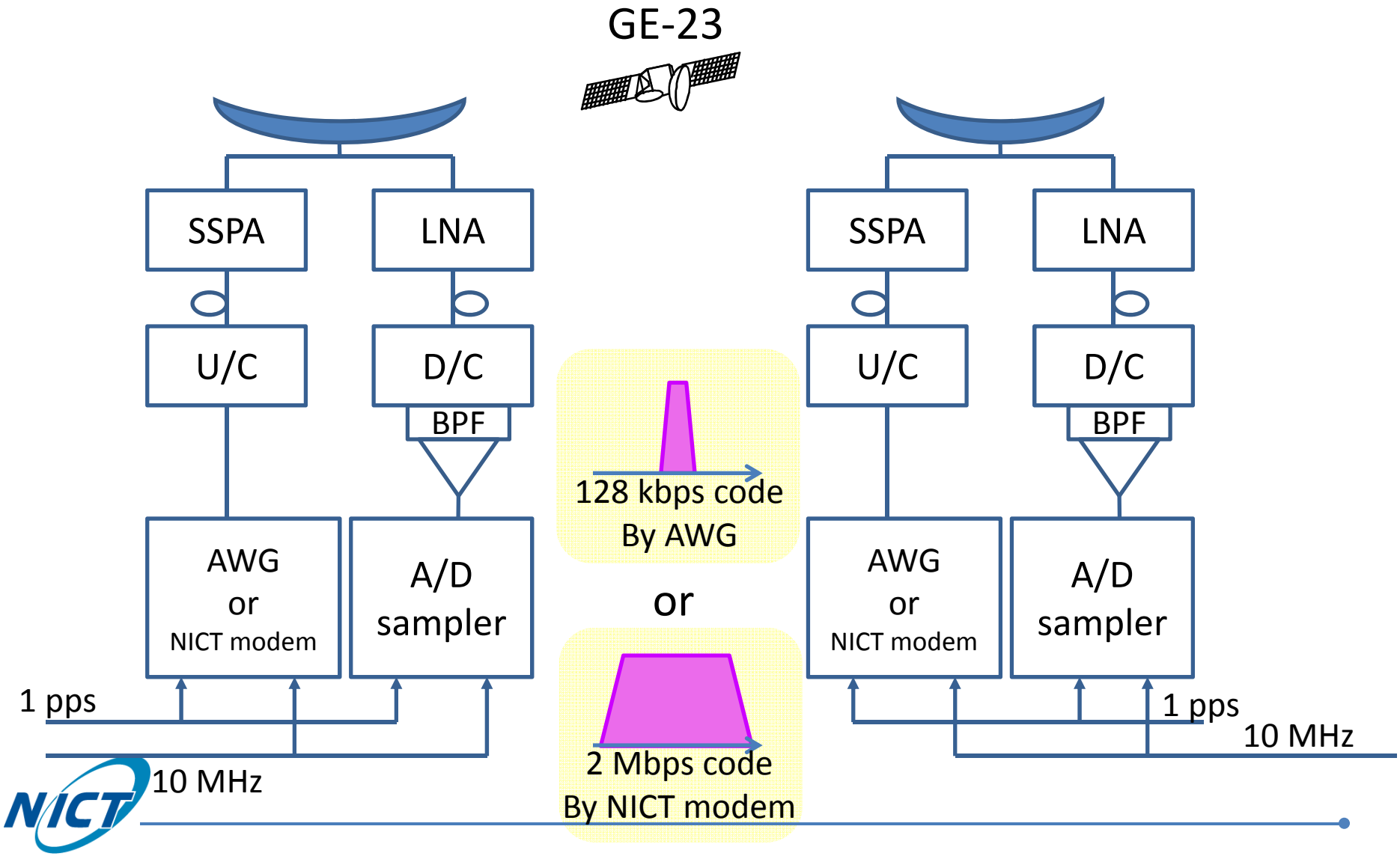
R&D status - Recent results by carrier-phase TWSTFT-

- Measurement setup
- Common clock measurement in zero baseline
- Short baseline measurement
- Summary & Future plan

R&D status - Recent results by carrier-phase TWSTFT-

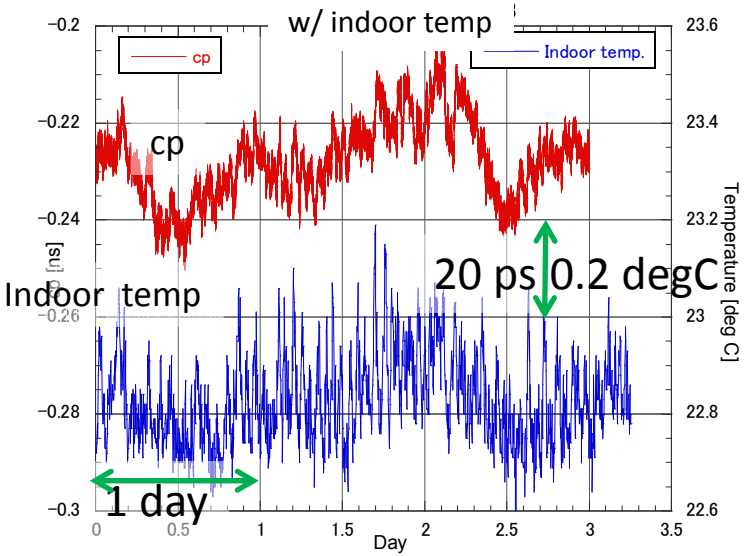
- Measurement setup

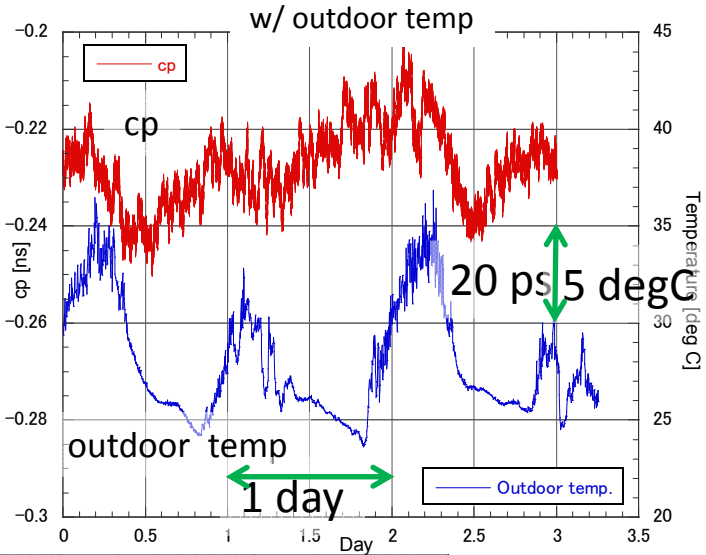
AWG: Arbitrary waveform generator
Freq. converters coherent to ext. 10 MHz

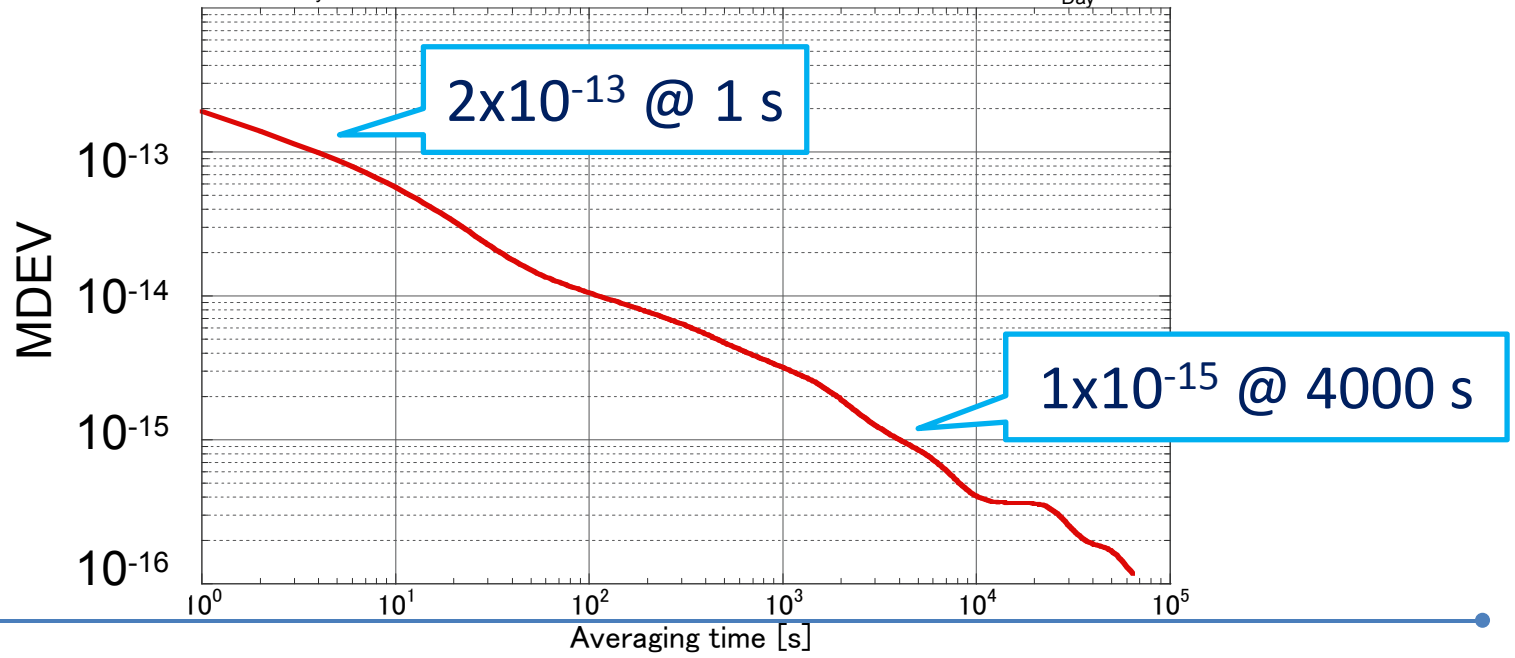


R&D status - Recent results by carrier-phase TWSTFT-

- Common clock measurement in zero baseline



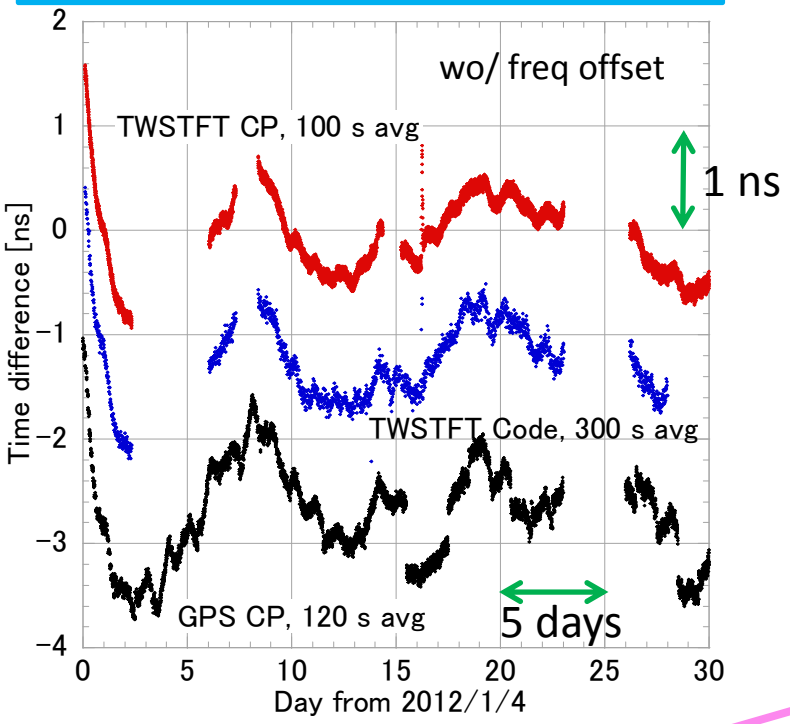




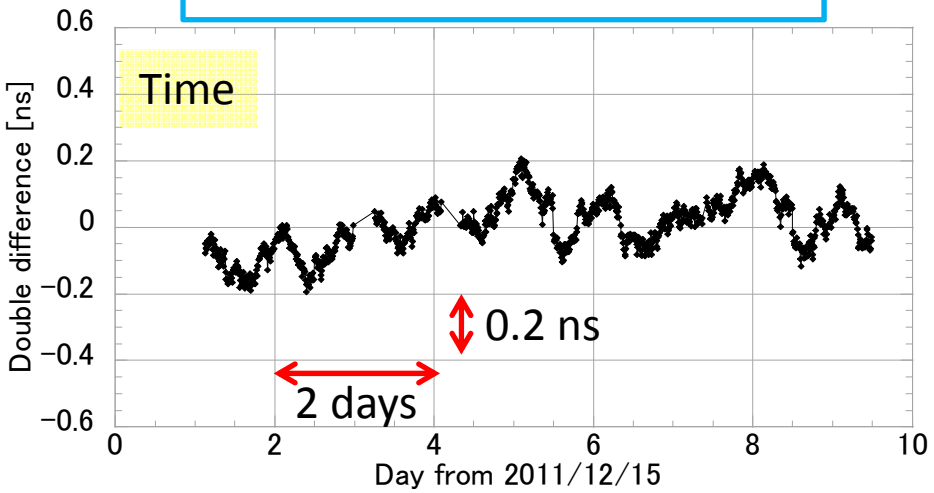
R&D status - Recent results by carrier-phase TWSTFT-

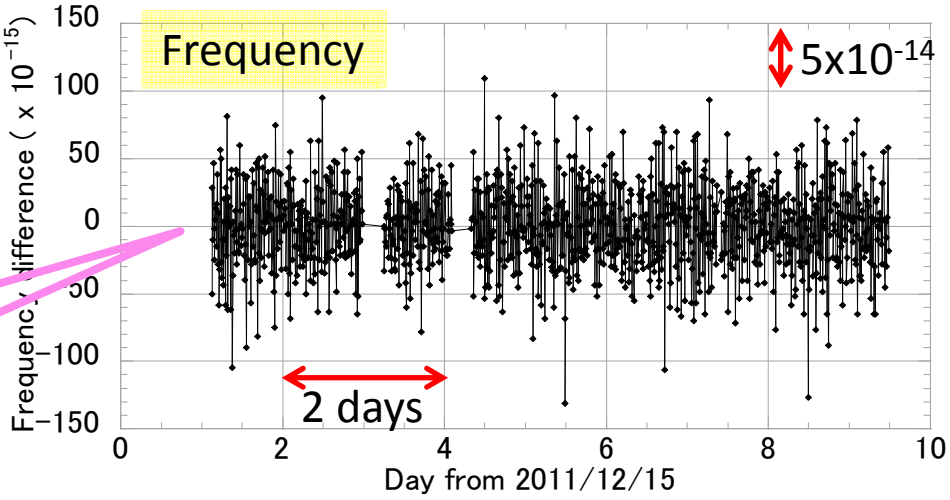
- H-maser comparison in a 150-km baseline

UTC(NICT)-HM(Kashima) via GE23



Double difference with GPS CP



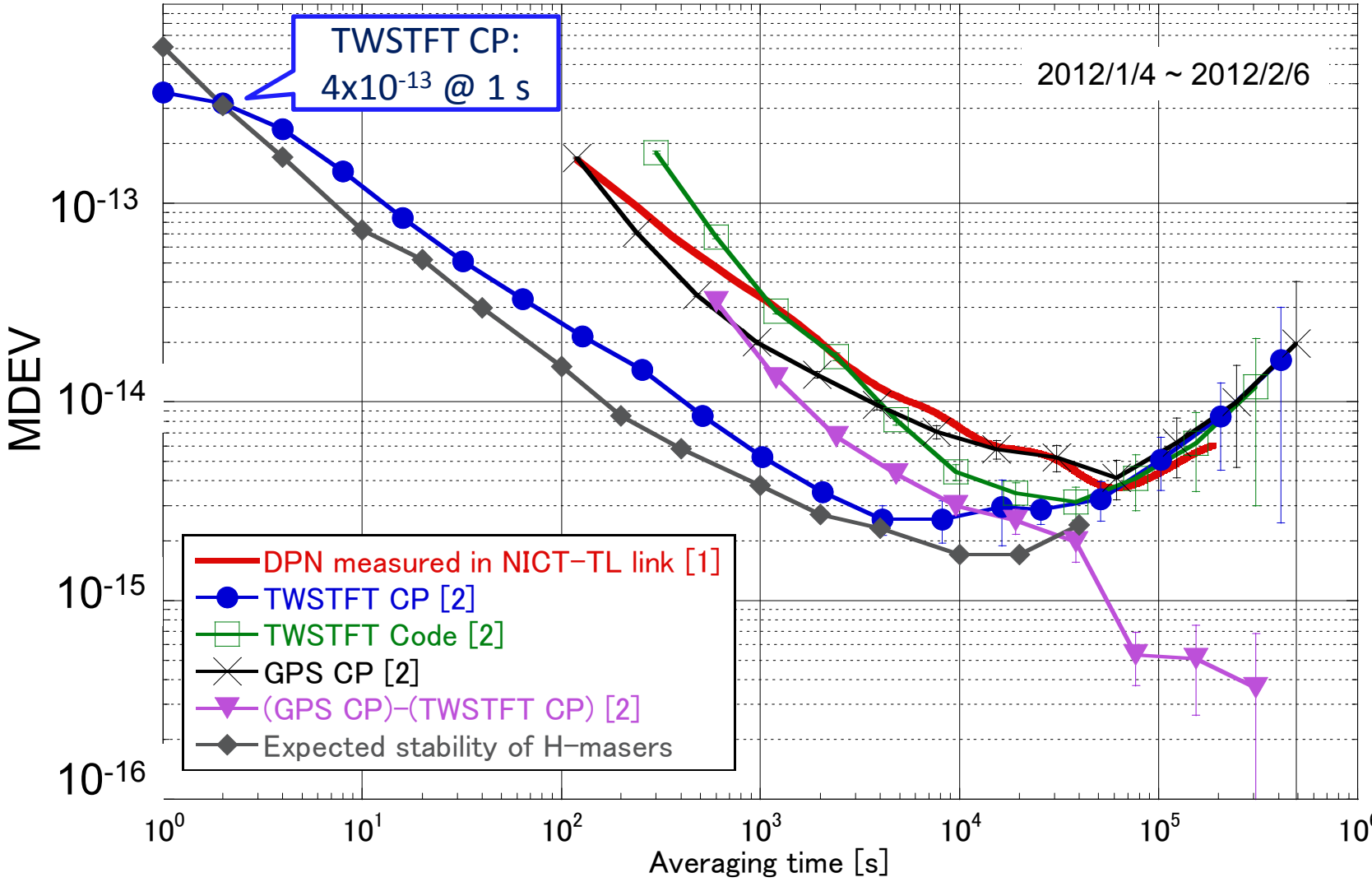


GPS CP-TWSTFT CP

Mean: $(-0.8 \pm 9) \times 10^{-17}$

R&D status - Recent results by carrier-phase TWSTFT-

- H-maser comparison in a 150-km baseline



[1] T. Gotoh et al., "Development of a GPU-Based Two-Way Time Transfer Modem", IEEE IM 60 7 2495 (2011).
[2] M. Fujieda et al., "Carrier-phase-based Two-Way Satellite Time and Frequency Transfer", submitted to IEEE TUFFC.

R&D status - Recent results by carrier-phase TWSTFT-

- Summary of common clock measurement
  - Short-term stability: 2×10^{-13} @ 1 s
    Limited by phase jitter in frequency converters
  - Mid-, Long-term stability: 1×10^{-15}@4000 s, 1×10^{-16}@1 day
    Affected by phase variation due to temperature variation
    Frequency converter gives a large impact.

- Future plan
  - Long baseline measurement to evaluate ionosphere effect
  - Trial to improve short-term stability
    Tightly phase-locked frequency converter is necessary.
  - Temperature stabilization of indoor equipment

Thank you for your kind attention.