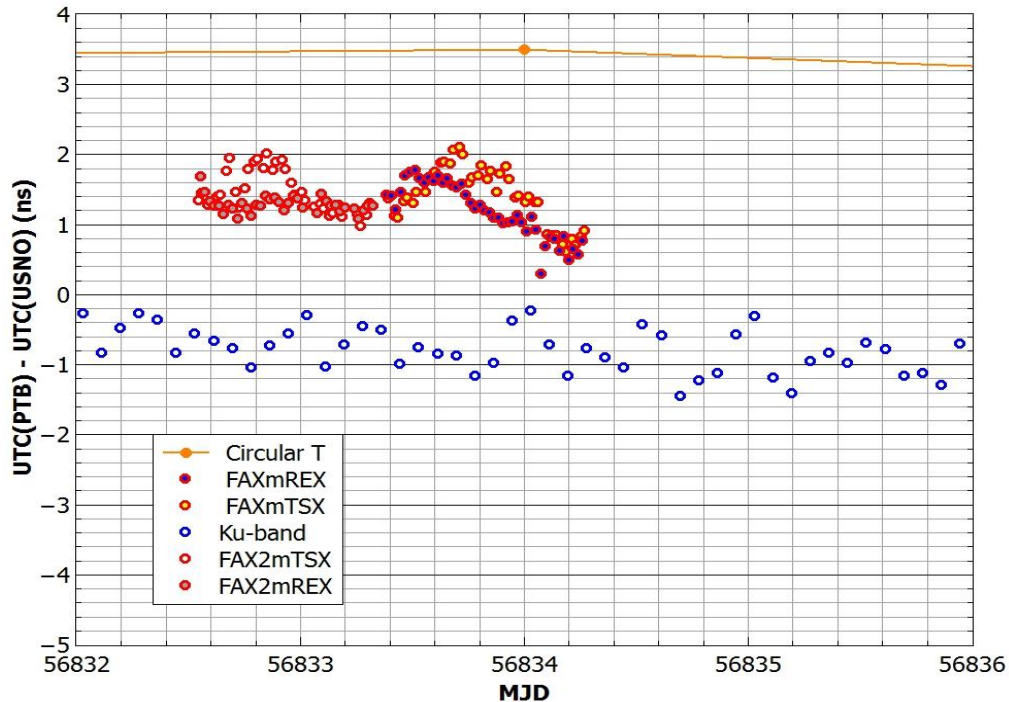


**The June 2014 calibration
of the link UTC(USNO) – UTC(PTB) by means of
the USNO portable X-band TWSTFT station**

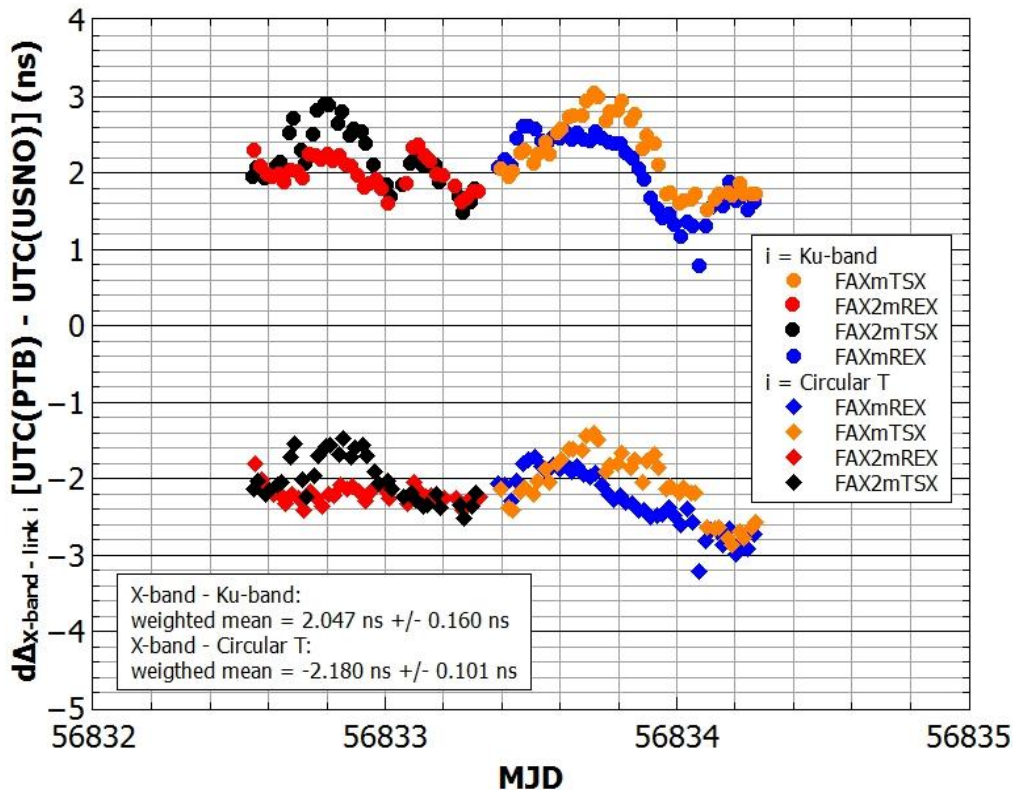
**Dirk Piester (PTB), Russell Bumgarner (USNO),
and Angela McKinley (USNO)**

Establishing an independent TWSTFT link in the X-band



The X-band TWSTFT link (red) clearly deviate from the operational Ku-band TWSTFT link (blue) as well from Circular T data (orange).

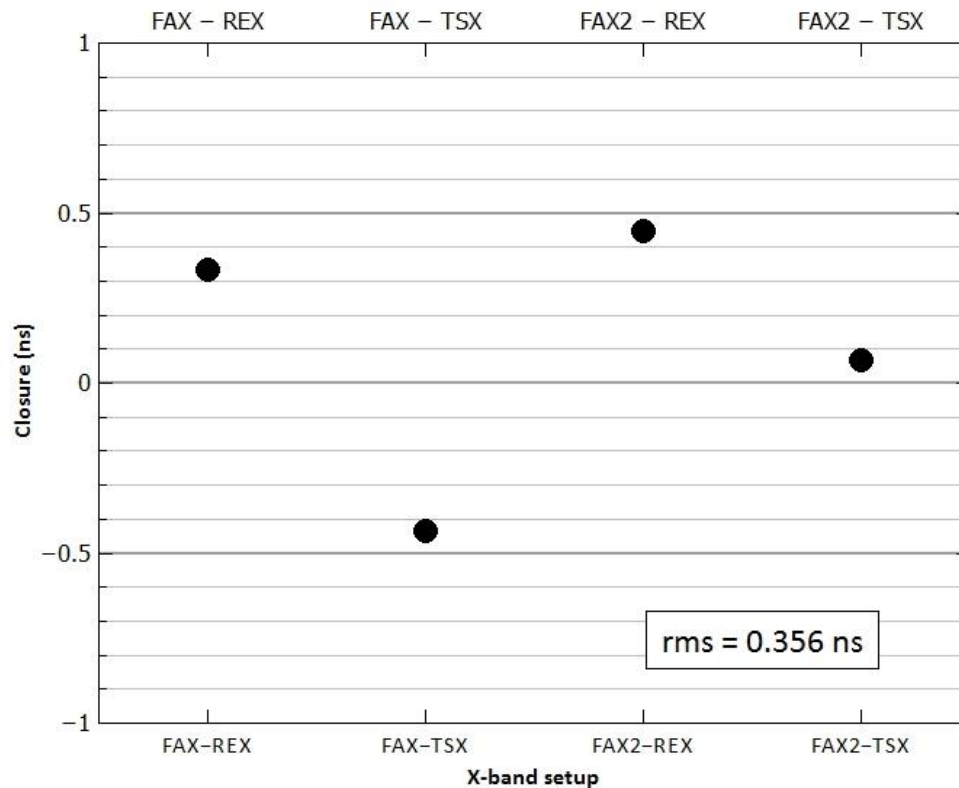
Double differences X-band – Ku-band (and Circular T)



For each setup configuration a mean value and the standard deviation of the single measurements around the mean were calculated. Then the weighted mean and sigma for the four setups belonging to each of the two double differences were computed. The sigma values represent the statistical uncertainty of the calibration.

	weighted mean (ns)	Sigma (ns)
X-band - Ku-band	2.047	0.160
X-band – Circular T	-2.180	0.101

Closure of all 4 hardware (link) configurations



The differences of the pre-campaign values with respect to the post-campaign values represent the uncertainty due to the long term or transportation instability especially of the portable station. The rms value ($\text{rms} = 0.356 \text{ ns}$) is a measure of the deviation of the single data points from the zero line as well as the scatter of the data and thus an appropriate means to state the uncertainty.

Uncertainty evaluation summary

	correction (ns)	u_A (ns)	$u_{B,1}$ (ns)	$u_{B,2}$ (ns)	$u_{B,3}$ (ns)	U (ns)
X-band - Ku-band	2.047	0.160	0.356	0.5	0.1	0.642
X-band – Circular T	-2.180	0.101	0.356	0.5	0.1	0.630

$u_{B,1}$: rms of the closure of all 4 hardware (link) configurations

$u_{B,2}$: Uncertainty of the so called REFDELAY measurement, according to time interval counter specifications.

$u_{B,3}$: The uncertainty of all other effects should be well below a tenth of a nanosecond and are summarized in a small contribution.

ITU formatted TWSTFT data files

Ku-band link calibration: The entries in the ITU formatted TWSTFT data files for the operational Ku-band link should be adjusted as follows:

Header line:

* CAL TBD TYPE: PORT ES REL MJD: 56832 EST. UNCERT.: 0.640 ns

	CI	S	CALR (old)	CALR (new)	ESIG (old)	ESIG (new)
TWPTB...	TBD	1	-212.129	-210.082	2.800	0.000
TWUSNO...	TBD	1	212.129	210.082	0.000	0.000

Thanks for your attention!

Благодаря за вниманието!

感谢您的关注

Děkuji vám za pozornost

Dank voor uw aandacht!

Merci pour votre attention!

Σας ευχαριστώ για την προσοχή σας

Grazie per l'attenzione!

ご清聴ありがとうございます

감사합니다

Ačiū už dėmesį

Dziękuję za uwagę!

Obrigado pela vossa atenção

Спасибо за внимание

¡Gracias por su atención!

Tack för er uppmärksamhet!

உங்கள் கவனத்திற்கு நன்றி!

Danke für Ihre Aufmerksamkeit!