Report from LNE-SYRTE

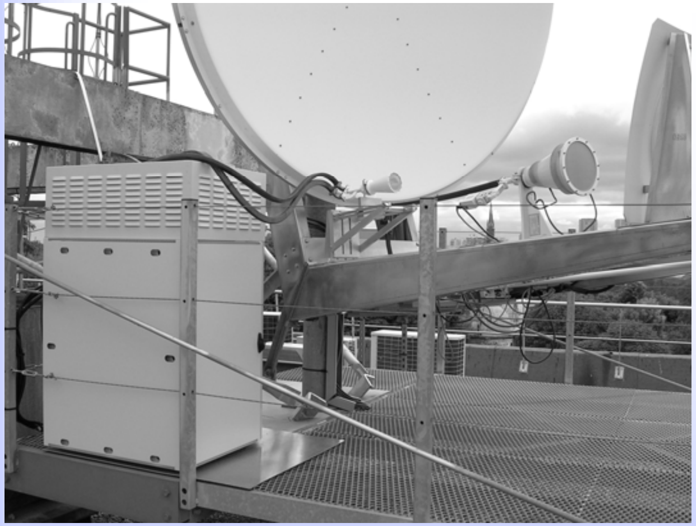
Progress work on:

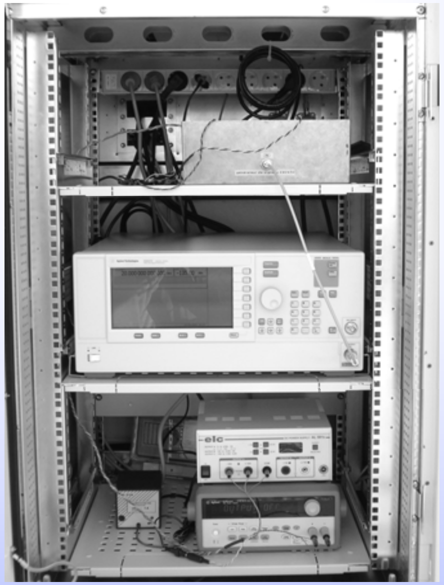
1- the satellite simulator;
2- the installation of a 2nd station for the links with Asia

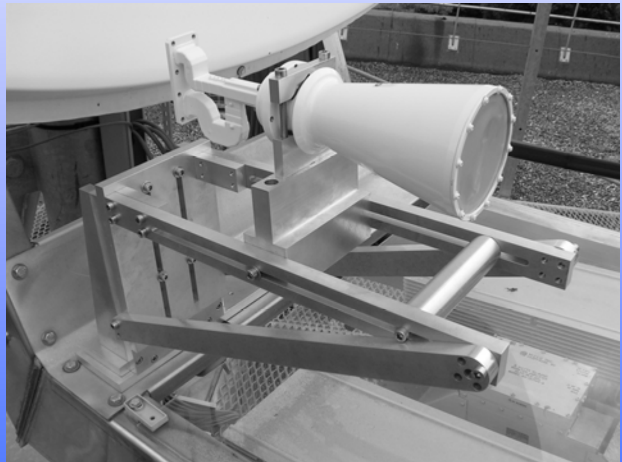
Tour of LNE-SYRTE:

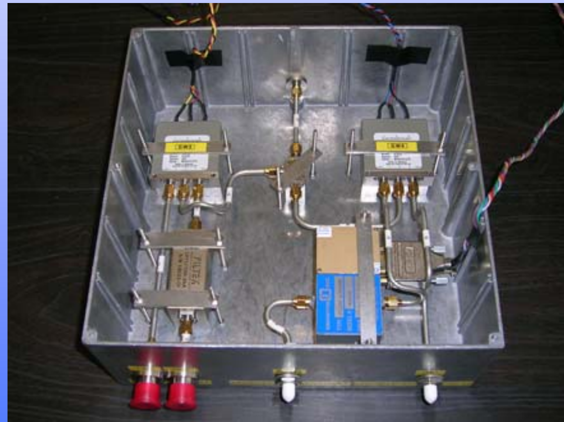
1- TWSTFT activities;
2- Time service;
3- Microwave Atomic Fountains;
4- Optical clocks (Sr);
5- Pharao project

Satellite simulator of LNE-SYRTE









Short-term time stability results

Time stability of the whole system including two-way station and satellite simulator studied for the short-term. TX and RX time delays were measured separately over a period of about 1 hour up to 3 hours, with a periodicity of one measurement per second. RX path delay was also measured by shortening the horns using a microwave coaxial cable, in order to study the impact of horns on the stability.

Received signal parameters on RX path (w/ horns):

➔ P_{RX} = -33,78 dBm ± 0,14 dB

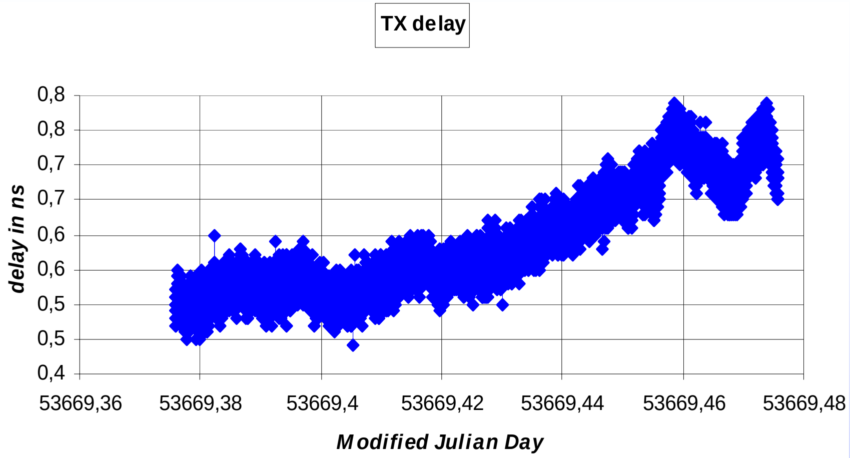
➔ C/N_0 = +67,90 dBHz ± 0,04 dB

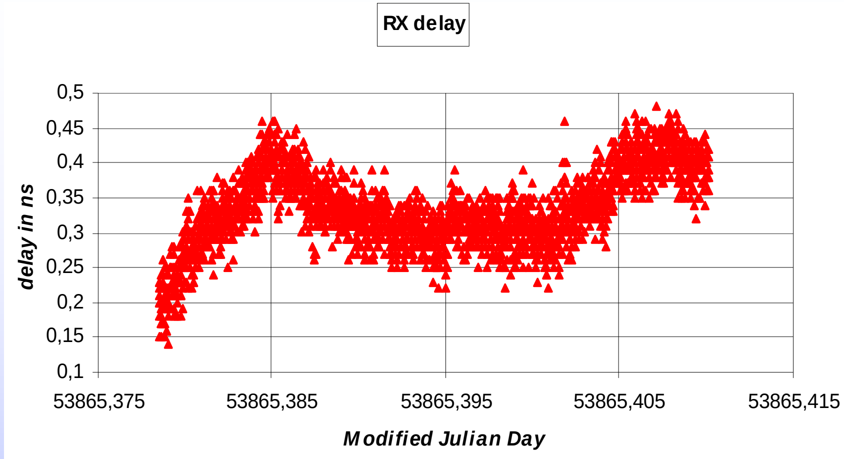
Received signal parameters on RX path (w/o horns):

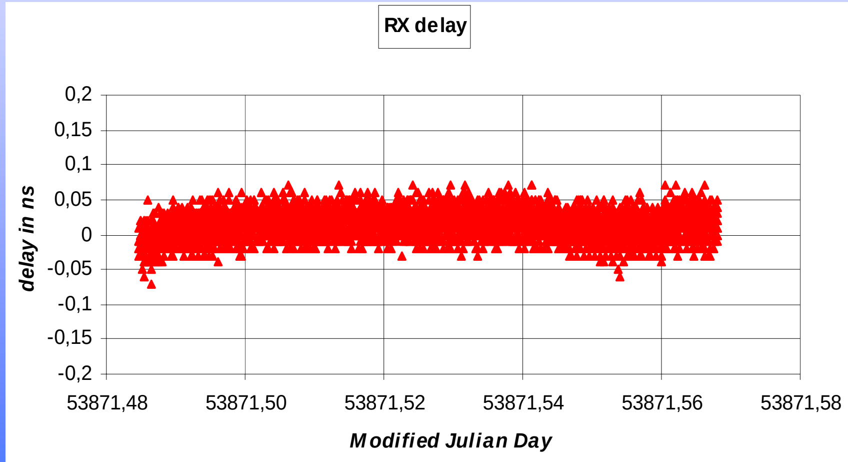
➔ P_{RX} = -33,03 dBm ± 0,07 dB

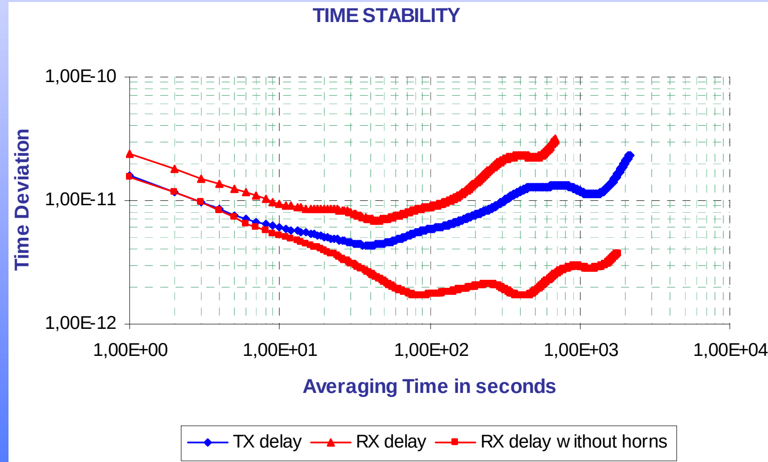
➔ C/N_0 = +68,37 dBHz ± 0,05 dB

Short-term time stability results









14th meeting of the CCTF WG on TWSTFT

LNE-SYRTE Paris 10-12 September 2006

Long-term time stability results

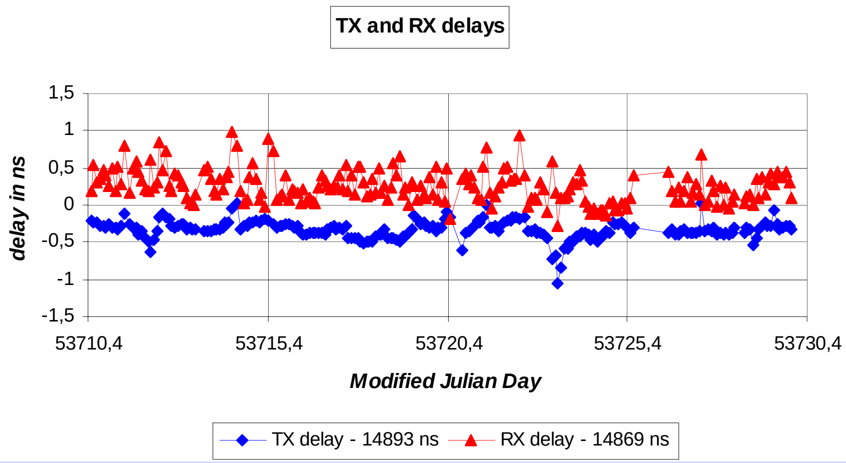
Time stability of the whole system for the long-term is also studied. Time delays were measured over a period of 20 days, from MJD 53710 (2005-12-06) to MJD 53729 (2005-12-25) with respect to twelve measurement sessions per day (every two hours) recording 2x120 measurement points (1 s data) during a session. No data were recorded from MJD 53725 at 15:00 UTC to MJD 53726 at 13:00 UTC due to a failure in the software.

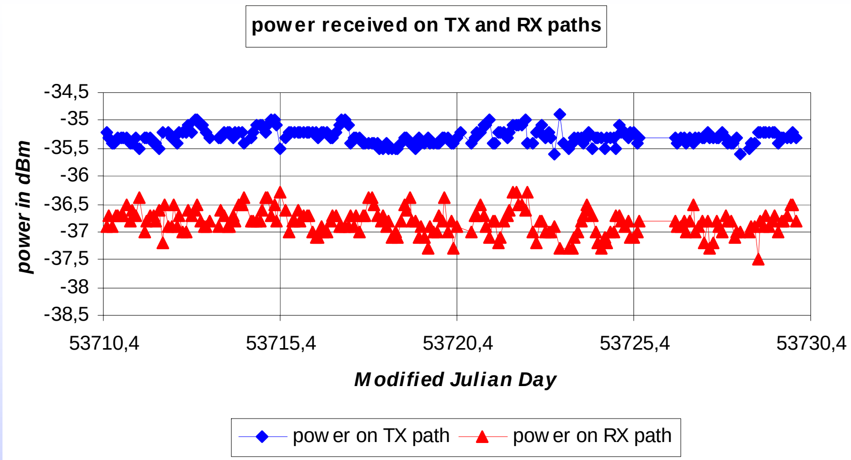
Received signal parameters

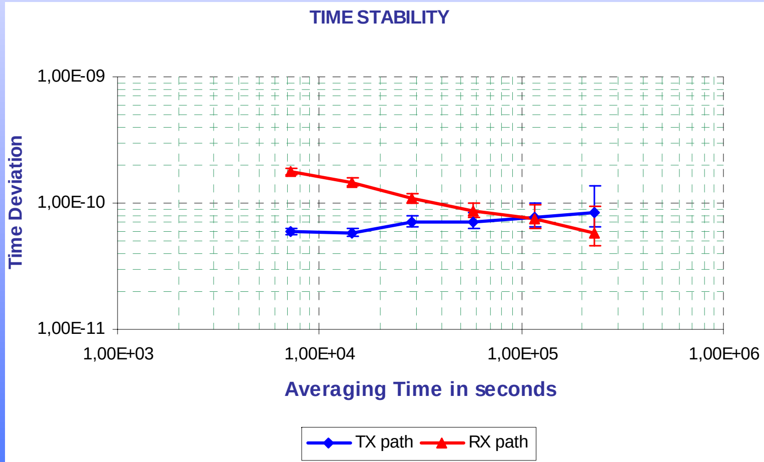
➔ TX: C/N_0 = 68,40 dBHz ± 0,00 dB ;

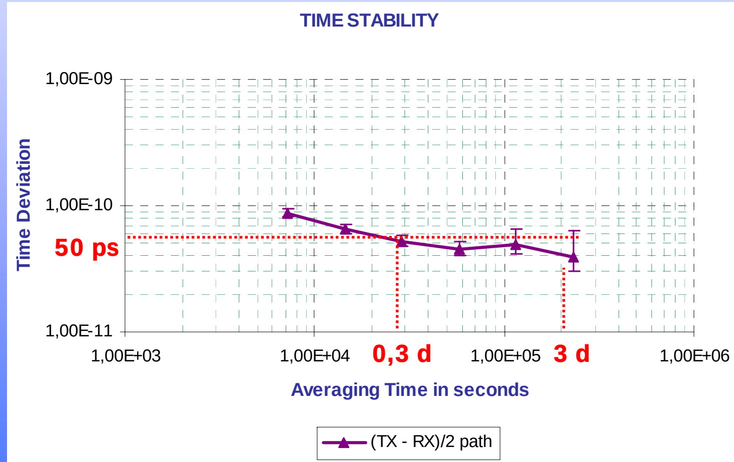
➔ RX: C/N_0 = 67,60 dBHz ± 0,08 dB

Long-term time stability results





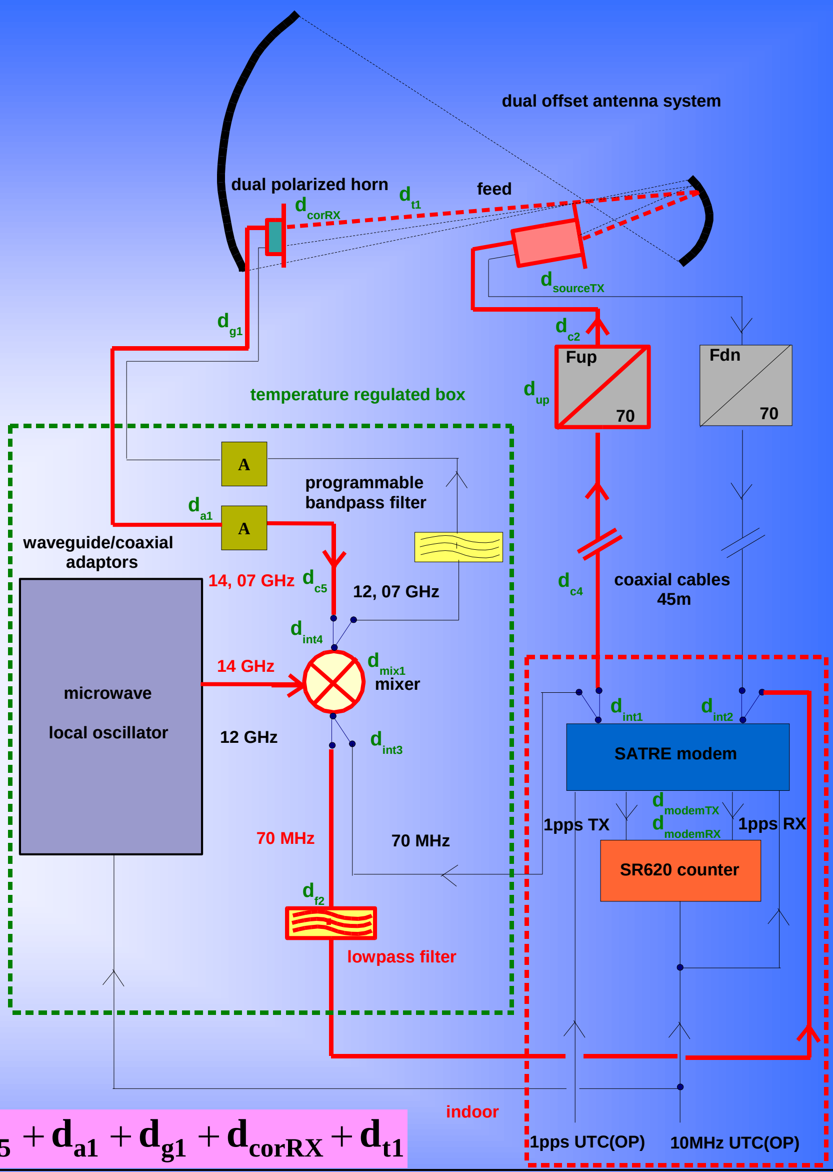




$$\delta t_1 = \tau_1^{TX} + Cal_1$$

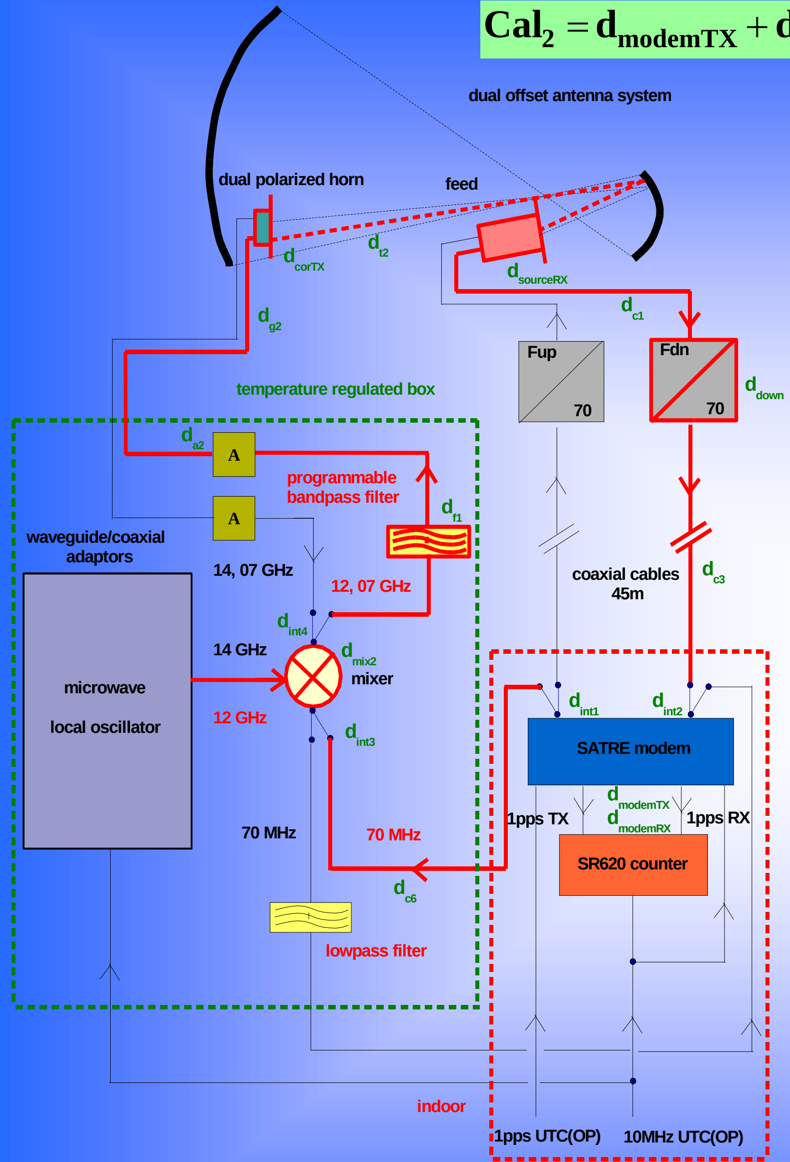
$$\tau_1^{TX} = d_{modemTX} + d_{int1} + d_{c4} + d_{up} + d_{c2} + d_{sourceTX}$$

TX path



$$Cal_1 = d_{modemRX} + d_{int2} + d_{f2} + d_{int3} + d_{mix1} + d_{int4} + d_{c5} + d_{a1} + d_{g1} + d_{corRX} + d_{t1}$$

$$Cal_2 = d_{modemTX} + d_{int1} + d_{c6} + d_{int3} + d_{mix2} + d_{int4} + d_{f1} + d_{a2} + d_{g2} + d_{corTX} + d_{t2}$$



RX path

$$\delta t_2 = \tau_1^{RX} + Cal_2$$

$$\tau_1^{RX} = d_{modemRX} + d_{int2} + d_{c3} + d_{down} + d_{c1} + d_{sourceRX}$$

Characterization of satellite simulator components using a vector network analyzer in the RF and microwave domain

Main equipment used:

- Agilent 8510C vector network analyzer with
  Agilent 8517B 45 MHz – 50 GHz S-parameter test set
- HP85052C precision calibration kit in 3.5 mm
- Agilent precision adapters:
  11901A: 3.5(m) – 2.4(m), 16.1 mm
  11903D: 2.4(f) – N(m), 46.1 mm

Calibration techniques applied:

- TRL Thru-Reflect-Line [10 – 15 GHz]
- SOLT Short-Open-Load-Thru [50 – 90 MHz]

Characterization of satellite simulator components using a vector network analyzer in the RF and microwave domain

$$\tau_1^{Tx} - \tau_1^{Rx} = \delta t_1 - \delta t_2 + (Cal_2 - Cal_1) = \delta t_1 - \delta t_2 + CAL$$

$$CAL = \{R_{x,delay} - T_{x,delay}\}_{modem} + \{M_{LF,delay} - M_{HF,delay}\}_{mixer} + \{H_{14GHz,delay} - H_{12GHz,delay}\}_{horns} + CAL_0$$

CAL_0 determined from measurements using a vector network analyzer

$CAL_0 = -5{,}413$ ns ➔ CAL = -14 057,482 ns (assuming M & H difference delays equal zero)

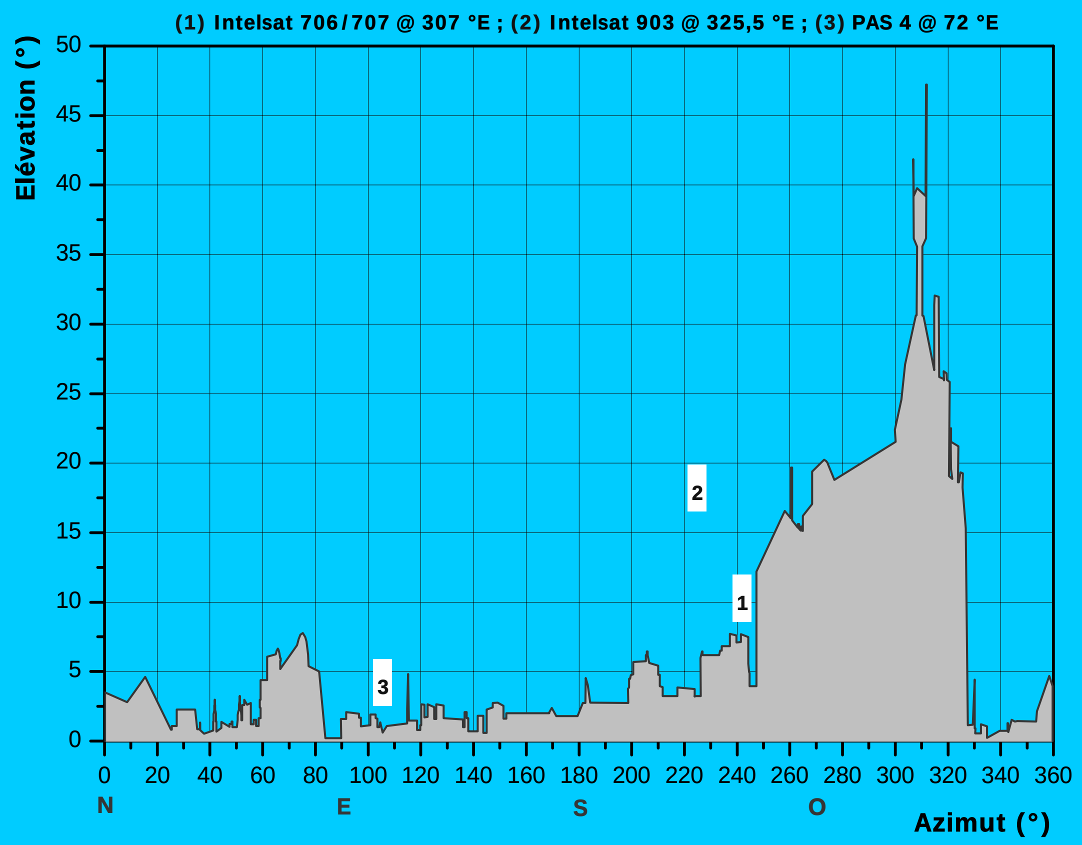
Assuming $\delta t_1 - \delta t_2 = \sim 24$ ns ➔ $\tau_1^{Tx} - \tau_1^{Rx} = -14\ 033{,}482$ ns

Having CALR(OP01) = -14 014,175 ns (from TUG 2005 report)
Difference [CALR(OP01) – ($\tau_1^{Tx} - \tau_1^{Rx}$)]= *19,307* ns

Having CALR(OP - VSL) = -14 036,200 ns (from TUG 2005 report)
Difference [CALR(OP - VSL) – ($\tau_1^{Tx} - \tau_1^{Rx}$)]= *-2,718* ns

The knowledge of TUG PS and/or VSL station difference delays could highly help this analysis!

Clear horizon from the site of the Observatoire de Paris (top roof of building B)



2nd station linking OP to NTSC, NICT and TL

Equipment already received or be received in September

- TimeTech SATRE-321 dual Rx channel
- SR620 Time Interval Counter
- Andrew 2.4 m Ku-band dual optics RxTx antenna system, SVS Telekom motorized mount (80 K @ 4,7 °)
- Miteq U-176-3-1k (1 kHz)
- Miteq BA-137145-8 (SSPA)
- Miteq (LNA) AMFW-7S-109128-70 / TC (70 K)
- Miteq D-128-3-1k (1 kHz)
- ...

Antenna Efficiency = 61 %

- EIRP @ 14,00 GHz = 57,2 dBW
- G/T @ 10,95 GHz @ 4,7 ° = 24,8 dB/K

Station to be installed from Oct. 2006, first tests to be started in January 2007