IERS Working Group on co-location and local ties (jointly with IAG Sub-Commission 1.2)

Meeting summary. Prepared by P. Sarti.
Wednesday, December 7, 2011, Hotel Westin SF, 50 3rd St., San Francisco

The third meeting of the *IERS WG on site surveys and co-location sites* took place on Dec. 7th at the Westin St. Francis, 3rd Market Street in San Francisco; h: 17.30. Despite the very short notice, the meeting was very well attended, with a total of 27 participants (Table 1). The large number of attendees confirms the strong interest related to the investigations promoted by the working group.

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Table 1: Working group meeting participants list. Names of the IERS working group members are highlighted.

The meeting started with a presentation given by Pierguido Sarti summarizing the most recent investigations about the assessment of the accuracy of the tie vectors; the presentation is available on the WG web page.

Particularly, Dawson et al. (2007) quantified the differences on the final estimate due to:

1. data processing software: STAR*NET and Geolab are consistent and do not impact the tie vector estimate

2. data post-processing software: Clem&nt and Axis were tested on a set of indirect observations to evaluate their performance and discrepancies. A proper selection of geometric conditions to be applied on the indirect observations reduces the discrepancies between the two software well within the mm level over an estimation of a VLBI conventional reference point.

Abbondanza and Sarti (2012) evaluate the contribution of:

1. the local ground control network design
2. the redundancy of the observations, simulating side shots or redundant forward intersection.
3. the effect of possible biases in the terrestrial measurements and originated by gravitational and thermal deformations of the VLBI telescope structure.
4. the alignment phase into the global frame of a tie vector surveyed with terrestrial techniques and expressed in a topocentric frame. This phase is critical and seriously impacts the tie vector final estimate.

In summary:

1. Network geometry, redundancy of observations: **3-D, <1.7 mm**
2. Processing software, post-processing software: **3-D, <0.5 mm**
3. Geometric conditions: **3-D** or **Up**, **(0.2 ÷ 3.5) mm**
4. Deformations of VLBI telescope
   - Thermal:
     - Up component: alidade=35 m (≈3.8 mm); ΔT=+9.1 °C => (4.1 ÷ 6.1) mm
     - Up component: alidade=35 m (≈1.7 mm); ΔT=+4.1 °C => (1.4 ÷ 2.5) mm
     - Up component: alidade=35 m (≈-0.4 mm); ΔT=-0.9 °C => (-0.9 ÷ 0.5) mm
     - Up component: alidade=35 m (≈-2.5 mm); ΔT=-5.9 °C => (-3.6 ÷ -2.3) mm
     - Up component: alidade=12 m (≈1.5 mm); ΔT=+10 °C
   - Gravitational:
     - Up component (ø=64 m) => (-12.7 ÷ -9.2) mm
     - Up component (ø=55 m) => (-9.3 ÷ -7.0) mm
     - Up component (ø=45 m) => (-6.6 ÷ -5.0) mm
     - Up component (ø=32 m) => (-2.7 ÷ -2.4) mm
     - ≈0 mm if targets are properly located on the telescope structure (e.g. close to the elevation axis)
     - >| -12.7| mm when located in highly flexible parts
     - Up component (ø=22 m) => ≈-1.5 mm

5. Alignment: **3-D, <5.6 mm**

In addition, the discussion also focussed on the possibility to infer/relate the tie vector accuracies from/to the ITRF combination residuals.

Paul Rebischung and Gary Johnston kindly contributed giving additional presentations that focussed on Tsukuba (VLBI-GPS) and Yaragadee (SLR-GPS-DORIS) co-location sites, respectively. They offered a deeper insight in the relationship between the space geodetic solutions, the ITRF combination residuals and the GPS radome effects (presentations are available on the WG web page).

The tie vector estimation follows a stepwise compound process involving a number of calculations, models and parameters (cf. figure 1).

In order to pursue a real improvement in the consistency between space geodetic solutions and tie vectors, these latter need a more permanent, organized and coordinated handling. Pierguido Sarti suggested the establishment of a service for tie vectors and local ties, similar to what is currently done for the space geodetic techniques. The proposal aimed at highlighting the urgent need of establishing a central, international entity in charge of i) setting the guidelines and harmonizing the survey process, ii) prioritizing the surveys iii) coordinating the tie vector computation, iv) defining central repositories to store raw and reduced data, results, parameters and metadata.

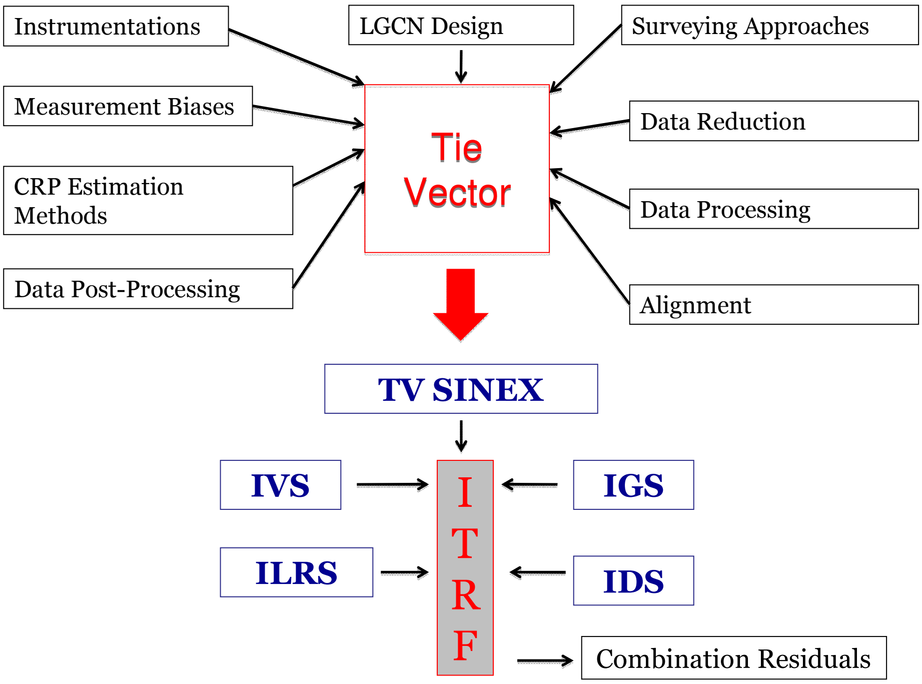

Figure 1: Schematic representation of the tie vector estimation process and contribution to the ITRF. Several aspects contribute to the tie vector accuracy contained in the SINEX file (TV SINEX).

Many of the participants agreed that these goals can uniquely be achieved establishing a permanent international entity. The accuracy of the tie vectors will be reliably assessed only if all the information regarding the tie vector estimation steps, from surveying to data reduction, from data processing and post-processing to tie vector alignment are correctly stored and available.
The proposal, although at a very first stage, boosted an active and interesting discussion during the meeting and in the following weeks.
The meeting ended at h: 19.00.

References

Abbondanza, C. and P. Sarti (2012) *Impact of network geometry, observation schemes and telescope structure deformations on local ties: simulations applied to Sardinia Radio Telescope*, J Geodesy, 86(3), 181-192, doi: 10.1007/s00190-011-0507-6.

Dawson, J., P. Sarti, G.M. Johnston and L. Vittuari (2007) *Indirect approach to invariant point determination for SLR and VLBI systems: an assessment*, J Geodesy, 81(6-8), 433-441, doi: 10.1007/s00190-006-0125-x.