49th CGSIC Meeting - Timing Subcommittee

Savannah, Georgia, 22 September 2009

Chair: **Włodzimierz Lewandowski, BIPM,**
Co-Chair: **Victor Zhang, NIST**

14:00 Introduction on UTC and ICG meetings – *Włodzimierz Lewandowski, BIPM*
14:20 Report from NIST – *Victor Zhang, NIST*
14:40 USNO Time Service – *Demetrios Matsakis,USNO*
15:00 Report on ITU works on UTC redefinition – *Ron Beard, NRL*
15:20 Break
15:40 Why leap seconds are difficult to get right for an equipment vendor
– *Sam Stein, Symmetricom, Inc.*
16:00 Time and Navigation Exhibition at the Smithsonian: An Update
– *Carlene E. Stephens, National Museum of American History*
16:20 Discussion
17:20 Session End

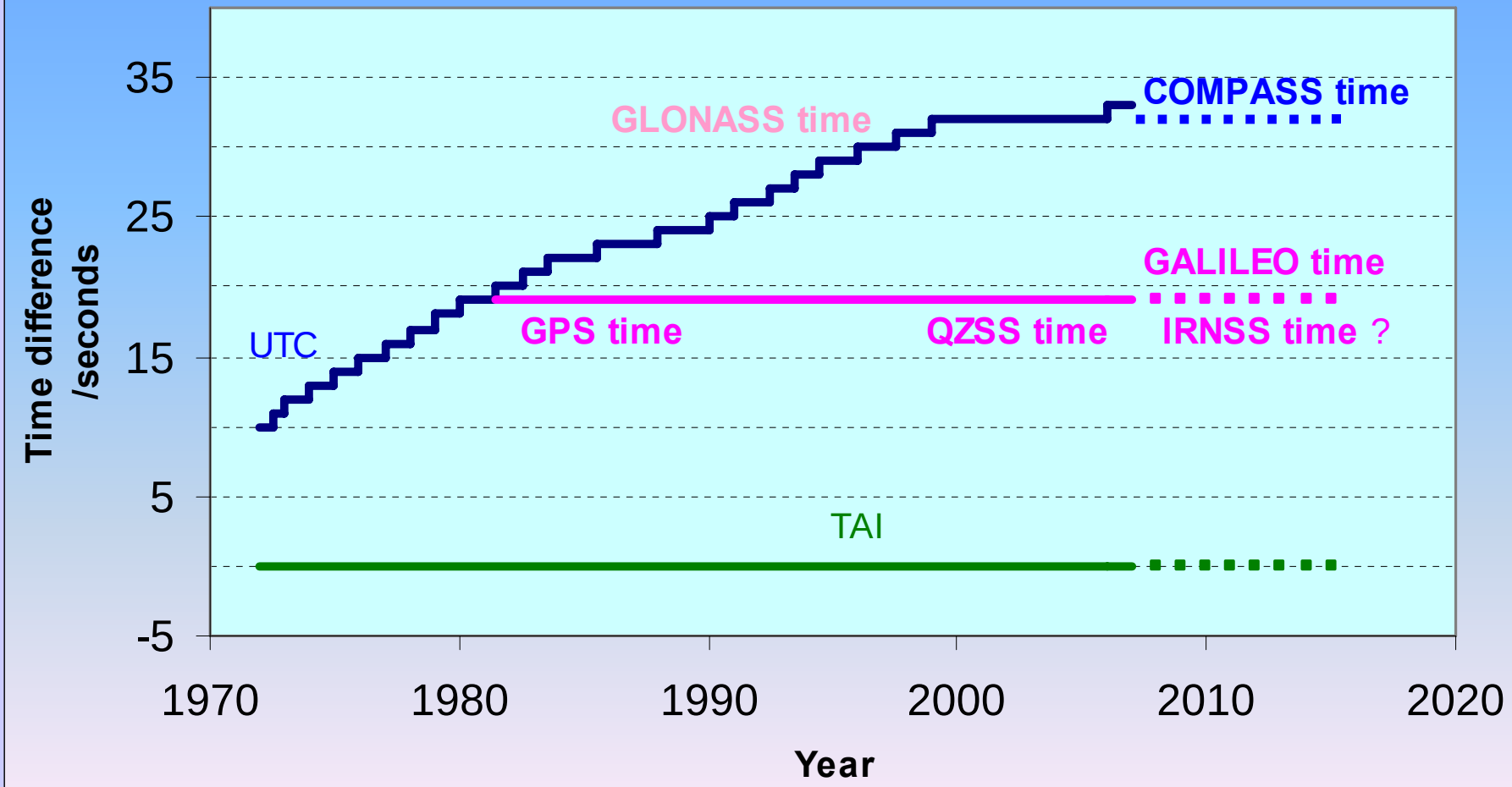
AREAS BEING SERVED

- UTC
- International Timing Centers
- GNSS interoperability
- Telecommunications Industries
- NASA/JPL Deep Space Network
- NIST Global Time Service
- Power Grids and other Industries
- As Research and Comparison Tool
- Other

Outline of presentation

- Change in the definition of international time scales (ITU, CCTF)
  - UTC
  - TAI
  - Leap second
- Relation between satellite time scales
  - GPS time
  - Glonass time
  - Galileo system time
  - Compass system time
- Relation between satellite reference frames (ICG, CGPM, ISO)
  - GPS WGS-84
  - Glonass PZ-90
  - Galileo GTR
  - Compass CRCS

[*TAI - Time scale (i)*]



System times

- GPS time: steered to UTC(USNO) modulo 1s
  - ✓ [TAI – GPS time] = 19 s + C_0
  - ✓ [UTC -GPS time] = -15 s + C_0
  - ✓ Tolerance is 1 μs
- GLONASS time: steered to UTC(SU) with leap second
  - ✓ [TAI – GLONASS time] = 34 s + C_1
  - ✓ [UTC – GLONASS time] = C_1
  - ✓ Tolerance is 1 ms
- Galileo time: steered to a set of EU UTC(k); using GPS time seconds, GGTO
  - ✓ [TAI – Galileo time] = 19 s + C_2
  - ✓ [UTC -Galileo time] = -15 s + C_2
  - ✓ Tolerance is 50 ns
- COMPASS time: will be steered to set of Chinese UTC(k)
  - ✓ [TAI –COMPASS time] = 33 s + C_3
  - ✓ [UTC -COMPASS time] = -1 s + C_3
  - ✓ Tolerance is 100 ns

Babel Tower

ITU meeting on redefinition of UTC
Geneva, 7 -15 September 2009

To avoid proliferation of time scales ITU plans to stop application of leap seconds to UTC

- September 2009: ITU Working Party 7A submitted to Study Group 7 draft recommendation on stopping leap second
- 2010: it is expected that Study Group 7 will submit draft recommendation to Radiocommunication Assembly
- January 2012: if 70 % member states agree Radiocommunication Assembly will approve recommendation
- About 2020: application of leap second should stop and UTC will become a continuous time scale
- But two administrations are opposing: British and Chinese

Recommendation CCTF 4 (2009) (1)

Concerning adoption of a common terrestrial reference system by the CGPM

The Consultative Committee for Time and Frequency,

considering that

- there exists at present only a few global satellite navigation systems but that new ones are being created and in the future there may be many more,
- different time and geodesy reference systems, which are in use in these navigation systems, produce additional ambiguities for users regarding interpretation of navigation and timing solutions and render systems interoperability more difficult,
- although the international terrestrial reference system ITRS is recommended by relevant scientific unions, it has not yet been adopted by an intergovernmental organization,
- such an adoption by the appropriate intergovernmental organization would lead to more user convenience regarding unification of navigation and timing solutions and systems interoperability;

Recommendation CCTF 4 (2009) (2)

noting that

one of the key factors that led to the creation of the BIPM and the Metre Convention was the recommendation of the Second International Conference on Geodesy for the Measurement of Degrees in Europe held in Berlin in 1867 that a European international bureau of weights and measures be set up in order to unify European geodesy standards.

recommends that

after agreement with the relevant scientific unions, the Director of the BIPM formally discuss with the CIPM the steps so that the 24th CGPM be asked to adopt the ITRS, as defined by the IUGG and realized by the IERS and IGS, as the international standard for terrestrial reference frames used for all metrological applications.

International Committee on Global Navigation Satellite Systems (ICG)
St Petersburg, Russia
14 - 18 September 2009

Objectives of the task force on time references ICG WG D, Task Force D2

E.F. Arias and W. Lewandowski

4th Meeting of the ICG

14-18 September 2009 – St Petersburg, Russian Federation

ICG Draft Recommendation

International Committee on Global Navigation Satellite Systems (ICG)

considering

- **the international value of having many GNSS operational with a composite contribution of several tens of satellites,**
- **the desirability of using all systems interchangeably,**
- **the use by GPS of references very close to UTC and ITRF,**
- **the GLONASS efforts to approach UTC and ITRF,**
- **the Galileo design referring to UTC and ITRF,**
- **that other important satellite navigation systems are now being designed and developed*),**

recommends

- **that the reference times (modulo 1 s) of satellite navigation systems be synchronized as closely as possible to UTC,**
- **that the reference frames for these systems be in conformity with the ITRF,**
- **that these systems broadcast, in addition to their own System Time (ST):**
  1. **the time difference between ST and a real-time realization of UTC,**
  2. **a prediction of the time differences between ST and UTC.**

***) Compass, IRNSS, QZSS, various SBAS, …**

ICG Task Force on Time Discussion/Analyses:

- With the proliferation of GNSS, coordination of navigation and UTC timing services is critical.
- Consequently, a common timing reference is essential. This Task Force should provide recommendations for timing standards.
- This would include coordination of navigation time scales and standards for precise time and time dissemination services, as well as promotion of the use of standard terminology and common quality metrics.

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THANK YOU!