REPORT ON
POSSIBLE REVISION OF THE UTC TIME SCALE

50th Meeting of the CGSIC
Timing Subcommittee
20 September 2010

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ITU-R Working Party 7A

Letter from Director BIPM to Secretary General, ITU (1999)

Requested by the Consultative Committee for Time and Frequency (CCTF)

Issues were raised in the CCTF concerning discontinuities in UTC creating problems in coordinating telecommunications systems

Time as used in navigation satellite and telecommunications systems could possibly lead to multiple independent timekeeping systems (e.g. GPS Time) vice UTC

Difficulties in computer systems and networks to adjust for time steps or leap seconds

ITU-R issued new Question ITU-R 236/7, The Future of The UTC Time Scale

The Future of The UTC Time Scale

Question ITU-R 236/7
(2000)

1. What are the requirements for globally-accepted time scales for use both in navigation and telecommunications systems, and for civil time-keeping?
   - Accuracy, Stability, Based on the SI Second
   - Uniformity, Accessibility
   - Reliability
   - Availability
   - Civil / National Timekeeping

2. What are the present and future requirements for the tolerance limit between UTC and UT1?
   - |UT1 – UTC| Tolerance of 0.9 seconds
   - Could a Greater Tolerance be Accommodated?

3. Does the current leap second procedure satisfy user needs, or should an alternative procedure be developed?
   - Availability of Leap Second Information for Users
   - Alternatives Used (Establishing System Independent Time)
   - Relationship of Telecom & NAVSAT System Internal Time to Time Scales

ITU-R TF.460-6 STANDARD-FREQUENCY AND TIME-SIGNAL EMISSIONS
(1970-1974-1978-1982-1986-1997-2002)

To maintain worldwide coordination of standard frequency and time signals

Disseminate standard frequency and time signals in conformity with the SI second

Continuing need for UT immediate availability to an uncertainty of 0.1 second

All standard-frequency and time-signal emissions conform as closely as possible to UTC

Time signals should not deviate from UTC by more than 1 ms; that the standard frequencies should not deviate by more than 1 part in 1010

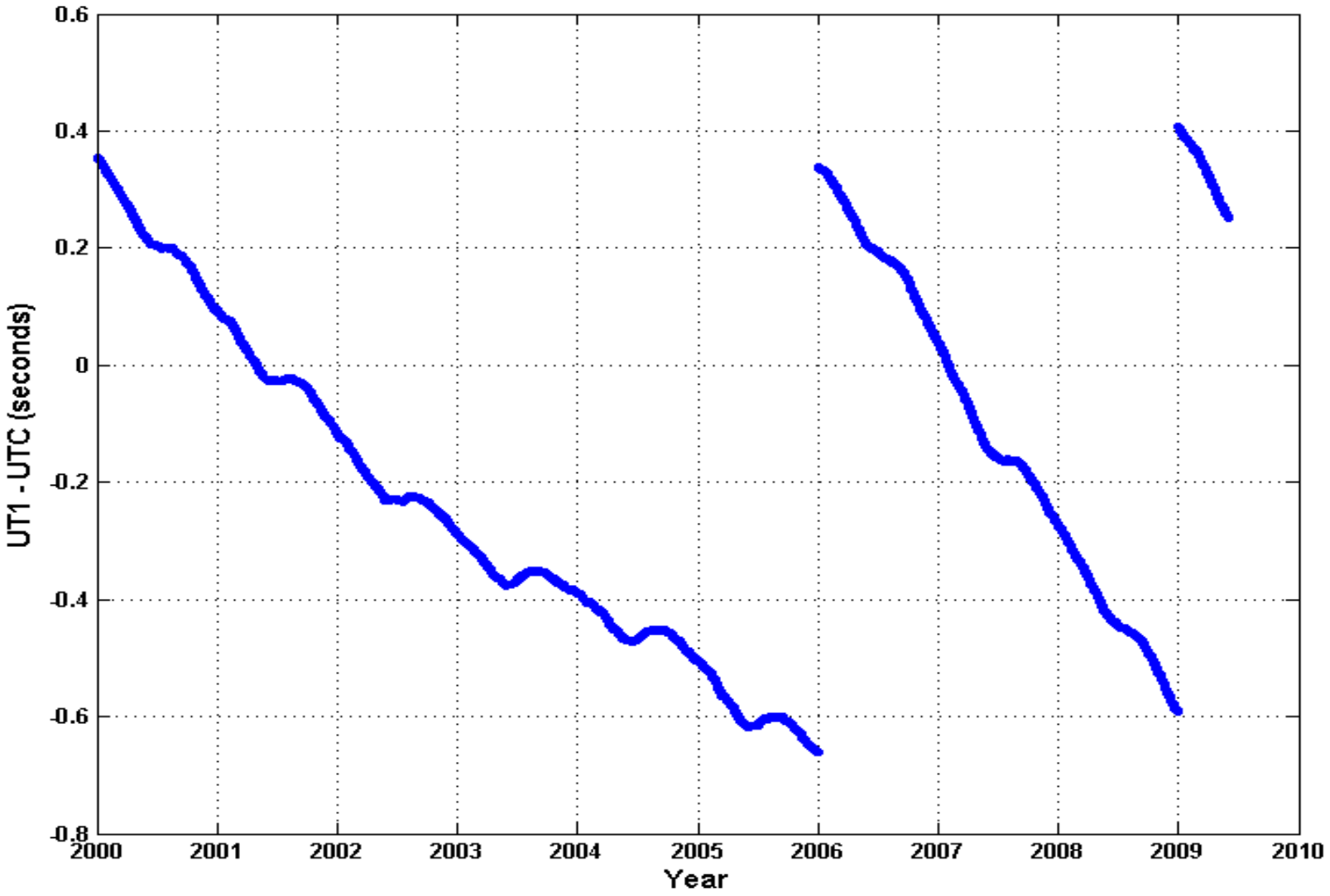
TAI - International reference timescale of atomic time based on SI second as realized on a rotating geoid. Continuous scale from origin 1 Jan 1958

UTC - Basis of coordinated dissemination of standard frequency and time signals. Corresponds exactly in rate with TAI but differs by integral number of seconds. UTC scale adjusted by insertion or deletion of seconds to ensure agreement with UT1

DUT1 - Dissemination to include *predicted difference* UT1 – UTC (values given by IERS in integral multiples of 0.1 s)

Leaps Seconds may be introduced as the last second of a UTC month December and June Preferred, March and September second choice

UT1 - UTC


0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
UT1 - UTC (seconds)
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year

WORKING PARTY ACTIVITIES

- Overall Working Party Special Rapporteur Group efforts were generally ignored
  - Surveys were inconclusive and data calls were less than fruitful
- Astronomical community at large has moved to dynamic relativistic time scales based on TT (1980)
- Definition of Spatial Reference Systems are benefiting from new capabilities such as GPS
- Assessment of developments in radio- and tele-commnication are indicative:
  - Ad hoc time in systems are driven by need for “Real-time” accuracy and precision
  - “Local Time” determined by statistical process of many standards/clocks are being employed in new systems - UTC(k)
  - Telecommunications capabilities increasing by distributed syntonized operation (CDMA Network)

CONCLUSIONS

Major scientific and GNSS organizations have not taken issue with the subject

- There has been ample opportunity and encouragement to contribute
- The lack of response has been interpreted as having no concern and thus no established opinion

Little information on quantitative costs has been provided

- The few estimates offered seem to be guesses at best
- Few observers noted there are costs associated with maintaining the status quo that may or may not be mitigated

Most experts in time metrology agree on the necessity for the change and offer technical support

The Consultative Committee on Time and Frequency strongly recommends proceeding with a decision so enough time is available for any necessary software and systems modifications

SUMMARY

- Documents demonstrate a clear misunderstanding of the definitions and applications of time scales and system times for internal synchronization
  - Indications that users have the choice between UTC, TAI, UT1, GPS Time for their applications is incorrect
  - UTC is the only international standard time scale, represented by local approximations in time laboratories, that should be used for worldwide time coordination and measurement traceability
  - TAI is not an option for applications needing a continuous reference as it has no means of dissemination, and it is not physically represented by clocks
  - GPS time is not a reference time scale, it is an internal time for GPS system synchronization, as other GNSS system times would be
  - A variety of continuous internal system time scales have proliferated to provide a solution to the problems associated with discontinuities in UTC
- The existence of multiple time scales creates potential problems in operational use as well as conceptual confusion on the proper definition and roles of time references

ACTIONS

Working Party &A exhausted technical considerations and studies

Consensus not reached on other than technical grounds

Submitted to Study Group 7 for resolution