

THE FUTURE OF THE UTC TIME SCALE

**53rd Meeting of the CGSIC
Timing Subcommittee
16 September 2013**

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 10^{10}

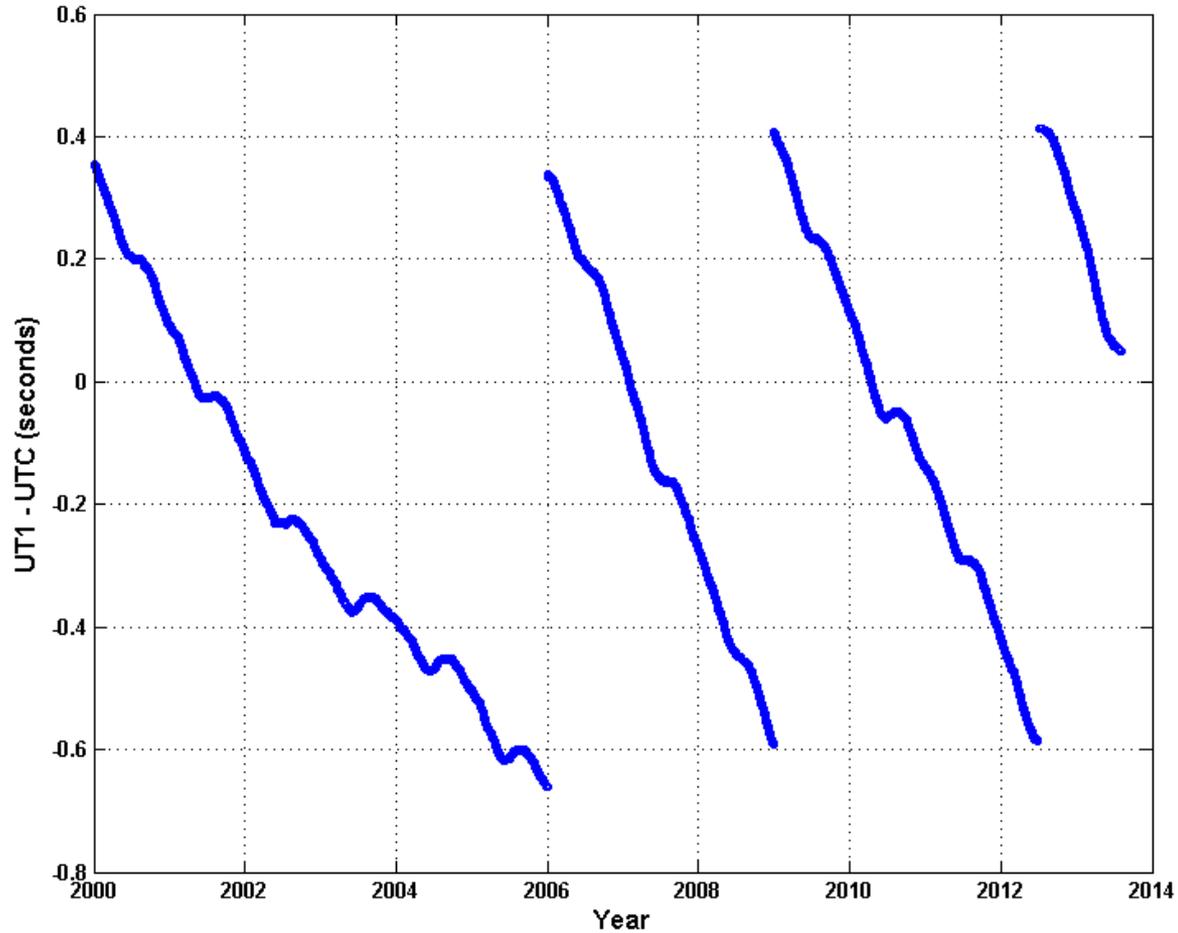
TAI - International reference timescale of atomic time based on SI second as realized on a rotating geoid. Continuous scale from origin 1 Jan 1958

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 (2000-2013)



WORKING PARTY ACTIVITIES

Prior efforts were generally ignored

Surveys were inconclusive and data calls were less than fruitful

Major scientific and GNSS organizations had 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

Assessment of developments in radio- and telecommunication changing need:

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 synchronized operation (CDMA Network)

STATUS AS OF 2011

Working Party 7A exhausted technical considerations and studies

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 system time scales creates potential problems in operational use as well as conceptual confusion on the proper definition and roles of time references

Consensus not reached on other than technical grounds

Submitted to Study Group 7 who forwarded to Radio Assembly (RA) for resolution

RA and WRC Actions in 2012

Proposed Modification to ITU-R TF460-6 discussed at Radiocommunication Assembly and forwarded to World Radiocommunication Conference (WRC-12)

WRC-12 decision contained in Resolution 653 which invited further study to be reported on the agenda for its next meeting in 2015

Resolution 653 recognized “that a change in the reference time-scale may have operational and therefore economic consequences” and invited ITU-R “to study issues related to the possible implementation of a continuous reference time-scale (including technical and operational factors)”

Agenda item 1.14 : “to consider the feasibility of achieving a continuous reference time-scale, whether by the modification of coordinated universal time (UTC) or some other method, and take appropriate action, in accordance with Resolution 653”

WRC-12 Results

Resolution 653 calls for notification of other organizations of Agenda item 1.14 (CGPM, CCTF, BIPM, IERS, BIPM and others)

Director of Radiocommunications Bureau to include presentation on the topic in Radiocommunications World Seminars

Included in Americas regional seminar held in Ecuador in September 2012

Administrations invited to participate in studies by submitting contributions to ITU-R

Recent ITU Activities

Conference Preparatory Meeting (CPM) 15-1 met February 2012 to begin the process

Designated ITU-R Working Party 7A (WP7A) as the responsible group to prepare text for WRC Agenda Item 1.14

WP7A to conduct further studies into:

Feasibility of achieving a continuous reference time-scale for dissemination by radiocommunication systems

Issues related to possible implementation of a continuous reference time-scale including technical and operational factors

WP7A continuing work on CPM Text and other study activities

Upcoming ITU Meetings

- **ITU-R WP7A 11-17 Sept 2013 in Geneva**
- **ITU/BIPM Workshop 19-20 Sept 2013 in Geneva**
 - **Future of International Time Scale Meeting**
 - **Jointly Sponsored by ITU and BIPM**
 - **“This workshop will provide a unique opportunity to get all available information on currently used and discussed precise frequency and time standards, sources and their characteristics, time scales and dissemination systems and different views on the future of UTC”**
- **WRC-15 27 November 2015 in Geneva**

