REPORT ON
CURRENT ACTIVITIES OF ITU-R WP7A

51th Meeting of the CGSIC
Timing Subcommittee
19 September 2011

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ITU-R Working Party 7A

The International Telecommunication Union
Radio Communications Sector
ITU-R

Agency responsible for coordination of Radio Spectrum and utilization

Promotes international cooperation in assignment of geostationary satellite orbits

Focal point for governments and private sector in developing networks and services

Maintains Frequency Allocations in ITU Radio Regulations, an international treaty, through World Radiocommunication Conferences (WRC)

- **Held every 3 to 4 years**
- **Process is implemented through seven Radiocommunication Study Groups**
- **Study Groups establish formalized series of questions, recommendations, reports, handbooks and opinions relevant to technology and operation in radio spectrum and satellite transmission characteristics**

Study Group 7-Science Services
Working Party 7A-Broadcast Time and Frequency Services

- Responsible for Time and Frequency Signal (TFS) Services both terrestrial and satellite
- Maintains questions, TF series of recommendations, reports, opinions and handbooks covering fundamentals of TFS generation, measurements and data processing
- Topics include
  - Terrestrial TFS transmissions, including HF,VHF and UHF
  - Television broadcasting
  - Microwave links
  - Coaxial and optical cables
  - Space based including navigation, communications and metrological satellites
  - Frequency standards, clocks and TFS measurements systems
  - TFS performance characterization
  - Time scales and time codes

ITU-R	Question
110-2/7	Time codes
111-1/7	Signal delays in antennas and other circuits and their calibration for high-accuracy time transfer
152-2/7	Standard frequencies and time signals from satellites
207-2/7	Time and frequency transfer using digital communication links
236/7	The future of the UTC time scale
238/7	Trusted time source for time stamp authority
239/7	Instrumentation time codes
244/7	Interference between standard frequency and time signal services operating between 20 and 90 kHz
245/7	Interference to the standard frequency and time signal service in the low-frequency band caused by noise from electrical sources
248/7	Timing Information from Global Navigation Satellite Systems (GNSS) and their augmentations
249/7	Time and frequency information from "enhanced" LOng Range Aid to Navigation (eLORAN)
250/7	Application and improvement of two-way satellite time and frequency transfer (TWSTFT)

ITU-R	Recommendation
TF.374-5	Precise frequency and time-signal transmissions
TF.457-2	Use of the modified Julian date by the standard-frequency and time-signal services
TF.460-6	Standard-frequency and time-signal emissions
TF.486-2	Use of UTC frequency as reference in standard frequency and time signal emissions
TF.535-2	Use of the term UTC
TF.538-3	Measures for random instabilities in frequency and time (phase)
TF.583-6	Time codes
TF.686-2	Glossary and definitions of time and frequency terms
TF.767-2	Use of global navigation satellite systems for high-accuracy time transfer
TF.768-6	Standard frequencies and time signals
TF.1010-1	Relativistic effects in a coordinate time system in the vicinity of the Earth
TF.1011-1	Systems, techniques and services for time and frequency transfer
TF.1153-3	The operational use of two-way satellite time and frequency transfer employing PN codes
TF.1876	Trusted time source for time stamp authority

Coordinated Universal Time (UTC)

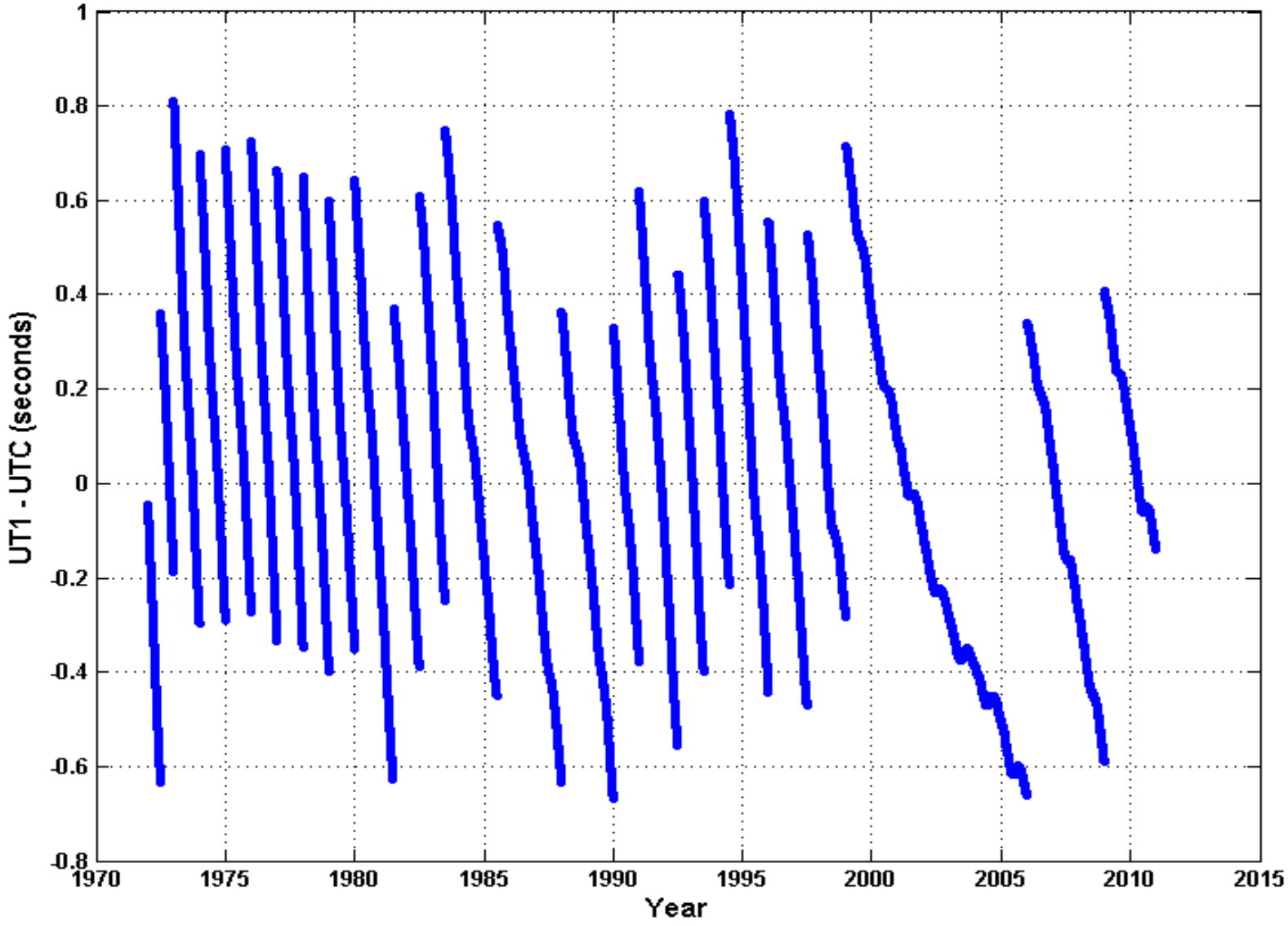
ITU-R TF.460-6 STANDARD-FREQUENCY AND TIME-SIGNAL EMISSIONS
(1970-1974-1978-1982-1986-1997-2002)

Originated from the need to "coordinate" time at different timing centers and their time broadcasts

Defined as stepped atomic time scale to approximate UT1 from International Atomic Time (TAI)

- **UTC = TAI + n seconds, where n = integer seconds**
- **Adjusted when the predicted difference will maintain**
  - **UT1 – UTC < 0.9 seconds**
- **Rate determined by TAI so basic interval is SI second**

UT1-UTC


UT1 - UTC (seconds)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year

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

Prior Working Party Activities on Future of UTC

A Special Rapporteur Group was formed to focus studies
- Efforts were generally ignored
- Associated surveys were inconclusive
- Data calls were less than fruitful

Credible impact to software for controlling telescopes and astrodynamic orbit determination a serious concern
- Cost estimates provided spanned orders of magnitude

Assessment of developments in radio- and tele-commnication are indicative of needs
- 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 needing distributed syntonized operation (CDMA Network) are increasing

Alternatives to Modifying UTC

Create a new time scale, to be known as International Time (TI)

- **Eliminate UTC and replace with TI**
- **Could result in major confusion**

Use TAI instead of UTC

- **TAI is metrologic scale and not distributed**
- **Transition could result in major time step**

Adopt GPS Time as the official international time scale

- **GPS Time is a system real time internal time scale**
- **Derived from system clocks not global timing centers**
- **Rate and time steps can be changed in accord with system demands**

Increase maximum tolerance of DUT1

- **One hour would be similar to Daylight Savings Time (Summer Time)**

Do Nothing

Results and Conclusions

- Major scientific and GNSS organizations have not taken issue with the subject
  - There has been ample opportunity and encouragement to contribute

- Major cost issues with systems have been raised
  - 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 – Example of impact of EOP re-definition

- A variety of continuous internal system time scales have proliferated to provide a solution to discontinuities in UTC
  - Multiple time scales in global systems could create potential problems in operational use as well as conceptual confusion on the proper definition and roles of time references

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

CURRENT SITUATION

Working Party 7A exhausted technical considerations and studies

- **Consensus not reached due to other than technical grounds**

Forwarded to Study Group 7 (SG7) for resolution

- **SG7 likewise unable to resolve the issue**
- **SG7 submitted informal survey to Member States for Comment – Few responses**

SG7 to submit issue to Radio Assembly for resolution

- **A second informal survey was circulated to raise awareness of issue**