|  |  |
| --- | --- |
|  |  CPG15(14)017 Annex IV-14 |
| CPG15-4  |  |
| Riga, Latvia 25th - 28th March 2014 |  |
|  |  |
| Date issued:  | 30th March 2014 |
| Source:  | CPG15-4 |
| Subject:  | Draft CEPT Brief on WRC-15 Agenda Item 1.14 |
|  |
| Summary:  |
|  |
| Proposal: |
|  |

DRAFT CEPT BRIEF ON AGENDA ITEM 1.14

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)

# ISSUE

This agenda item will consider the feasibility of achieving a continuous reference time-scale, whether by modification of coordinated universal time (UTC) or by some other method, and take appropriate actions in accordance to Resolution 653 (WRC-12).

Resolution 653 (WRC-12) invites ITU-R “to conduct the necessary studies on the feasibility of achieving a continuous reference time-scale for dissemination by radiocommunication systems”; and “to study issues related to the possible implementation of a continuous reference time-scale (including technical and operational factors)”.

# Preliminary CEPT position

* CEPT supports the necessary studies on the feasibility of achieving a continuous reference time-scale, by modification of UTC or by other method, for dissemination by radiocommunication systems
* CEPT also supports study on issues related to the possible implementation of a continuous reference time-scale (including technical and operational factors.

# Background

This agenda item was created as a result of the outcome of RA-12 following discussion of the proposed modifications to ITU-R Recommendation TF 460-6 proposing to discontinue the insertion of leap seconds in the definition of UTC. The approval of the recommendation was sent to RA-12 as there was no consensus in working party 7A and Study Group 7 after extensive debate over several years.

At RA-12 there was an even balance between those administrations in favour of the draft revision of the Recommendation and those opposing it. A large third group of administrations indicated that they had not participated actively in the work of Study Group 7 and Working Party 7A and that more time/information was required to form an opinion. As a result RA-12 decided not to approve the draft revision, and that instead it be returned to ITU-R Study Group 7 to consider other technical options, such as consideration of the use of a leap-minute adjustment, in addition to those already considered in the preparation of the draft revision. These additional studies should take account of broader implications and include consultations with appropriate external organisations. A key element of this compromise package was that the Chairman of RA-12 would include a proposal for an Agenda item at WRC-15 to discuss the issue and ensure wider discussion in the framework of WRC preparation.

****Why is UTC not a continuous time scale ?****

For millennia time was measured as a consequence of Earth rotation around itself and around the Sun where 24 hours marked the crossing of the Sun at the meridian. Universal time is a measure of time that conforms to the mean diurnal motion of the Sun as observed at the prime meridian. The unit of time, the second, used to be considered as the fraction 1/86400 of the mean solar day. This definition was sufficient at a time when no telecommunication systems existed and navigation was based on celestial observation.

However because of the irregular rotation rate of the Earth the duration of a day is not constant, this became noticeable when systems (i.e. telecommunications etc) began to rely on precise and constant time scale. A first attempt to create a constant time scale was made by defining the ephemeris second in 1952. Later on in 1967 the SI second (close to the ephemeris second of 1952) was defined as the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.

From1967 time became linked to the atomic SI second whatever the irregularities of the Earth rotation making the days longer or shorter when measured with new atomic time scale.

This created a time difference between the atomic time and the universal time which was initially about 1s per year. This is the background to the issue which has arisen implementing the system using this time discontinuity.

Coordinated Universal Time (UTC) is the international standard time scale for all practical timekeeping in the modern world. Recommendation ITU-R [TF.460-6](http://www.itu.int/rec/R-REC-TF.460-6-200202-I/en) which is incorporated by reference in the Radio Regulations provides the official definition of UTC. UTC is maintained by the International Bureau of Weights and Measures (BIPM) by the contribution from timing laboratories throughout the world, operating atomic clocks, and data from the International Earth Rotation and Reference Systems Service (IERS).

UTC which is a time scale based on atomic time but synchronized with the universal time UT1 in such a way that the difference between UTC and the solar time UT1 is always less than 0.9 s was introduced in 1972.The current practice to solve this problem is to adjust the UTC by inserting or deleting a second anytime the difference with the universal time became close to 0.6 s.

In the initial years after 1967 there was need to insert one and some cases two leap seconds per year. However in recent years the slowing of the Earth rotation has reduced slightly and this has resulted in leap seconds being applied far less frequently. Currently this is about once every 3 to 4 year.

****Preliminary analysis of possible solution to satisfy the issue****

WP 7A met during 11-17 September 2013 and further revised the draft CPM text which now has two methods to satisfy the requirement of the agenda item.

One of the methods to achieve a continuous time-scale proposes modification to current UTC definition by ending leap seconds and revising Recommendation ITU-R TF. 460-6 accordingly, while maintain the name UTC. The advantages and disadvantages of this possible solution are show below;

****Disadvantages****

Problem related to correction action In the event of transition to a continuous time-scale it will still be necessary to transmit corrections to allow converting the continuous time scale into UT1 and UTC for tasks based on the usage of the current UTC time-scale. Therefore the procedure of leap second will need to be retained for corrections allowing conversion from the continuous to UTC time-scale.

In this respect failures caused by inadequate software or human factor will remain. Since the difference between UT1 and UTC will increase the consequences of failure due such corrections could be significantly greater than the application of the procedure described in the current version of Recommendation ITU-R TF. 460-6.

****Problem related to backward compatibility****

If the above mentioned proposal is implemented the backward compatibility principle will not be ensured as some existing equipment such as earth stations of the satellite non-GSO systems, radio astronomy stations, radionavigation systems and others may not operate in full mode without updates and/or replacements leading to significant costs.

Furthermore it may be necessary to modify legal and technical documents on both the international and national levels since many of them refer to the UTC time-scale for time measurements.

****Advantages****

The use of UTC without leap seconds will establish a continuous reference time-scale, based on atomic time, from which other specialized continuous time scales with or without fixed offset can be derived. A UTC time scale without leap second can result in the use of only one continuous reference time scale for all telecommunication systems making it truly universal.

The definition of civil time based on UTC will not change as the deviation between UTC without leap second and solar time although increasing will be negligible on a human scale as it should be approximately one minute per century which is far less than the difference between solar time and local time in most of the places on Earth.

Suppression of the use of leap seconds in UTC eliminates the software, protocols, or coordination necessary to insert leap second.

Because leap seconds adjustments are irregular they are therefore inserted manually rather than automatically, many systems in operation worldwide will not notice that the insertions have ceased altogether.

The continued use of the name “Coordinated Universal Time” (UTC) will avoid confusion and maintain consistency, as UTC will continue to be “universally” used and “coordinated” worldwide.

Applications such as astronomy or celestial navigation requiring a precise knowledge of UT1 will not be affected as the precise link between UT1 and UTC will be preserved. The International Earth Rotation and Reference Systems Service (IERS) publishes electronically in the IERS Bulletin A (weekly) near real time predictions of UT1-UTC over one year that give users access to UT1 with a precision that is 100,000 times better than that available from present broadcast UTC.

****Possible way forward****

Because of the above disadvantages it is proposed to consider alternative methods. One such possible proposed method is a revision of Recommendation ITU-R TF. 460-6 keeping the current UTC time-scale without changes but bringing into use the continuous time-scale on an equal basis. This solution is in line with method 2 in the draft CPM text under development in WP7A.

This method allows operation of the systems using the current UTC time-scale without any changes and costs and also allows elimination of many of the problems related to corrective action i.e. because in each case the most suitable time-scale can be chosen and applied for a particular system.

To implement this solution it is necessary to study the possibility of disseminating the continuous time-scale TAI together with UTC and if results are positive prepare appropriate proposals for modification of Recommendation ITU-R TF.460-6.

Furthermore a section on the analysis of the results of studies outlines the difficulties of either removing or keeping the leap second as on one hand introduction of leap seconds may prove more and more difficult for some systems relying on precise time synchronization while some radionavigation satellite systems implementing the leap second such as Glonass may need to be updated to continue safe and reliable operations.

# List of relevant documents

ITU-R Recommendation TF 460-6 - Standard-frequency and time-signal emissions

Resolution 653 (WRC-12)

Study Group 7 chairman report to RA-12, Document 7/1001

ITU-R WP7A chairman’s report – 11-17 September 2013 (Doc 7A/42)

Preliminary draft text WRC-15 agenda item 1.14 (Doc 7A/42 annex 1)

Proposed revision of Recommendation ITU-R TF.686-2 in response to WRC-15 Agenda item 1.14 (Doc. 7A/28 Annex 2)

Draft working document relating to WRC-15 agenda item 1.14 (Doc 7A/28 Annex 3)

ITU/BIPM workshop presentations (19-20 Sep 2013)

(<http://www.itu.int/ITU-R/index.asp?category=conferences&rlink=itu-bipm-workshop-13&lang=en>)

Editor’s note: to add descriptions of UTC/UT1

# Actions to be taken

* to support ITU-R and CEPT studies.
* to study wider implications (including technical, operational and economic consequences) of the changes to ITU-R Recommendation TF 460-6 by stopping the insertion of leap seconds
* to provide information on the studies above to CPG to ensure the widest understanding of this issue. To study the possibility of (1) discontinuing the insertion of leap seconds to UTC or (2) disseminating the continuous time-scale based on TAI together with UTC with leap seconds as currently defined.

# Relevant information from outside CEPT (examples of these are below)

## European Union (date of proposal)

## Regional telecommunication organisations:

APT (28 November 2013)

* APT Members are generally supportive of the studies undertaken by ITU-R WP 7A on the feasibility of achieving a continuous reference time scale
* A continuous reference time scale is beneficial for most users, and an appropriate implementation of continuous international time scale should be developed and agreed by relevant international organizations
* Considering its wide applications, the redefinition of UTC must be treated with caution

ATU (date of proposal)

Arab Group (1 December 2013)

* Follow up the current studies in WP 7A.
* Invite the concerned entities in each country to provide their advice on the change on the UTC.

CITEL (4 December 2013)

Preliminary Views

(Brazil/Canada)

* Support ITU-R studies with the aim of finding a compromise solution that would satisfy the need by some administrations to have a continuous reference time-scale while at the same time preserving Coordinated Universal Time (UTC) with its current definition;
* Noting that the current UTC timescale has been used satisfactorily since 1972, and is used in many types of applications and telecommunications systems, any change must be properly justified, carefully studied and planned, considering the possible risks the change may have on these applications;
* The studies should also highlight the impact of a possible change from the standard UTC to a new continuous time scale, especially with respect to the costs involved and the consequences for all including developing countries.
* All options including better implementation and enhanced distribution should be looked at.
* Clarification of the nomenclature associated with the definition of time in the ITU is required.

United States:

Supports the adoption of UTC without leap seconds as the solution for achieving a continuous reference time-scale for dissemination by radiocommunication systems if the studies, in accordance with Resolution 653 (WRC-12), support this as a viable solution.

RCC (25 April 2013)

RСС preliminary position:

The RCC administrations support determination of the need for transition to continuous reference time-scale taking into account advantages, disadvantages and implications of such a transition in terms of its effect on existing telecommunication systems and on their development.

The RCC administrations also support determination of various methods for transition to the continuous reference time-scale (e.g. by the modification of the Coordinated Universal Time (UTC) or by other methods) with the aim of selecting the most appropriate method as well as procedure and required time span for implementation of the selected method.

The RCC administrations are of the opinion that some transition period would be required for implementation of a new scale in the case of favourable finding on feasibility of such a scale.

## International organisations

IATA (date of proposal)

ICAO (date of proposal)

No impact on aeronautical services has been identified from WRC-15 Agenda 1.14.

IMO (18 November 2013)

Draft IMO position

IMO considers that a linear timescale would simplify the operation of some automated equipment. On the other hand, a timescale based on Earth rotation is essential for a number of navigational purposes.

NATO (December 2013)

Preliminary NATO Military Position

NATO will continue to monitor the progress on this item and will evaluate the potential impact on military systems.

SFCG ( )

SFCG supports studies of the technical and operational benefits/impact of implementing a continuous reference time-scale. SFCG is of the opinion that space science satellite operations and launches would benefit from a continuous time scale. The effects on GNSS should be studied.

WMO and EUMETNET (date of proposal.

## OTHER INTERNATIONAL AND REGIONAL ORGANISATIONS

ESA (date of proposal)

Eurocontrol (date of proposal)

International Astronomical Union (IAU)

CRAF

CRAF has decided to adopt the position of the International Astronomical Union (IAU) which has not yet been finalized