

## **Recommendation 16-A for Committee Decision**

**Prepared by:** Working Group D

**Date of Submission:** 12 November 2013

**Issue Title:** Information on the works related to the proposed redefinition of UTC (revision of Recommendation 16 (2012))

### **Background/Brief Description of the Issue:**

Considering that:

- the navigation systems have unique timing and geodetic references for operational necessity. Interoperability of the GNSS requires interrelationship of the timing and geodetic references to reduce ambiguities for users with regard to the interpretation of navigation and timing solutions.
- discussion on redefinition of UTC started in 2000 at the ITU-R, SG7 Science Services WP7A Time Signals and Frequency Standard Emissions,
- during 2000-2010 WP7A studied the issue, considered different options, organized an open meeting (Torino, 2003), and worked on a proposal for an amended ITU recommendation,
- in 2010 the Draft Revision of Recommendation ITU-R TF.460-6 (new proposed version) was submitted by ITU-R WP7A to ITU-R SG7; while considering this issue at SG7 no consensus on the Draft Revision of Recommendation ITU-R TF.460-6 was achieved,
- the SG7 sent the Draft Revision of Recommendation ITU-R TF.460-6 to the Radiocommunication Assembly 2012 (RA -12) for « final decision »,
- at RA-12 after several statements of Administrations and Sector members supporting different views the Chairman stated that there are almost even balance between those administrations that are in favour of the draft revision of the Recommendation, those that are opposing it, and a third group of administrations who indicated that as they had not participated actively at SG7 and WP7A meetings, more information is required to enable them to form an opinion,
- as a result RA-12 decided to address this issue in the RA-12 Report for World Radiocommunication Conference 2012 (WRC-12) to develop a new WRC-15 Agenda item.
- WRC-12 started a new study question on WRC-15 Agenda item 1.14 in accordance with Resolution 653 (WRC-12) and put back the Draft Revision of Recommendation ITU-R TF.460-6 to SG7-WP7A for a final decision at WRC-15,
- WRC-12 Resolution 653 on the feasibility of a continuous UTC involves the BIPM, CCTF, CGPM, IAU, IUGG, URSI, ICAO, IMO, WMO, ISO, and invites to consider the feasibility of achieving a continuous reference time-scale, whether by the modification of UTC or some other method, and take appropriate action, taking into account ITU-R studies.

### **Recommendation of Committee Action:**

- It is recommended that the ICG monitors the ongoing development of the proposed redefinition of UTC and that reports be presented until a decision is made at WRC-15.

## **Recommendation 18 for Committee Decision**

**Prepared by:** Working Group D

**Date of Submission:** 12 November 2013

**Issue Title:** Assessment of the alignments of GNSS associated reference frames to the ITRF

### **Background/Brief Description of the Issue:**

Considering

- The alignment of CGS2012 for Beidou, JGS2010 for QZSS, PZ-90.11 for GLONASS and WGS84(G1674) for GPS, the GTRF13v02 for Galileo to the latest realization of the International Terrestrial Reference System in the form of ITRF2008,
- The IGS effort in conducting MGEX project and in making publicly available all data collected at MGEX sites, including broadcast orbits and clocks

### **Discussion/Analyses:**

The users of different GNSS broadcast orbits contained in the corresponding navigation messages need consistent and precise point positioning results expressed in a reference frame that is pre-aligned to the ITRF.

### **Recommendation of Committee Action:**

The ICG WG-D recommends that interested groups to determine multiple sets of coordinates for MGEX or/and other stations where multi-GNSS receivers are operated, using individual sets of GNSS broadcast ephemeris, evaluate their consistency and provide feedback to the IGS multi-GNSS experiment.

## Recommendation 19 for Committee Decision

**Prepared by:** Working Group D

**Date of Submission:** 12 November 2013

**Issue Title:** Official provision of a rapid UTC (UTC<sub>r</sub>) by the BIPM

### Background/Brief Description of the Issue:

In November 2012 the ICG recognized that a rapid computation of UTC at the BIPM was an important service benefiting interoperability of navigation systems.

Considering that:

- after a successful pilot experiment started in January 2012, UTC<sub>r</sub> has attained the expected stability and accuracy,
- at the issue of the validation process, UTC<sub>r</sub> become an official BIPM product in July 2013, and is regularly published on the BIPM website every Wednesday at 18 h UTC at latest,
- the weekly provision of the offsets between local realizations UTC(k) in national institutes with respect to UTC<sub>r</sub> enhances the traceability of these local realizations to the ultimate reference UTC,
- the UTC(k) serving for synchronizing the GNSS times to UTC participate to the weekly UTC<sub>r</sub> solution, and that predictions of these UTC(k) are broadcast by GNSS,
- users of GNSS get a better synchronization of GNSS times to UTC, through improved UTC and UTC(k) predictions.

### Discussion/Analyses:

N/A

### Recommendation of Committee Action:

WG-D recommends that GNSS Providers consider the use of UTC<sub>r</sub> for

- getting a better synchronization of GNSS times to UTC,
- improving the quality of the predictions of UTC(k) broadcast by GNSS,

and further recommends studying the possibility of using UTC<sub>r</sub> as a common time reference for interrelationship between GNSS times.

## Recommendation 20 for Committee Decision

**Prepared by:** Working Group D

**Date of Submission:** 12 November 2013

**Issue Title:** BIPM publication of [UTC – GNSS times] and [UTC – UTC(k)]<sub>GNSS</sub>

### Background/Brief Description of the Issue:

Considering that

- Coordinated Universal Time UTC is the sole international reference time scale,
- That GNSS times are constraint to keep within specified offsets from UTC(k),
- That GNSS broadcast a prediction of UTC(k) namely  $UTC(k)_{GNSS}$ .

Noting that

- the BIPM has been publishing in its monthly Circular T for over 25 years daily values of [UTC – GNSS times] and more recently also of [UTC – UTC(k)]<sub>GNSS</sub>
- This information is useful to users of GNSS services, but also to GNSS systems to assess the quality and interoperability of their systems.

### Discussion/Analyses:

The monitoring of the values of [UTC – GNSS times] and [UTC – UTC(k)]<sub>GNSS</sub> serves to a better coordination of the various GNSS and to provide a better time service to users.

The procedure for calculation of these values is provided in Section 5 of BIPM Circular T, available at <http://www.bipm.org/jsp/en/TimeFtp.jsp?TypePub=publication>.

### Recommendation of Committee Action:

The ICG WG-D recommends that the BIPM continues the regular provision of the values of [UTC – GNSS times] and [UTC – UTC(k)]<sub>GNSS</sub> and extends them to other GNSS, in particular Galileo and BeiDou.

## **Recommendation 21 for Committee Decision**

**Prepared by:** Working Group D

**Date of Submission:** 13 November 2013

**Issue Title:** On the monitoring of offsets between GNSS times

### **Background/Brief Description of the Issue:**

Offsets between GNSS times are important information for GNSS users. Monitoring of the offsets between GNSS times and provision of consistent broadcast information are essential to improve interoperability and combined navigation using multiple GNSS.

### **Discussion/Analyses:**

Information of the differences between the GNSS times is the basis of interoperability and combined application of the various GNSS systems. Every GNSS system has its own time system and they are different. The time offsets between different GNSS could be measured continuously by GNSS timing receivers, could be obtained by direct time comparison link or computed from a common reference. The monitoring and broadcast of GNSS time offsets are technically possible and will benefit GNSS providers and users.

The time offset between GPS and Galileo (GGTO) is currently being monitored and is planned to be broadcast in their navigation messages. The time offset parameters of BDT relative to the other three GNSS times have been designed in BeiDou navigation messages and the relevant experiments of monitoring and prediction have been implemented.

In order to improve the monitoring of offsets between GNSS times, the different GNSS should work for reaching consistency in the procedures for monitoring and broadcasting the GNSS time offsets.

### **Recommendation of Committee Action:**

1. GNSS Providers should consider monitoring of offsets between GNSS times and implement the broadcast of this information in the navigation messages.
2. GNSS Providers are encouraged to undertake studies on possible approaches for giving information on the offsets between GNSS times.
3. In order to improve consistency of offsets between GNSS times broadcast by the various systems, GNSS Providers should discuss on the adoption of the same or similar models.