RADIOCOMMUNICATION
STUDY GROUPS

International Telecommunication Union – Radiocommunication Sector (ITU-R)

24th Meeting of the CCU
Redefinition of the Second
9 October 2019

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Chairman, ITU-R Working Party 7A

ITU-R Radiocommunications Study Groups

- To determine a ITU-R position on Possible Redefinition of the Second the technical aspects and impacts need to be studied and considered by the Participating Member States

- The ITU-R Study Groups develop the technical basis for decisions taken at World Radiocommunication Conferences and develop global standards (Recommendations), Reports and Handbooks on radiocommunication matters.

- There are seven Study Groups and the Responsible Group is Study Group 7, Science Services

- Within Study Group7, Working Party 7A deals with Broadcast Frequency and Time Signals Services

ITU-R Study Group 7 Science Services

Working Party 7A, Frequency and Time Signals Services

Responsible for Standard Frequency and Time Signal (STFS) services, both terrestrial and satellite.

Scope includes the dissemination, reception and exchange of STFS services and coordination of these services, including satellite techniques, on a worldwide basis.

Goals are to develop and maintain ITU-R Recommendations in the TF Series and Handbooks relevant to SFTS activities, covering the fundamentals of the SFTS generation, measurements and data processing. These ITU-R Recommendations are of paramount importance to telecommunication administrations and industry, to which they are first directed. They also have important consequences for other fields, such as radio navigation, electric power generation, space technology, scientific and metrological activities and cover the following topics:

- Terrestrial SFTS transmissions, including HF, VHF, UHF broadcasts; television broadcasts; microwave link; coaxial and optical cables;
- Space-based SFTS transmissions, including navigation satellites; communication satellites; meteorological satellites;
- Time and frequency technology, including frequency standards and clocks; measurement systems; performance characterization; timing interface standards; time scales; time codes

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WP 7A QUESTIONS

Question ITU-R	Title	Category	Proposed target date
110-2/7	Time codes	S2	2023
111-1/7	Signal delays in antennas and other circuits and their calibration for high-accuracy time transfer	S2	2023
152-2/7	Standard frequencies and time signals from satellites	S2	2023
207-3/7	Time and frequency transfer using digital communication links	S2	2023
236/7	The future of the UTC time scale	C2	2023
238/7	Trusted time source for time stamp authority	S2	2023
239/7	Instrumentation time codes	S2	2023
244/7	Interference between standard frequency and time signal services operating between 20 and 90 kHz	S2	2023
245/7	Interference to the standard frequency and time signal service in the low-frequency band caused by noise from electrical sources	S2	2023
248/7	Timing Information from Global Navigation Satellite Systems (GNSS) and their augmentations	S2	2023
249/7	Time and frequency information from “enhanced” Long Range Aid to Navigation (eLORAN)	S2	2023
250/7	Application and improvement of two-way satellite time and frequency transfer (TWSTFT)	S2	2023
253/7	Relativistic effects in the transfer of time and frequency in the vicinity of the Earth and in the solar system	S2	2023

Establish Basis for Reports, Recommendations and Handbooks

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

The Consultative Committee for Time and Frequency (CCTF) has concerns to raise since the ITU-R is responsible for the Definition of UTC

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

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 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

WP 7A RECOMMENDATIONS

ITU-R	Title	ITU-R Questions	Revision
TF.374-5	Precise frequency and time-signal transmissions	102/7	04/99
TF.457-2	Use of the modified Julian date by the standard-frequency and time-signal services	102/7	10/97
TF.460-6	Standard-frequency and time-signal emissions	102/7	02/02
TF.486-2	Use of UTC frequency as reference in standard frequency and time signal emissions	102-1/7	02/98
TF.535-2	Use of the term UTC	102-1/7	02/98
TF.538-3	Measures for random instabilities in frequency and time (phase)	104/7	03/94
TF.583-6	Time codes	110/7	05/03
TF.686-2	Glossary and definitions of time and frequency terms	N/A	02/02
TF.767-2	Use of global navigation satellite systems for high-accuracy time transfer	152/7	03/01
TF.768-6	Standard frequencies and time signals	N/A	05/03
TF.1011-1	Systems, techniques and services for time and frequency transfer	102/7	10/97
TF.1153-3	The operational use of two-way satellite time and frequency transfer employing PN codes	250/7	04/10
TF.1876	Trusted time source for time stamp authority	238/7	04/10
TF.2018	Relativistic time transfer in the vicinty of the Earth and in the solar system	253/7	08/12

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ITU-R RECOMMENDATION 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

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

Handbook Selection and Use of Precise Frequency Systems, 1997 Edition

Contents

Chapter 1 Introduction and basic concepts
Chapter 2 Available frequency and time sources
Part A Local frequency and time sources
Part B Steering references
Chapter 3 Characterization: frequency domain, time domain
Chapter 4 Measurement techniques (Metrology)
Chapter 5 Characteristics of various frequency standards
Chapter 6 Time Scales
Chapter 7 Uses of frequency sources
Chapter 8 Operational experience, problems, pitfalls
Chapter 9 Future prospects
Chapter 10 Conclusions

Handbook Satellite Time and Frequency Transfer and Dissemination, 2010 Edition

CONTENTS

1 Satellites and Time And Frequency Transfer And Dissemination Introduction
2 The Global Positioning System
3 Satellite Based Augmentation System To Gps
4 GPS System Time
5 GLONASS Navigation Satellite System
6 Communication Satellite Systems
7 Time Scales
8 National Timing Centres
9 Relativistic Effects In Satellite Time And Frequency Transfer And Dissemination
10 Earth Orientation and Geodetic System
11 Propagation and Environmental Factors
12 Global Navigational Satellite System – As A Primary Tool For Time Transfer
13 Geodetic Techniques Using Gps Phase And Code Measurements
14 Two Way Satellite Time and Frequency Transfer (TWSTFT)
15 Summary Time and Frequency Dissemination

Current WP 7A Activities

Revising the Handbook Selection and Use of Precise Frequency Systems, 1997 Edition.

Preparing a report summarizing technical studies and analyses related to Time-Scale determination and distribution applications to provide supporting technical information in depth to support proposals to be submitted to WRC-23.

This Technical Report will discuss technical aspects of time-scale realization and applications to support proposals for future systems, and provide detailed information for WRC decisions

Content and structure of time signals to be disseminated by radiocommunication systems and various aspects of current and potential future reference time scales, including their impacts and applications in radiocommunication

1 Introduction
2 Background
- 2.1 The origins of UTC
- 2.2 Organizations responsible for UTC
- 2.3 Other organizations associated with time scales and related standards

3 Description of current and potential future reference time-scales
4 Synchronization and dissemination of time signals via radiocommunication systems
5 Use of UTC in radiocommunication services and other applications
6 Impact of using UTC on radiocommunication services and other applications
- 6.1 Impact on radionavigation satellite service
- 6.2 Impact on mobile satellite service
- 6.3 Impact on the fixed satellite service
- 6.4 Impact on the broadcasting satellite service
- 6.5 Impact on the mobile service
- 6.6 Impact on the radioastronomy service
- 6.7 Impact on the maritime mobile service, including global maritime distress and safety service (GMDSS), aeronautical mobile service and radiodetermination service
- 6.8 Impact on the time-stamping service
- 6.9 Impact on other applications

7 Summary of results
8 References