

REPORT FROM THE ITU-R WORKING PARTY 7A ON TIME SIGNALS AND FREQUENCY STANDARD EMISSIONS

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Abstract

The Working Party 7A (WP-7A) on "Time Signals and Frequency Standard Missions" is one of the four Working Parties of Study Group 7 "Science Services" (SG 7) of the Radiocommunication Sector of the International Telecommunication Union (ITU-R). The subjects which are addressed in the WP-7A meetings on the basis of input documents as answers to Questions are: (worldwide) Standard frequency and time (T&F) dissemination from terrestrial transmitters and from satellites, including GPS, GLONASS, and Two-Way Satellite T&F transfer, time codes, requirements for high precision time, performance of T&F standards, time scale stability characterization, signal delays in antennas and other circuits, time delay measurements, compensation methods in SDH/SONET systems, etc. The results of the discussions during the meetings are presented, preferably in the form of ITU-R Recommendations to the ITU member states.

Also, for the purpose of communication of the best use and selection of T&F systems to a wide group of users, the writing of handbooks in WP-7A has been started with contributions from internationally recognized specialists. The manuscript of the first handbook has been finished under Dr. R. Sydnor as main editor and D.W. Allan as co-editor. The English version has been prepared for press and is also being translated into French and Spanish.

Several ITU-R Study Group and Working Party meetings were held in Geneva in October 1996. The results of the last WP-7A meeting, held 8 to 16 October 1996, are presented.

ITU-R Working Party 7A Schedule

1996

Publication of accepted Recommendations:
1995 TF Series Fascicle

Oct 8-16 Meeting WP 7A in Geneva

Oct 17-18 Meeting of Study Group 7 in Geneva

Publication TF Handbook Selection & Use Precise T/F Systems

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1997

June 2-6 Meeting WP 7A

June Meeting SG 7

Oct Meeting Radiocommunication Assembly

**1998 Publication accepted Recommendations:
1997 TF Series Volume**

Draft revision of Question ITU-R 111/7

Signal Delays in Antennas and other Circuits and their Calibration for High-Accuracy Time Transfer

- * What methods can be recommended and standardized to calibrate delay introduced by antennas and associated circuits for accurate time transfer (down to below one nanosecond)**
- * What parameters influence the delay**
- * What environmental effects affect delay**
- * What level of agreement exists between calibrated Two-Way and GPS/GLONASS Time Transfers**
- * what standard reference systems would be useful for calibration purposes**

Frequency Comparisons of Remotely Located Standards at the 10^{-15} Level of Uncertainty

The ITU Radiocommunication Assembly,

Considering

- that the stability of primary and some commercial frequency standards at the 10^{-14} level at one day and expected to improve to the 10^{-16} level;
- that present time transfer are at best stable to about one nano second and need an integration time of many days to reach a frequency transfer at 10^{-15} level;
- that;

decides that the following Questions should be studied

***How can frequency be transferred at the 10^{-15} level within a day?**

***What means of self calibration and self monitoring are needed for these highly reproducible and accurate transfers?**

Standard Frequencies and Time Signals

(Question ITU-R 106/7)

Additions and revisions to the Annex, tables 1 and 2

DCF 77, WWVB, Loran-C, etc.

EXAMPLES

The examples contain actual and fictious data (especially for calibration).

```
* TWUSNO49.933
* FORMAT      01
* LAB         USNO
* REV DATE    1995-07-10
* ES USNO01 LA: N 38 55 00.000   LO: W 77 04 00.000   HT: 51.30 m
* REF-FRAME    WGS84
* LINK        04 SAT: IS706      NLO: W 53 00 00.000   XPNDR: 99999.999 ns
* SAT-NTX: 11922.3750 MHz      SAT-NRX: 14221.6275 MHz
* CAL 002 TYPE: GPS             MJD: 49639   EST. UNCERT.: 5.000 ns
* CAL 003 TYPE: GPS             MJD: 49649   EST. UNCERT.: 5.000 ns
* LOC-MON      NO
* MODEM        MITREX 2500A

* EARTH-STAT  LI  MJD  STTIME NTL      TW      DRMS SMP ATL      REFDELAY      RSIG  CI S      CALR      ESDV.
* LOC  REM      hhmms s      s      ns      s
USNO01  TUG01 04 49933 140200 299 0.263265762933 1.529 300 299 0.000001334100 9.999 002 1 296.350 99999.
USNO01  NPL01 04 49933 141000 299 0.260419315503 0.613 300 299 0.000001334200 9.999 999 0 99999.999 99999.
USNO01  VSL01 04 49933 141800 299 0.261451406897 0.387 300 299 0.000001334200 9.999 999 0 99999.999 99999.
USNO01  PTB01 04 49933 143400 299 0.262748501558 1.822 233 232 0.000001334240 9.999 003 1 449.500 99999.
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Draft New Opinion

Operational Use of Geostationary Direct TV Satellites for Time transfer

(Question ITU-R 103-1/7)

Considerings:

- availability of direct TV satellites
- positioning tolerance +/- 0.1 degree
- common view accuracy 10 ns when satellite position is known good enough

Opinion:

* TV satellite operators should make available the satellite coordinates with a resolution for example up to 100 m each 60 minutes. This could be done on an Internet site or incorporated in the TV signal

Draft New Opinion

Future Use of the Global Navigation Satellite System (GNSS) for High-Precision Time Transfer

(Questions ITU-R 103-1/7 and 152-1/7)

Considerings:

- *satellite navigation signals have been simultaneously used for distribution of time and frequency*
- *a new enhanced system (GNSS) will be introduced in 1998 to 1999*
- *time oriented navigation receivers showed uncertainties below 10 ns*

Opinion:

- * *new time-oriented receivers should be studied and developed*
- * *suitable delay calibration methods should be developed to enable uncertainties less than 1 ns*

Liaison Statement to ITU-T Study Group 13, Working Party

Cooperation in the study and developement of Time Transfer and/or Distribution using overhead capacity in SONET/SDH Networks

Contact Points for WP 7A:

- * **D.W. Hanson, NIST, Boulder, CO., USA**

and:

- * **T.R. Bartholomew, TASC, Anapolis Junction, MD., USA.**

Progress of the TF Series of Handbooks

Handbook on the Use of Satellite Time and Frequency Dissemination

editor: J.McA. Steele (UK)

* manuscript planned to circulate December 1996.

Handbook on the Selection and Use of Precise Frequency and Time Systems

main editor: R. Sydnor (USA)

* accepted and in press at the ITU, Geneva.