State Scientific Center
of the Russian
Federation

VNIIFTRI

National Research Institute for
Physical-Technical and Radio Engineering Measurements

System timescales Interoperability approach

I. Norets, Y. Smirnov, P. Bogdanov, I. Silvestrov

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Recommendation

Providers should agree on an organization which can monitor system time differences on a global basis and supply each Provider with its system time offset relative to the [ensemble time (defined?)] so each provider can transmit that offset information in its GNSS message. It is envisioned that all system offsets also would be provided via the Internet or other means of communication

Legal basis for calculation and transferring of the National Time Scale UTC(SU)

Federal Law "On the calculation of time» № 107-FZ of 04.03.2011

National Time Scale of the Russian Federation - an ordered sequence of numbers of units of time, reproduced and stored by the State Service of Time, Frequency and Earth's Orientation Parameters on the basis of the State primary standard of time, frequency, and the National Time Scale.

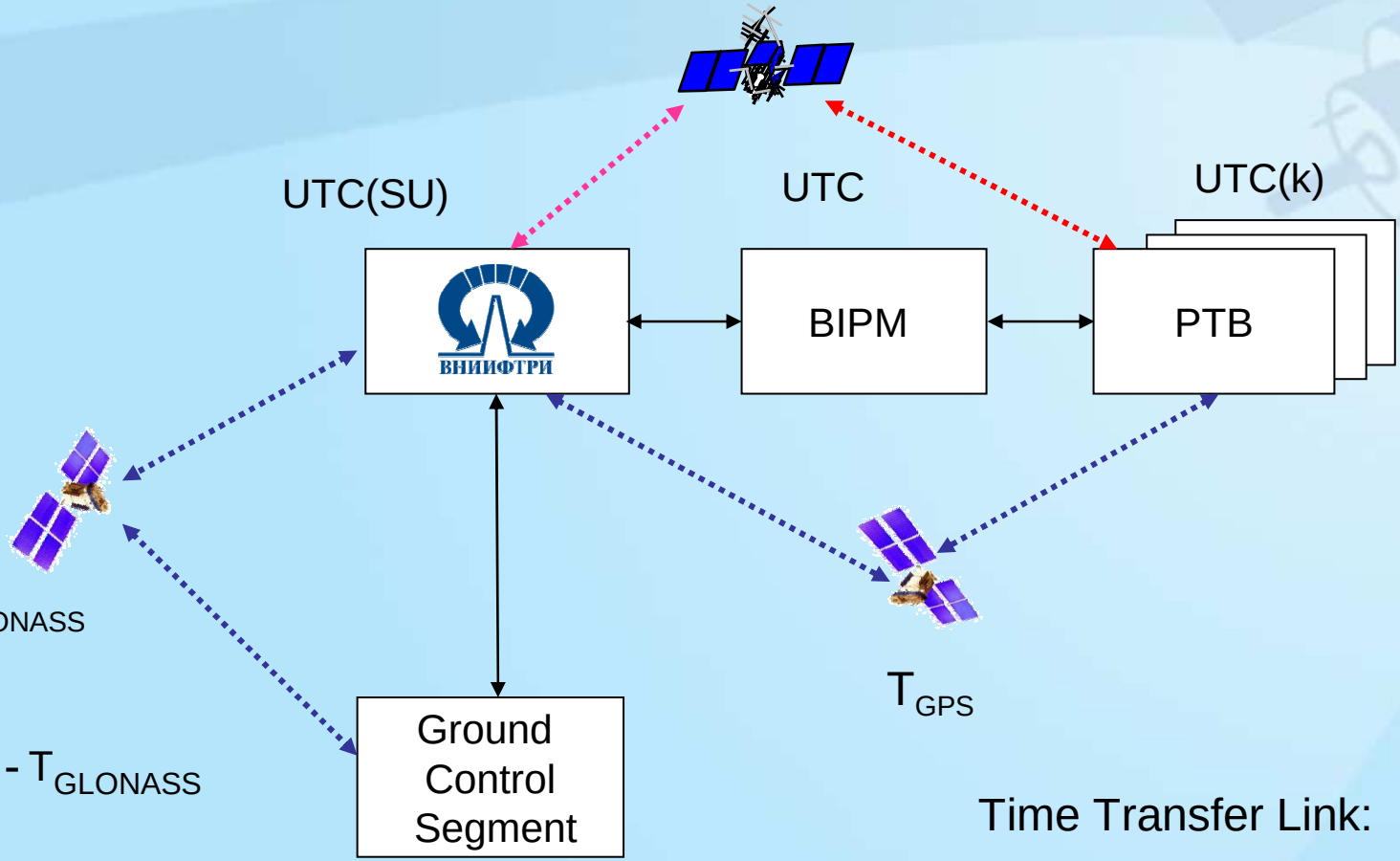
Interface control document GLONASS ICD 05.01, March 2008

Reference time scale for the GLONASS system is the national coordinated time scale UTC(SU).

Government Decree № 323 of 30.04.2008

Federal Agency for Technical Regulation and Metrology carries out support for GLONASS reference values of time and frequency, the National Time Scale and the Earth's Orientation Parameters data.

UTC(SU) time scale generating and transferring in GLONASS



τ_c = UTC(SU) - $T_{GLONASS}$

τ_{GPS} = T_{GPS} - $T_{GLONASS}$

Time Transfer Link:

GNSS

TWSTFT

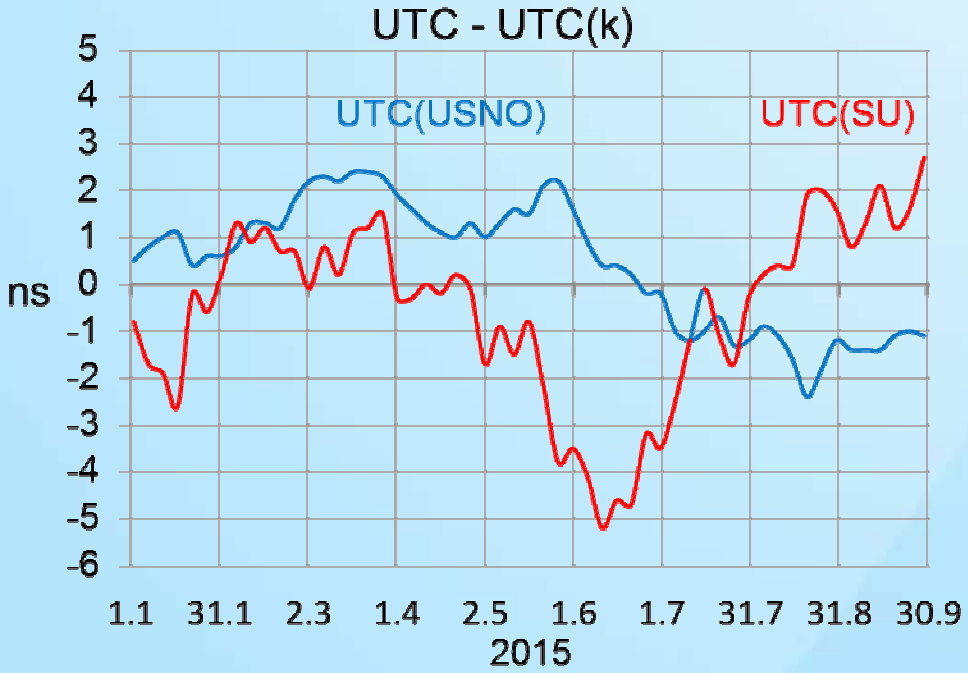
GNSS Timescales are generated on the basis of the reference time scale UTC(k), which are the physical realizations of UTC.

National Time and Frequency Standard of Russian Federation

TA(SU) calculated on the basis of the frequency difference measurements of Cs Fountain vs H-Masers

UTC(SU) calculated on the basis of TA(SU) and steering for providing UTC - UTC(SU) ≤ 7 ns

1 pps UTC(SU) generated in real-time



CsFO2 included in calculations TAI uB < 5 E-16

8 H-Maser CH1-75A used for keeping TA(SU) σ_y(1 day) < 5 E-16

TWSTFT link VNIIFTRI / PTB : uA 0.5 ns uB 1.1 ns BIPM CI 281

uB < 0.5 ns

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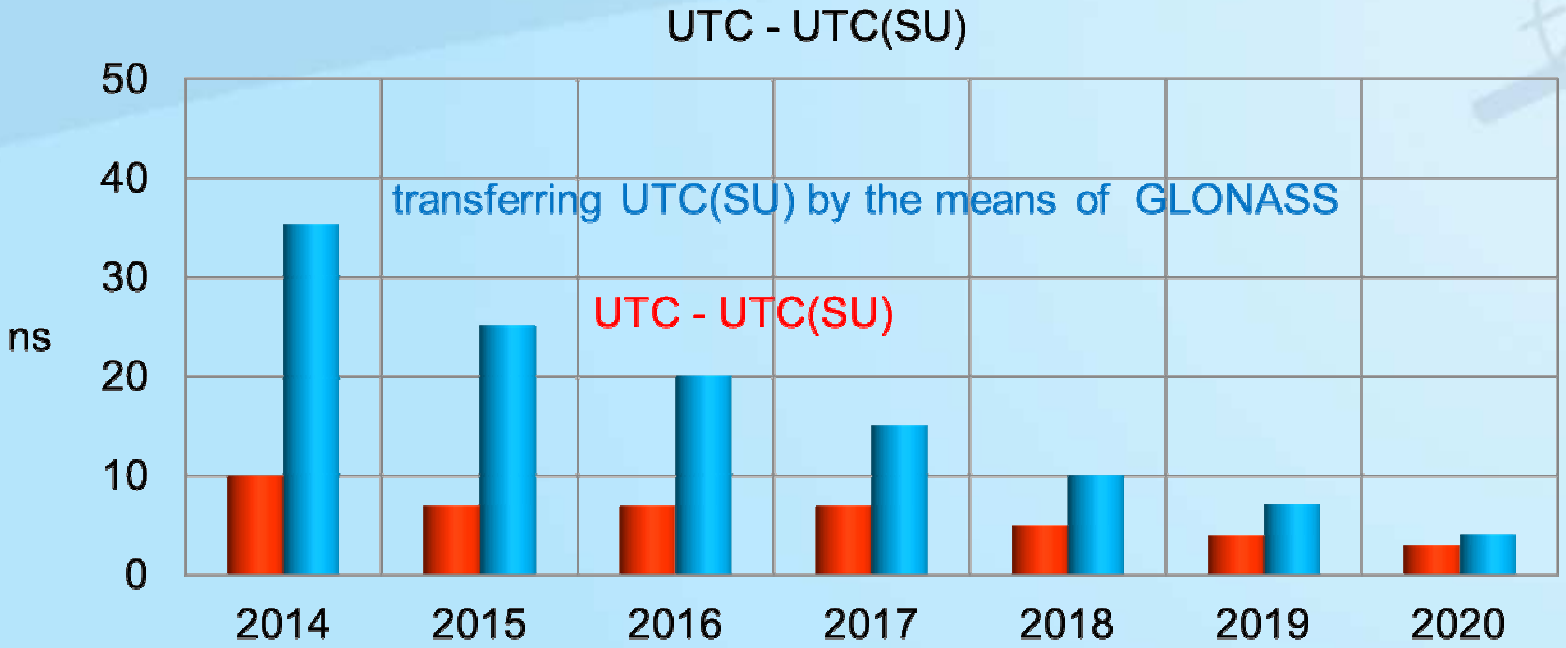
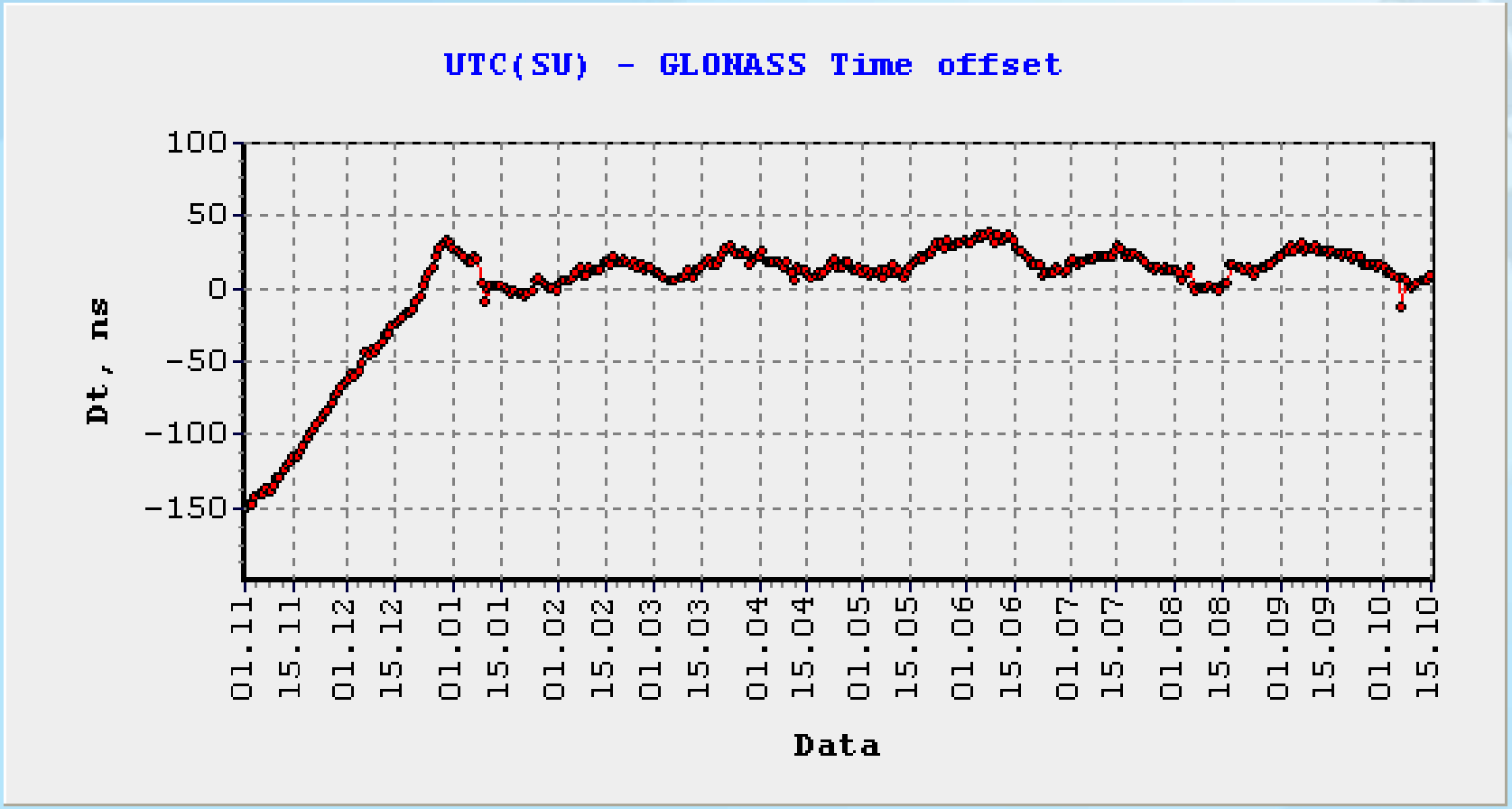
Main characteristics of UTC(SU) and GLONASS time scales matching



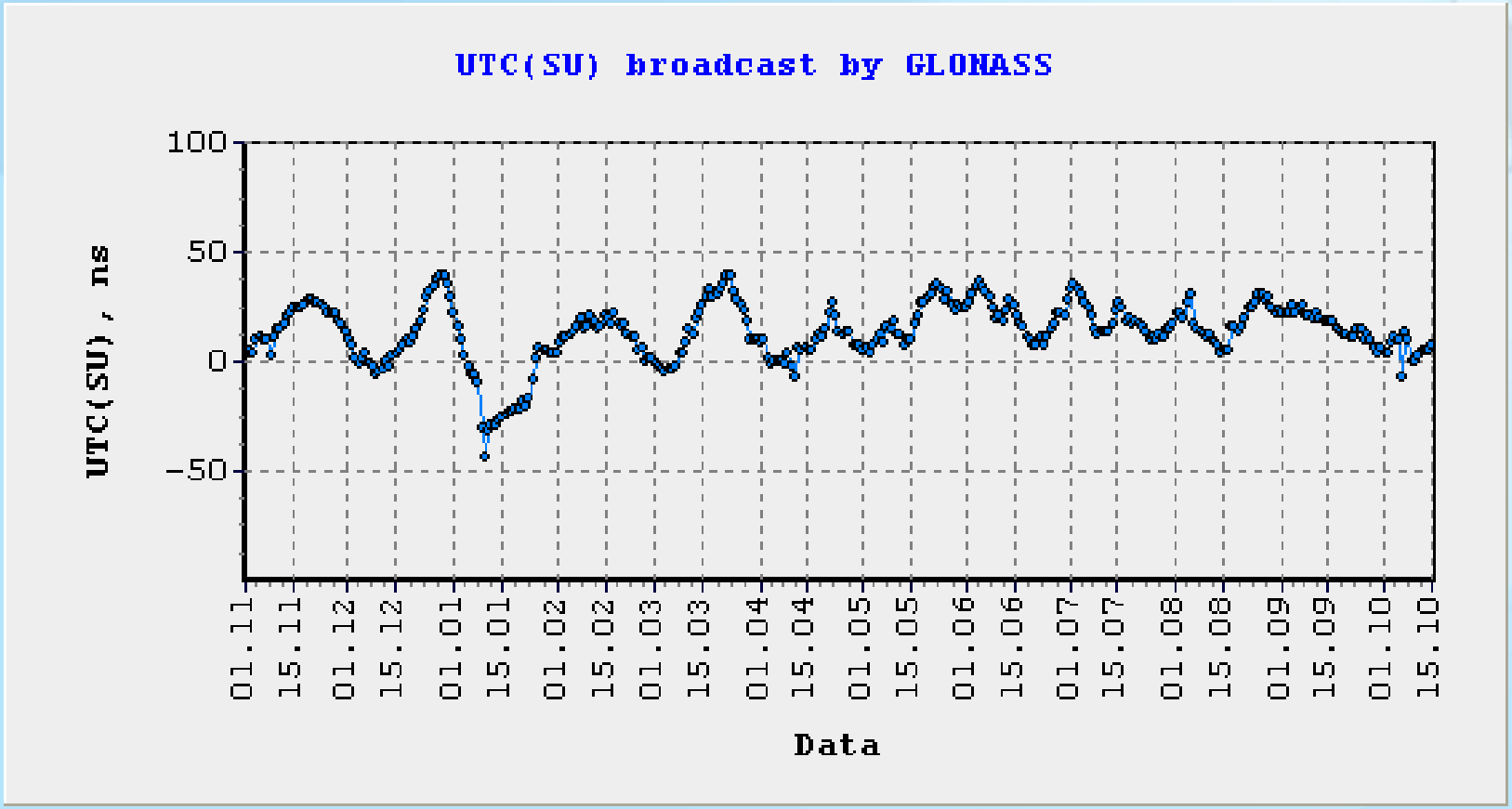
Main target characteristics of UTC(SU) and GLONASS time scales matching	2016	2020
Accuracy of national time scale synchronization to the UTC	7 ns	3 ns
Accuracy of UTC(SU) transferring by GLONASS	20 ns	4 ns

GLONASS Time offset relative to UTC(SU)



GLONASS Time offset is supported within 35 ns relative to UTC(SU) now.

UTC(SU) transferring by the means of GLONASS



Now the error of broadcast corrections for GLONASS Time – UTC(SU) offset does not exceed 10 ns (rms).

Circular T BIPM

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BUREAU INTERNATIONAL DES POIDS ET MESURES
ORGANISATION INTERGOUVERNEMENTALE DE LA CONVENTION DU METRE
PAVILLON DE BRETEUIL F-92312 SEVRES CEDEX TEL. +33 1 45 07 70 70 FAX. +33 1 45 34 20 21 tai@bipm.org

5 - Relations of UTC and TAI with predictions of UTC(k) disseminated by GNSS and their System Times.

[UTC-GPS time] = -17 s +C0 , [TAI-GPS time] = 19 s + C0 , global uncertainty is of the order of 10 ns.
[UTC-UTC(USNO)_GPS] = C0', [TAI-UTC(USNO)_GPS] = 36 s + C0', global uncertainty is of the order of 10 ns.
[UTC-GLONASS time] = C1 , [TAI-GLONASS time] = 36 s + C1 , global uncertainty is of the order of hundreds ns.
[UTC-UTC(SU)_GLONASS] = C1 , [TAI-UTC(SU)_GLONASS]= 36 s + C1', global uncertainty is of the order of hundreds ns.

2015	0h UTC	MJD	C0/ns	N0	C0'/ns	N0'	C1/ns	N1	C1'/ns	N1'
	AUG 30	57264	-0.1	89	-2.2	79	219.7	89	218.9	89
	AUG 31	57265	-0.6	89	1.0	89	216.9	79	219.0	78
	SEP 1	57266	-0.5	89	-1.0	89	217.6	88	218.7	88
	SEP 2	57267	-1.4	78	-0.6	78	218.7	89	217.3	89
	SEP 3	57268	-1.4	89	0.7	89	219.5	82	215.7	82
	SEP 4	57269	-1.0	89	-1.8	89	221.1	87	217.7	86
	SEP 5	57270	-0.8	89	-0.7	88	221.9	81	219.8	80
	SEP 6	57271	-0.9	90	0.7	90	223.0	90	219.6	90
	SEP 7	57272	0.1	89	0.8	89	224.0	89	219.4	89
	SEP 8	57273	1.3	89	1.8	89	221.0	87	216.8	86
	SEP 9	57274	3.1	89	1.1	89	220.8	88	215.7	88
	SEP 10	57275	4.1	90	1.6	90	223.0	88	216.0	88

The standard deviations S0, S0', S1 and S1' characterize the dispersion of individual measurements.
The actual uncertainty of users' access to GPS and GLONASS times may differ from these values.
For this edition of circular, S0= 0.9 ns, S0'= 1.1 ns, S1= 6.7 ns, S1'= 6.7 ns

Proposals to Working Group recommendations

Taking into account that :

•GNSS Timescales are generated on the basis of the reference timescales UTC(k), which are the physical realizations of UTC, and this is shown in the GNSS ICDs.

•UTC(k) is calculated in accordance with CCTF documents.

•In BIPM, GPS and GLONASS timescales offset monitoring system relative to UTC (Circular T) is organized. The modernization of the system including the UTCr development, will ensure the metrological control of all GNSS timescales offsets.

•Potentially necessary accuracy of GNSS timescales offsets relative to UTC measurements can be ensure by BIPM only.

Proposals to Working Group recommendations

•The existing system of GPS and GLONASS Timescales offsets monitoring relative to UTC on base of BIPM provides the potentially necessary accuracy of measurements.

•To ensure GNSS interoperability, it is necessary to modernize BIPM monitoring system, extending it to all GNSS.

•Creating of a new organization that will monitor the GNSS Timescales offsets with lower accuracy than BIPM is unnecessary.

Thank you for attention

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