



State Scientific Center
of the Russian
Federation



National Research Institute for
Physical-Technical and Radio Engineering Measurements

National time scale UTC(SU): current status and perspectives

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in GLONASS

Summary

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, reproducible 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 a national coordinated time scale UTC(SU).

Government Decree № 323 of 30.04.2008

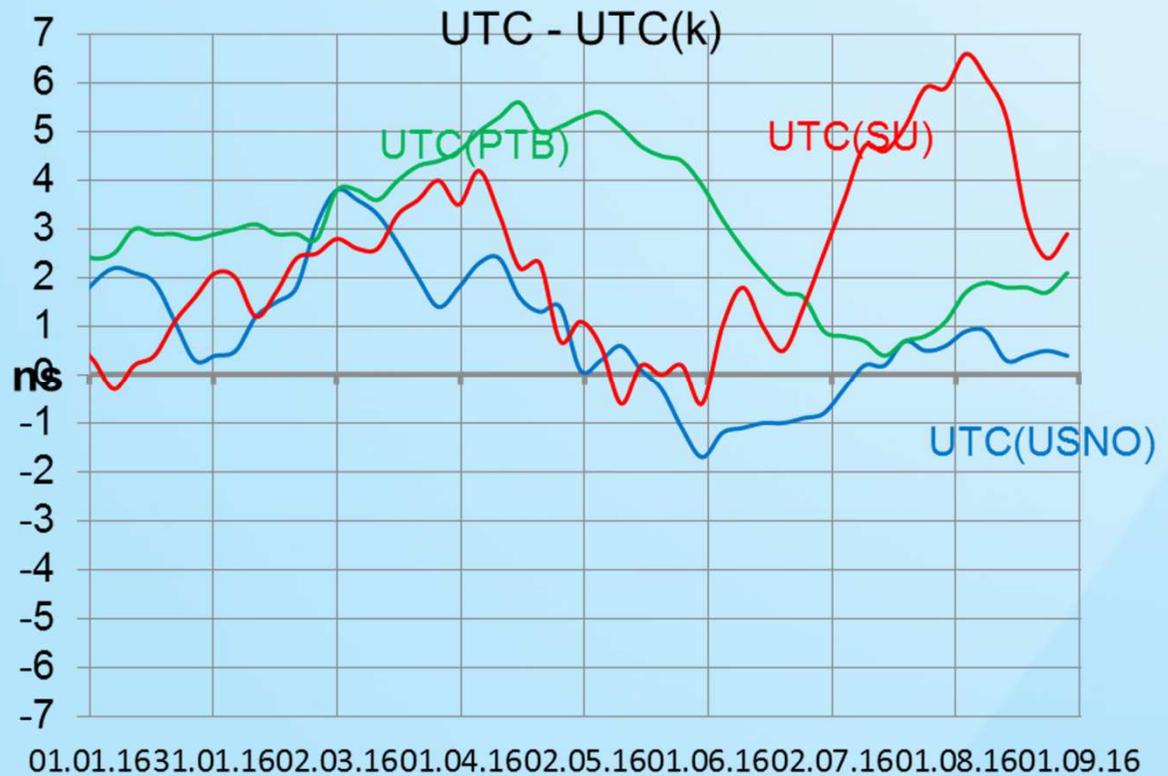
Federal Agency for Technical Regulation and Metrology carries out support for GLONASS reference values of time and frequency, the National Time Scale and the Earth's Orientation Parameters data.

Progress at the State Time and Frequency Standard of Russia

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 $UTC - UTC(SU) \leq 7$ ns

1 pps UTC(SU) generated in real-time



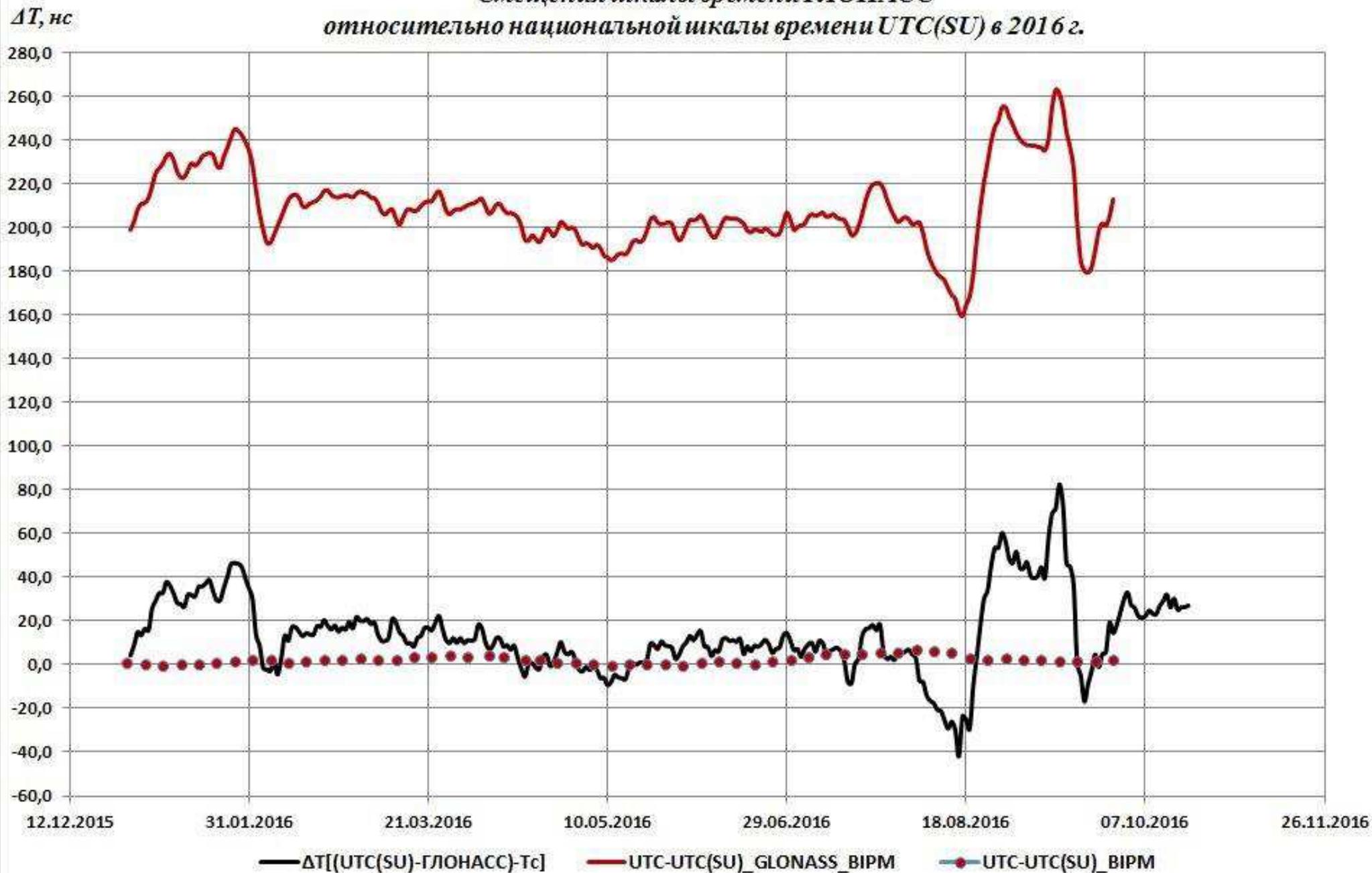
CsFO2 included in calculations TAI
 $u_B < 5 \text{ E-16}$

8 H-Maser CH1-75A used for keeping TA(SU)
 $\sigma_y(1 \text{ day}) < 5 \text{ E-16}$

TWSTFT link VNIIFTRI / PTB :
 $u_A 0.5 \text{ ns}$ $u_B 1.1 \text{ ns}$

$u_B < 0.5 \text{ ns}$

Смещения шкалы времени ГЛОНАСС
относительно национальной шкалы времени UTC(SU) в 2016 г.



The Agreement on absolute calibration receiver TTS-4 BIPM

Agreement on calibration

M- 9/14
« 28 » 07 2014

The **International Bureau of Weights and Measures (BIPM)**, an intergovernmental organisation, the headquarters of which are located Pavillon de Breteuil, 92312 Sèvres Cedex, FRANCE, represented by Director, Dr Martin Milton (hereinafter “the BIPM”),

and

Federal State Unitary Enterprise "Russian Metrological Institute of Technical Physics and Radio Engineering"(the FSUE VNIIFTRI), the headquarters of which are located MLB, urban settlement Mendeleevo, Solnechnogorsk district, Moscow region, 141570, RUSSIA, represented by General Director Sergey Donchenko, (hereinafter “the FSUE VNIIFTRI”), acting in accordance with the company rules. The Parties, noting the existence of the Arrangement on the Mutual Recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes (CIPM MRA), the fact that the FGUP VNIIFTRI is a participant in the Key Comparisons and the necessity to calibrate regularly time links used for these purposes, **have concluded this Agreement as follows:**



1. Subject of the Agreement

The BIPM accepted the FSUE VNIIFTRI offer to carry out free of charge absolute calibration complete set of TTS-4 receiver (hereinafter the Receiver). The FSUE VNIIFTRI agrees to undertake all procedures to calibrate the Receiver and to issue a calibration Certificate. The FSUE VNIIFTRI will use the receiver for mutual time link calibration which results will released by the BIPM in the BIPM report.

The results of absolute calibration of BIPM GLONASS/GPS receivers TTS-4 in VNIIFTRI

Table 1 GPS L1 C/A

Receiver TTS-4	INT DLY, ns	Diff, ns
OLD	-34.6	0.8
NEW	-33.8	

Table 2 GLONASS L1 C/A

Receiver TTS-4	INT DLY, ns	Diff, ns
OLD	- 242.2	203.6
NEW	- 38.6	

We hope that upon completion of the BIPM receiver TTS-4 calibration
GLONASS Time estimation of BIPM will be equal to VNIIFTRI estimation.

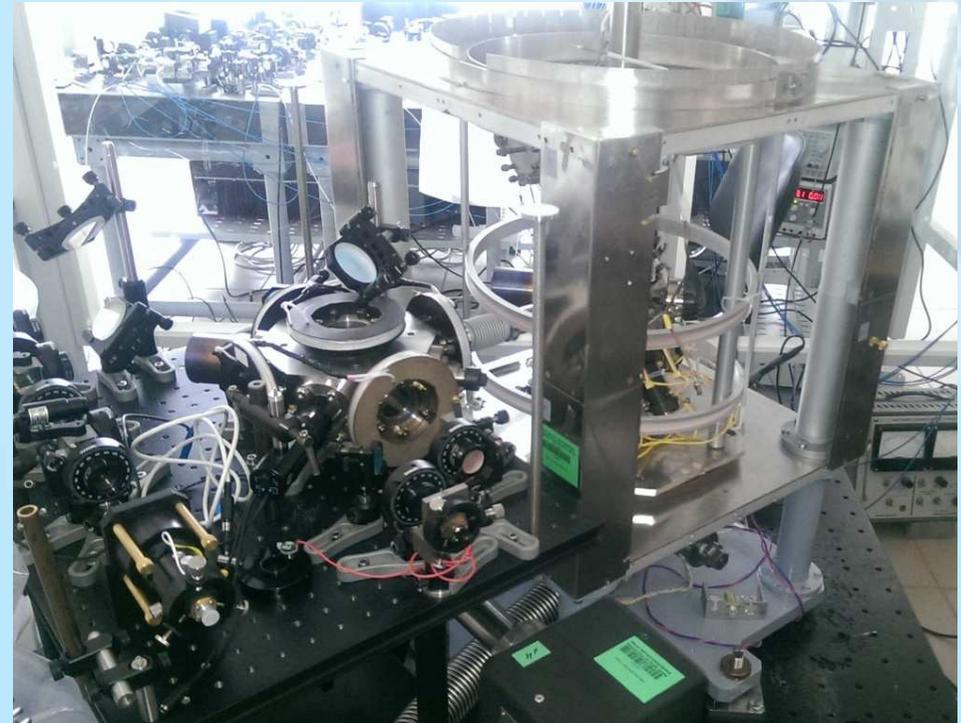
Directions of development for UTC(SU) time scale generating and transferring in GLONASS

- National time scale UTC(SU) system of the generation and storage modernization
- Creation of time and frequency standard based on the Rb-fountain
- Development of optical frequency standards on 87 Sr
- Development of high-precision comparisons system of national time scale with GLONASS time
- Investigation of transferring time and frequency signals channels over a fiber optic link

Creation of time and frequency standard based on the rubidium fountain



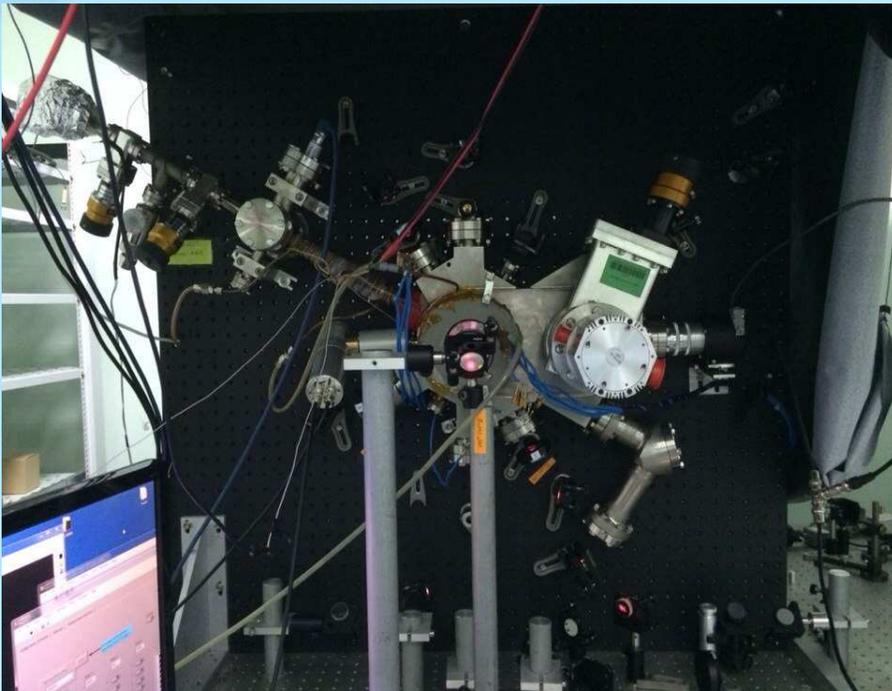
Laser Optical System



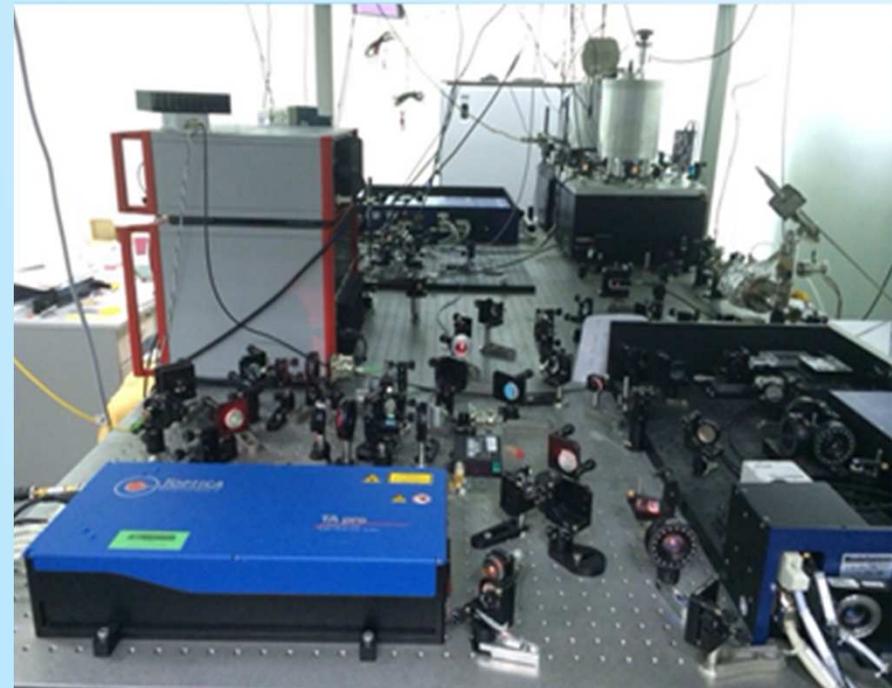
Atomic spectroscopy

Planning frequency stability RbFO $\sigma_y(\tau) \leq 2 \text{ E-16}$ in 2016

Development of optical frequency standards on ^{87}Sr



The experimental setup



System of secondary cooling

Experimental prototype: planning $u_B \leq 1 \text{ E-16}$ in 2016

Модернизация комплексов хранения национальной шкалы времени



Стандарт частоты и времени водородный (4 шт.)

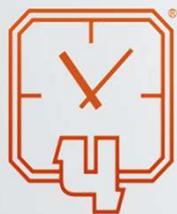


Устройство сличения частот сигналов

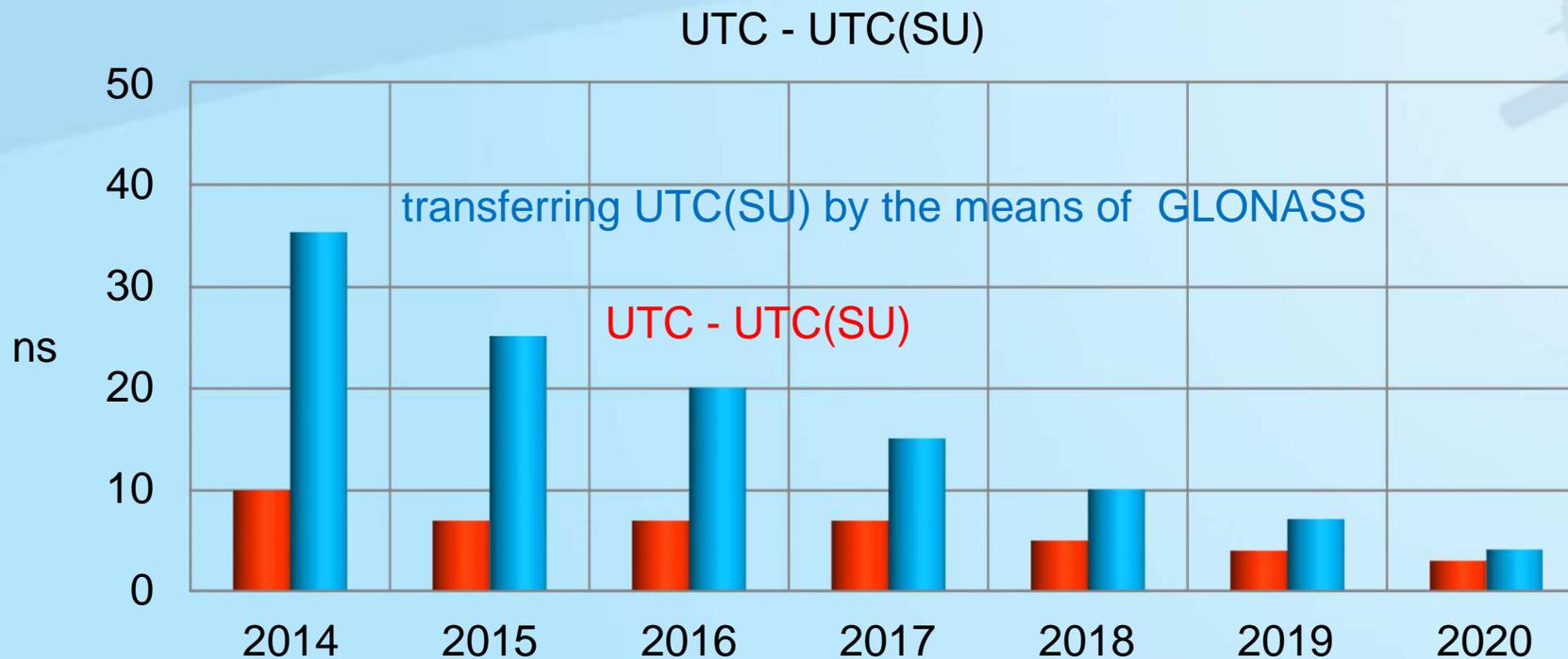


Устройство сличения шкал времени

Опытный образец базового комплекса времени и частоты БКВЧ



Main target 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

Summary

- UTC(SU) realization is corresponding to requirements of CCTF;
- as a result of GLONASS time correction new level of UTC(SU) transferring was achieved;
- calibration problem of GLONASS receivers for transferring the national time scale UTC(SU) was resolved;
- directions of development for UTC(SU) time scale generating and transferring in GLONASS are presented.

Thank you for attention

VNIIFTRI