STATE SCIENTIFIC CENTER
OF THE RUSSIAN
FEDERATION

VNIIFTRI

NATIONAL RESEARCH INSTITUTE FOR
PHYSICAL-TECHNICAL AND RADIO ENGINEERING MEASUREMENTS

GENERATION OF THE NATIONAL TIME SCALE UTC(SU), ITS TRANSFER TO GLONASS AND HARMONIZATION WITH UTC

ICG-7
WG-D

Igor Silvestrov
4-9 november 2012, ICG-7, Beijing

Main documents, that set the legal basis for generation and transferring of the national time scale UTC(SU) to GLONASS

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

National 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.

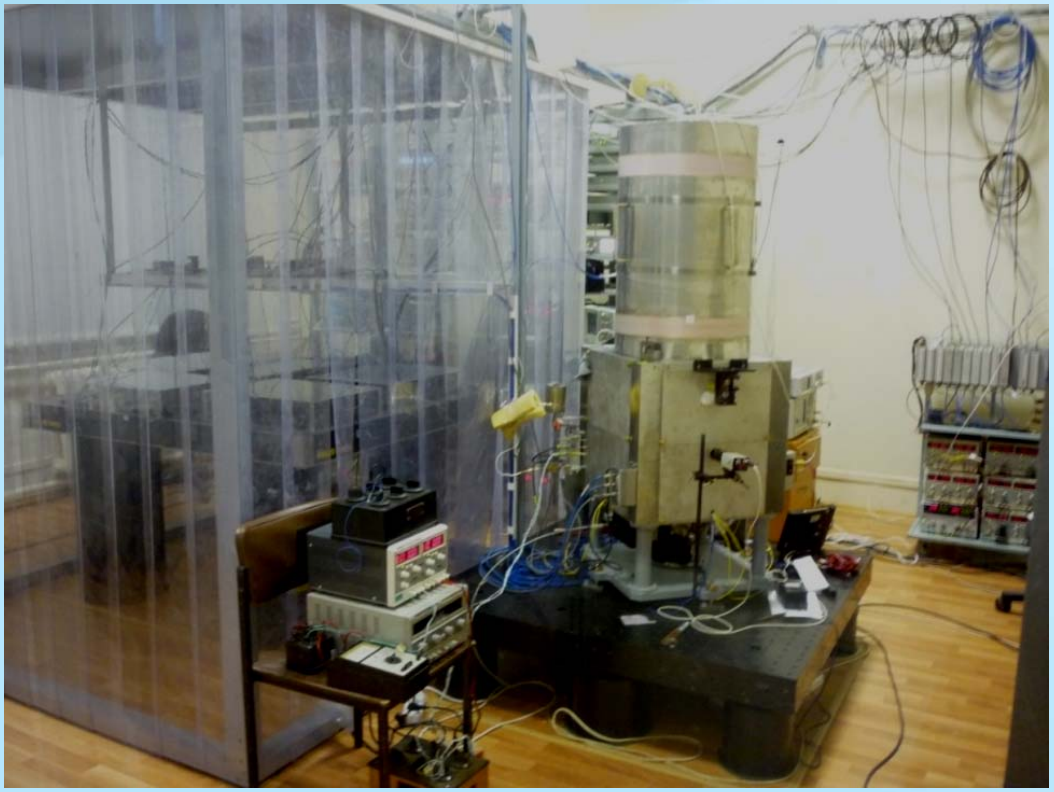
Government Decree № 323 of 30.04.2008

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

Interface control document GLONASS ICD 05.01, March 2008

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

Generation of the National time scale UTC(SU)

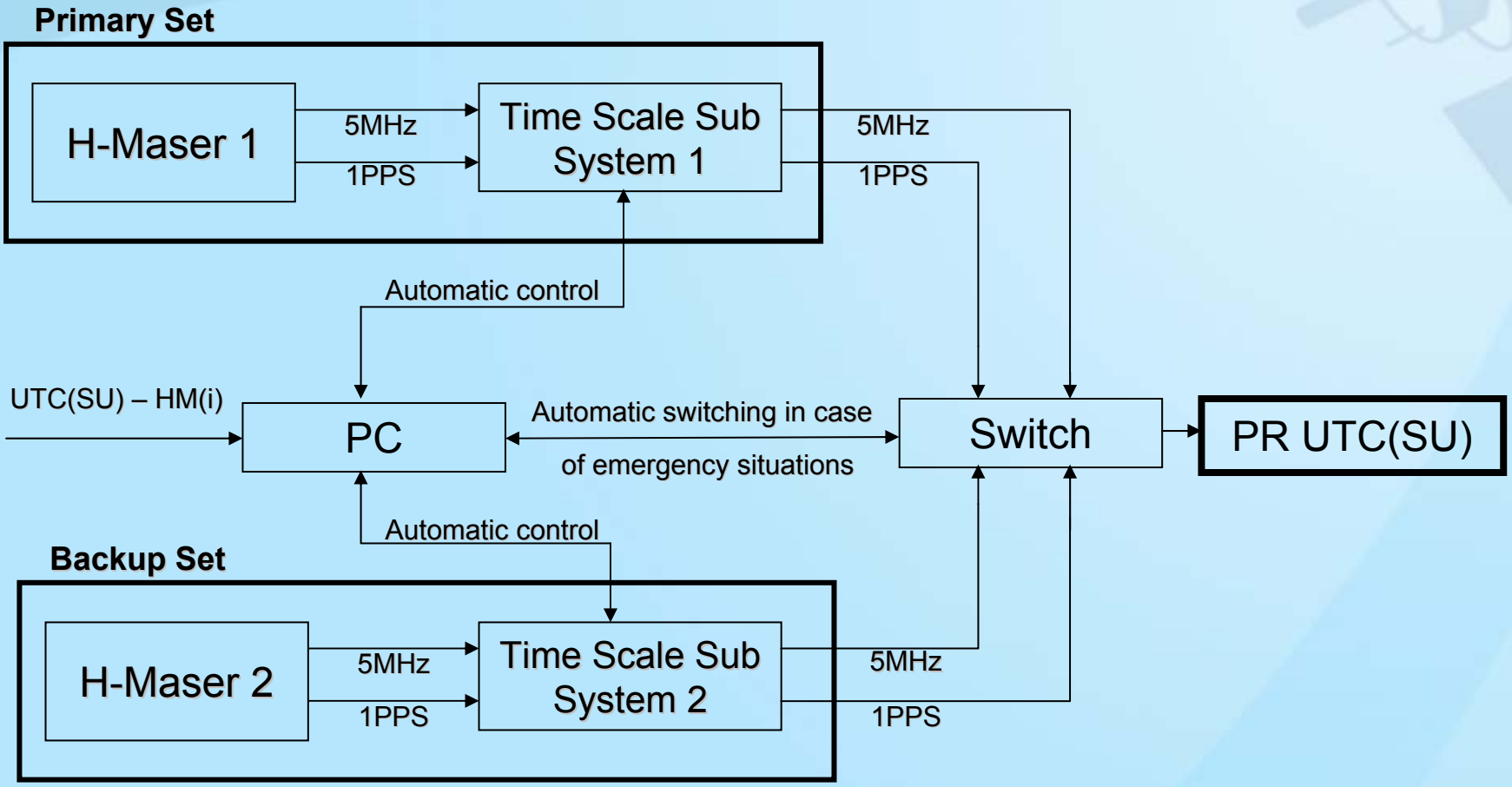


CSFO1 VNIIFTRI
accuracy ≤ 5.0 E-16

8 H-Maser clocks
Kvarz CH1-75A
$\sigma_y(\tau) \leq 5$ E-16 per day

Physical UTC(SU) realization accuracy ≤ 0.5 ns

Physical UTC(SU) Realization



UTC(SU) – PR UTC(SU) ≤ 0.5 ns

Time Transfer System
from VNIIFTRI to GLONASS Ground Control Segment

VNIIFTRI
Equipment

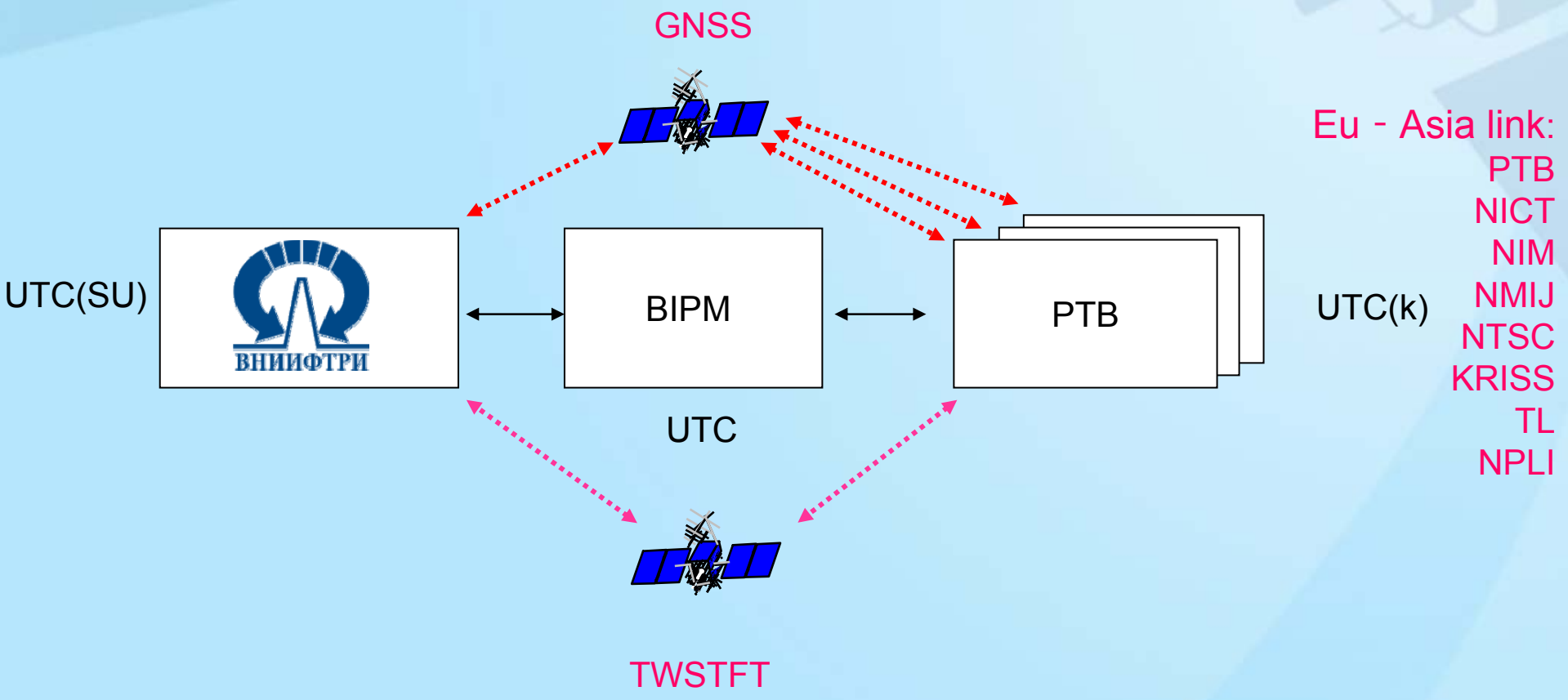
TTS-4
receivers
GPS/GLONASS
C/A and P3

Uncertainty:

Ua ≈ 1 ns
Uв ≈ 2 ns

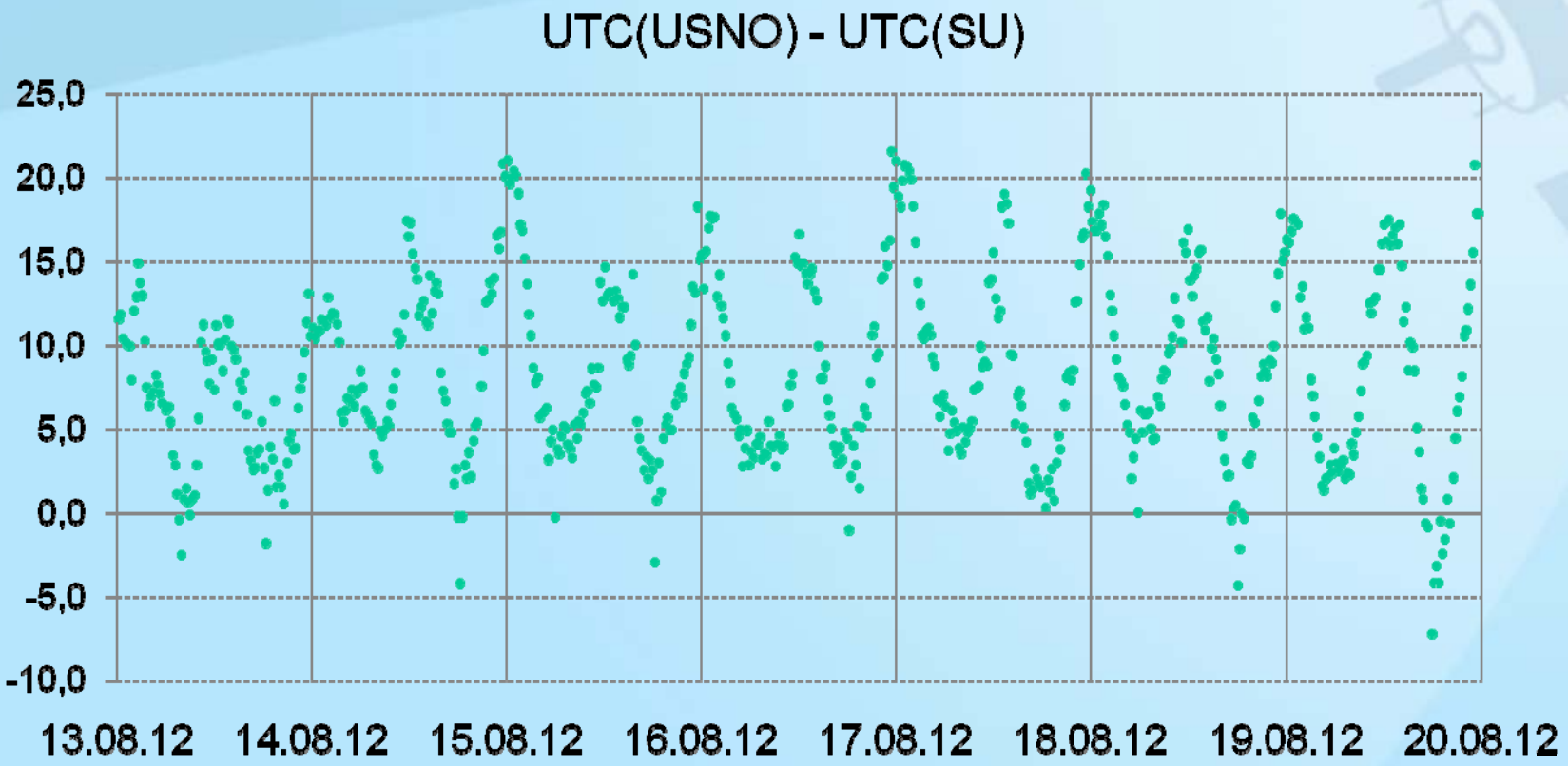
Ground Control
Segment Equipment

Harmonization of UTC(SU) and UTC



Eu - Asia link:
PTB
NICT
NIM
NMIJ
NTSC
KRISS
TL
NPLI

Results of the UTC(USNO) и UTC(SU) matching using the GPS receivers



Uncertainty:

- Ua ≈ 5,0 ns
- Uв ≈ 5 ÷ 7 ns (with calibration)

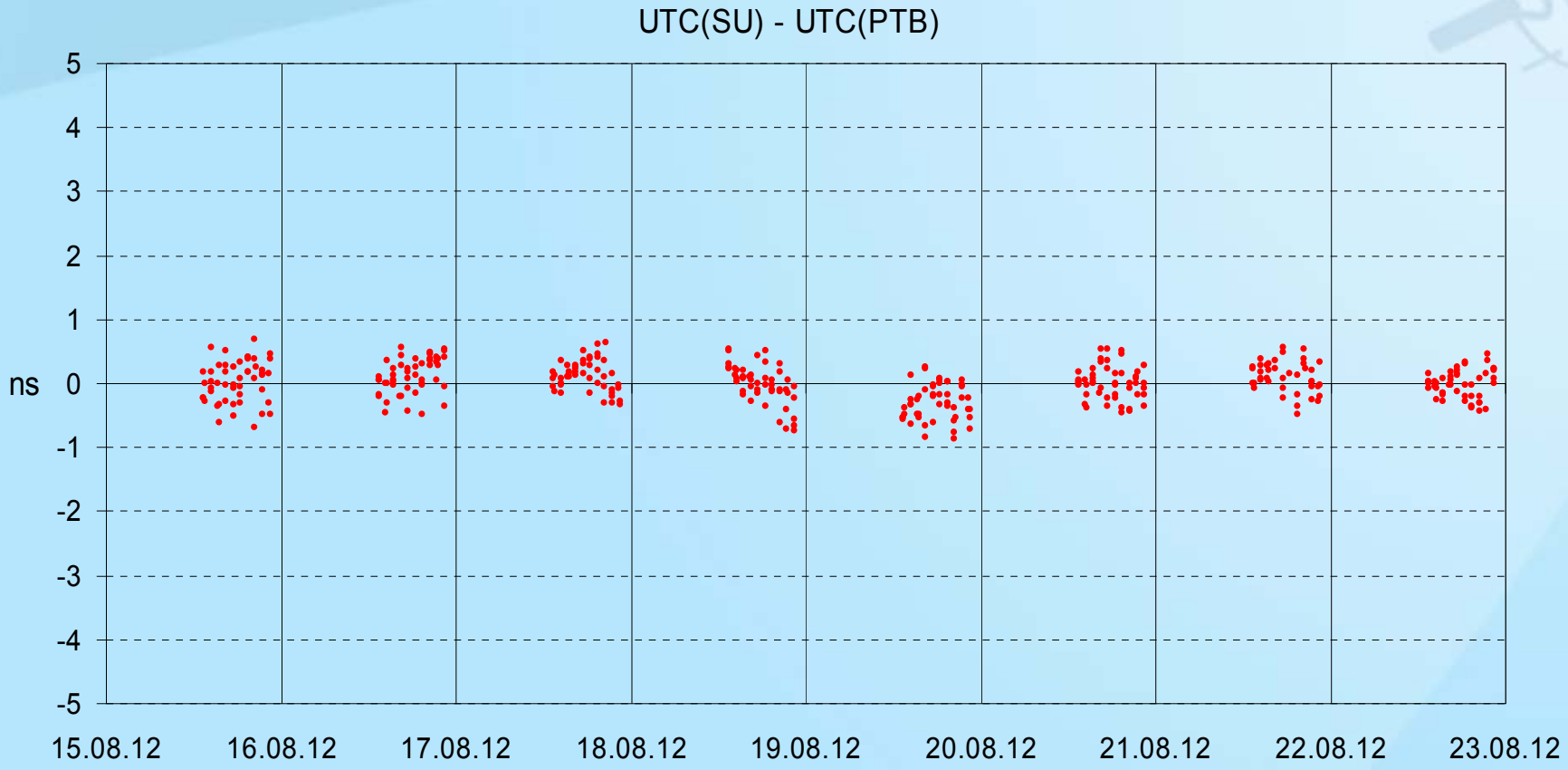
SU01 TWSTFT Stationary station

- Satellite: AM2 (80°E)
- Antenna: 1.8 meters
- TimeTech SATRE 2 channel modem
- Up and Down converter : Comtech Company, 8 W
- TimeTech SATSIM
- Links with PTB and Asia

TWSTFT link
UTC(SU) - UTC(PTB)

Uncertainty:
Ua ≈ 0.5 ns
U_B ≈ 2.0 ns
(after calibration)

TWSTFT link UTC(SU) - UTC(PTB)



Uncertainty:

- Ua ≈ 0.3 ns
- Uв ≈ 1 ÷ 2 ns

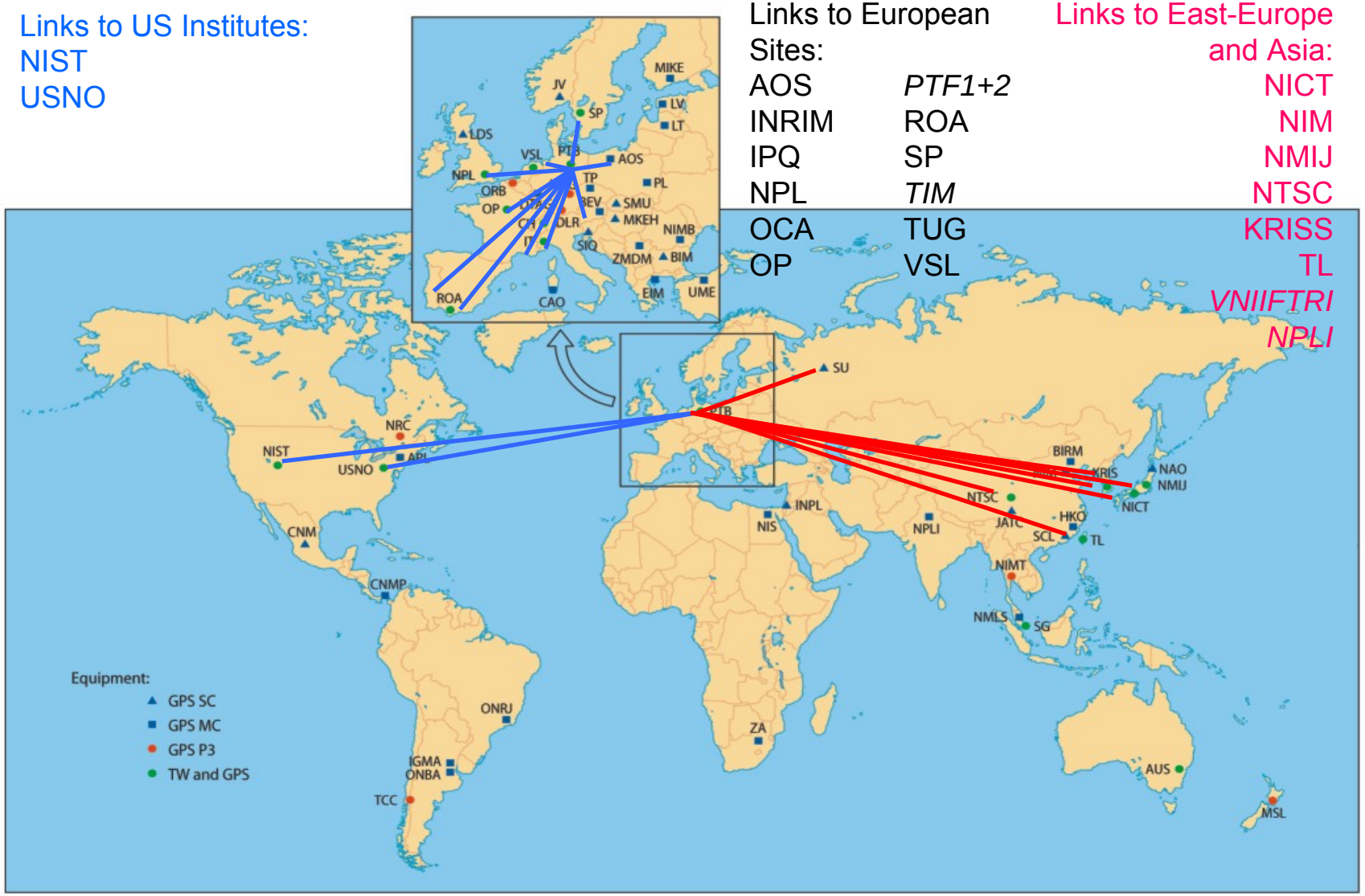
PTB - time scale matching center using TWSTFT

Links to US Institutes:
NIST
USNO

Links to European Sites:

AOS	*PTF1+2*
INRIM	ROA
IPQ	SP
NPL	*TIM*
OCA	TUG
OP	VSL

Links to East-Europe and Asia:
NICT
NIM
NMIJ
NTSC
KRISS
TL
VNIIFTRI
NPLI

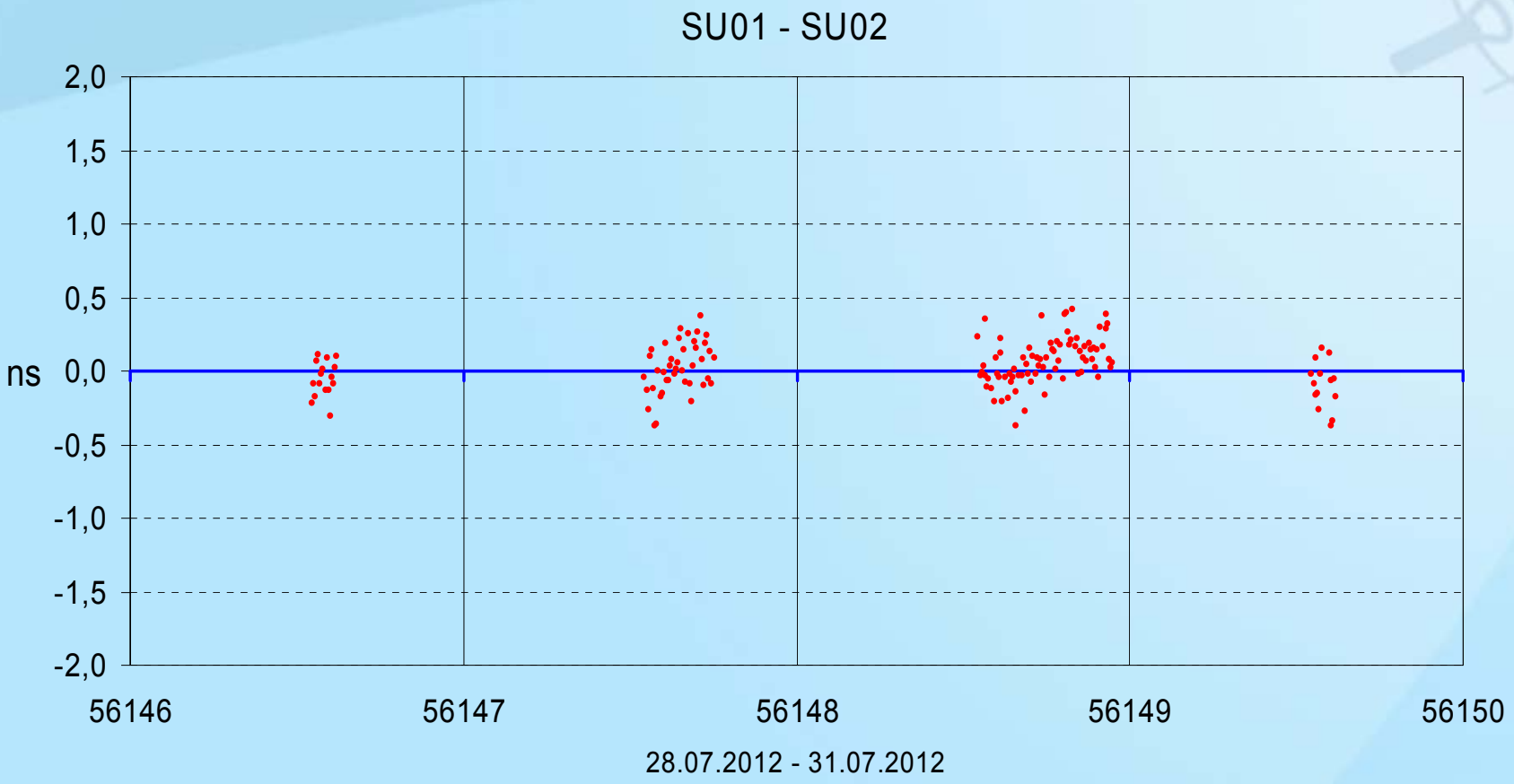


SU02 TWSTFT Transportable Station

- Satellite: AM2 (80°E)
- Antenna: 1.2 meters
- TimeTech SATRE 1 channel modem
- Up and Down converter : Cross Tech, 16 W
- TimeTech SATSIM
- Transportable H-Maser clock Kvarz CH1-76A, $\sigma_y(\tau) \leq$ 5E-15

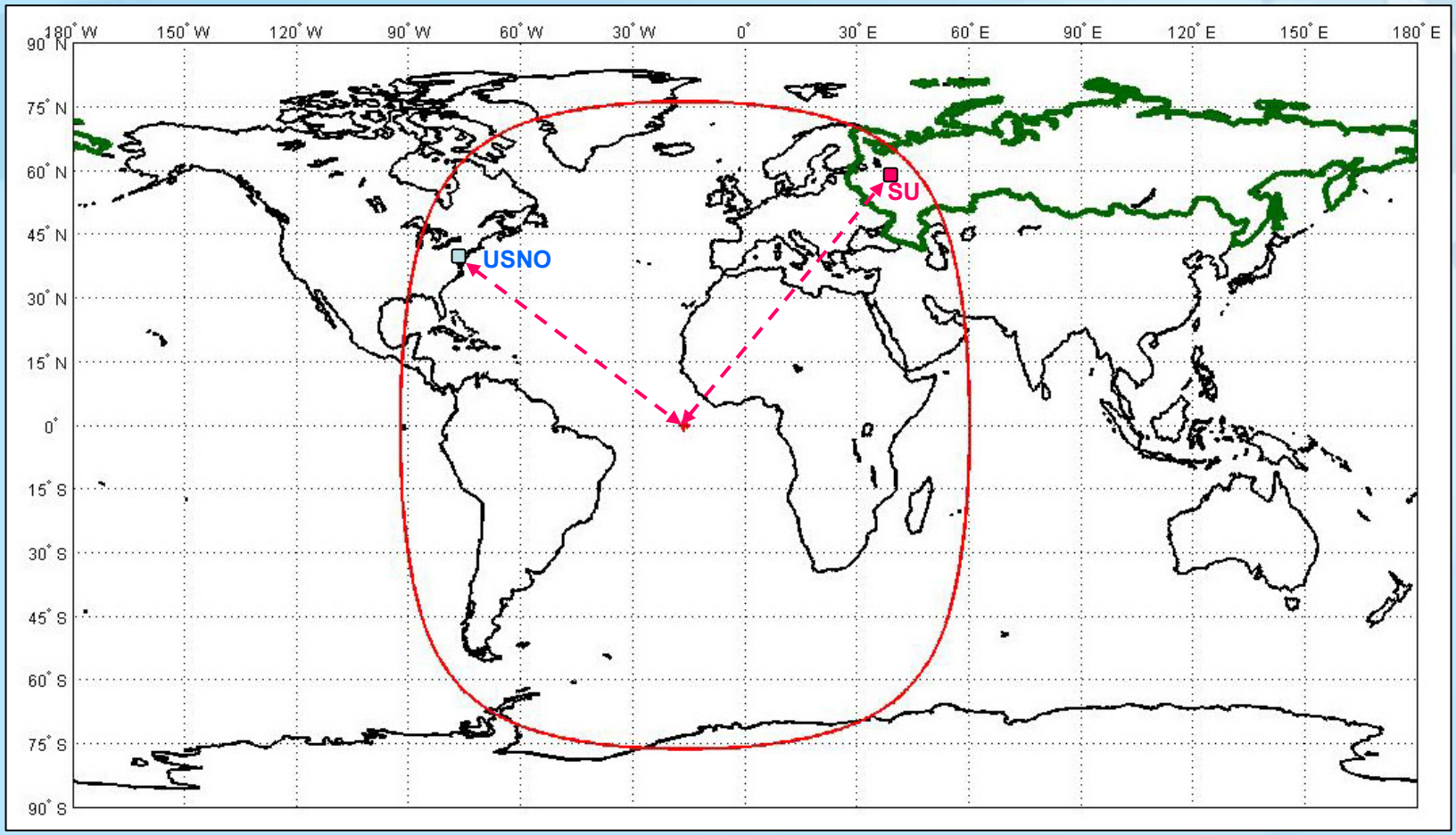
Calibration Uncertainty:
Ua ≈ 0.5 ns
Uв ≈ 1.0 ns

VNIIFTRI SU01 – SU02 Short base line experiment data



Uncertainty:
Ua ≈ 0.2 ns
Uв ≈ 0.5 ns

Potential coverage area for the new Luch-5B satellite Ku-range



Potential characteristics of the UTC(SU) and UTC(USNO) matching:

- continuous real-time mode
- Uncertainty Ua ≈ 0,1 ÷ 0,3 ns
- Uncertainty U_B ≈ 1 ÷ 2 ns

Characteristics for the possible methods of UTC(SU) и UTC(USNO) matching

1. The same existing GNSS receivers set both in VNIIFTRI and USNO
   Uncertainty Ua ≈ 5 ns
   Uncertainty Uв ≈ 5 ÷ 7 ns delay - 1 day

2. Existing TWSTFT scheme: VNIIFTRI – PTB – USNO
   Uncertainty Ua ≈ 1 ns
   Uncertainty Uв ≈ 3 ÷ 4 ns delay - 1 day

3. Perspective TWSTFT scheme using «Luch–5B»: VNIIFTRI – USNO
   Uncertainty Ua ≈ 0,3 ns
   Uncertainty Uв ≈ 1 ÷ 2 ns
   continuous real-time mode

Proposals on the UTC(SU) and UTC harmonization accuracy increase

1. Set the GNSS time receivers (GLONASS/GPS) of the same type in VNIIFTRI and USNO as well as on the GPS Master Control Station and in the GLONASS Ground control segment

2. Organize the direct UTC(SU) and UTC(USNO) time scales matching using new satellite “Luch-5B”

Thank you for your attention!

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