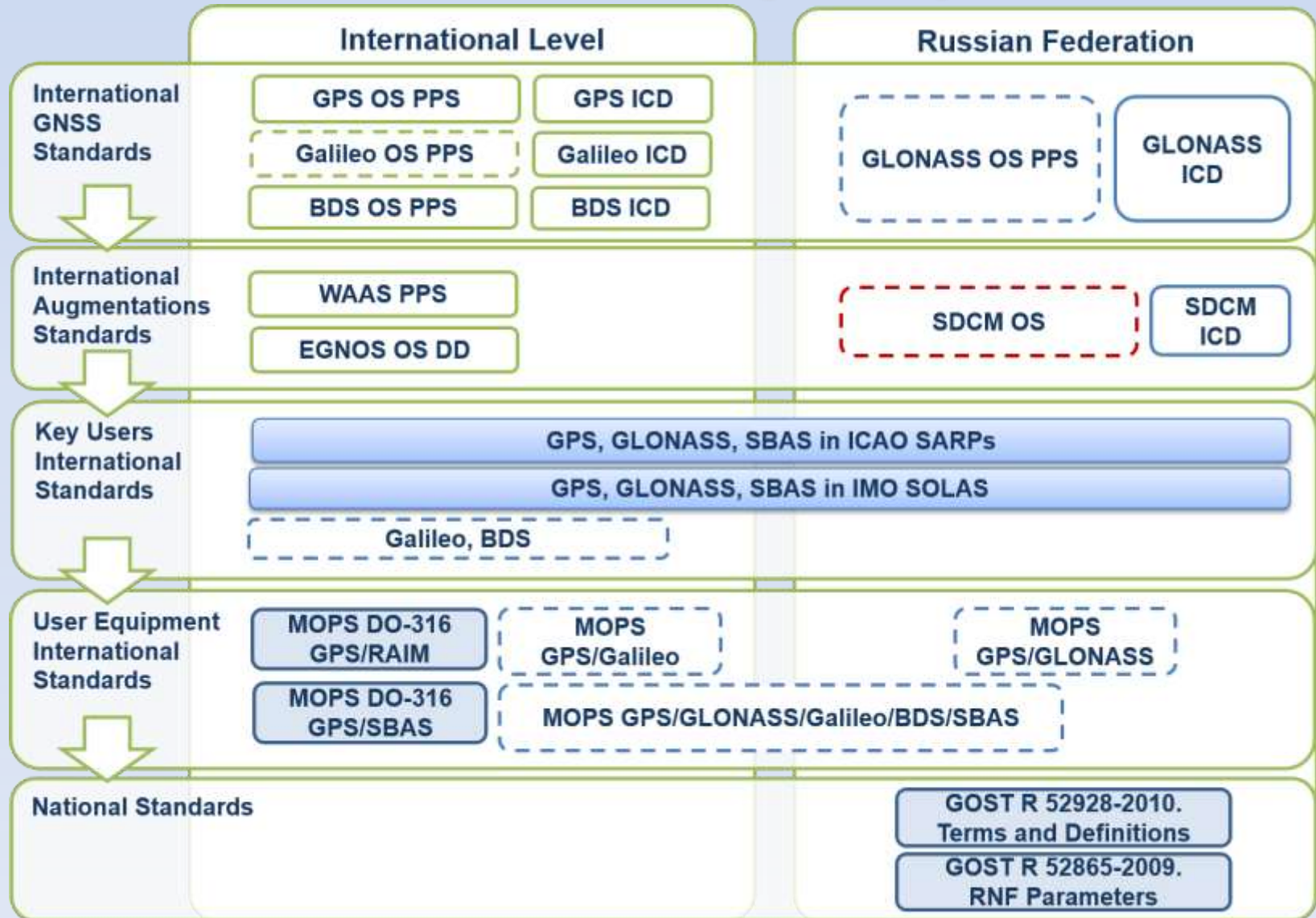# GLONASS Open Service Performance Parameters Standard and GNSS Open Service Performance Parameters Template Status

Bolkunov Alexey

Russian Federal Space Agency

Central Scientific-Research Institute for Machine building
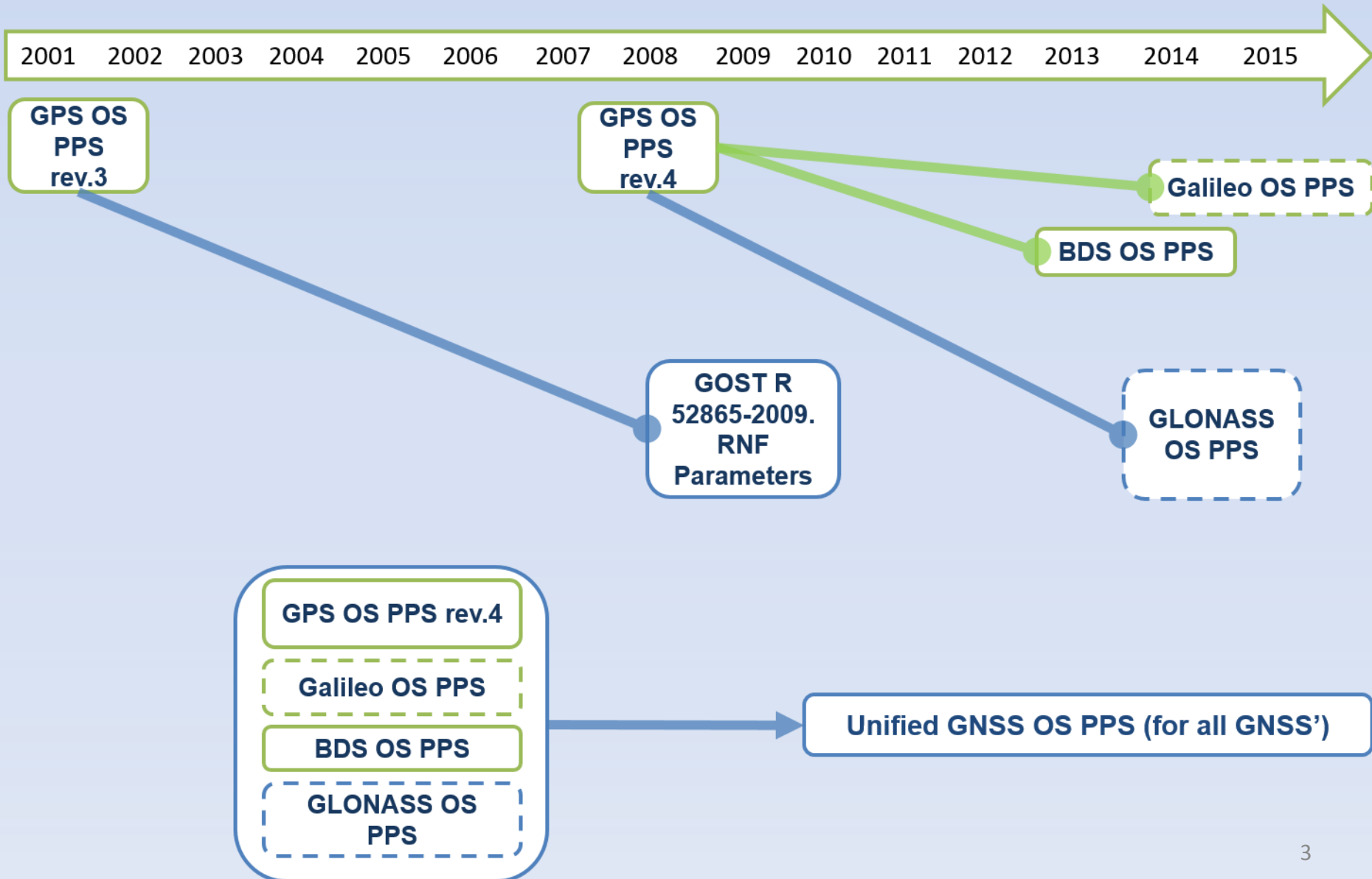
PNT Information and Analysis Center

GLONASS OS PPS and GNSS OS PPS Template in National and International Regulatory Framework

International Level — Russian Federation

International GNSS Standards
- GPS OS PPS
- GPS ICD
- Galileo OS PPS
- Galileo ICD
- BDS OS PPS
- BDS ICD
- GLONASS OS PPS
- GLONASS ICD

International Augmentations Standards
- WAAS PPS
- EGNOS OS DD
- SDCM OS
- SDCM ICD

Key Users International Standards
- GPS, GLONASS, SBAS in ICAO SARPs
- GPS, GLONASS, SBAS in IMO SOLAS
- Galileo, BDS

User Equipment International Standards
- MOPS DO-316 GPS/RAIM
- MOPS GPS/Galileo
- MOPS GPS/GLONASS
- MOPS DO-316 GPS/SBAS
- MOPS GPS/GLONASS/Galileo/BDS/SBAS

National Standards
- GOST R 52928-2010. Terms and Definitions
- GOST R 52865-2009. RNF Parameters

2

OS PPS Harmonization Trends

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

GPS OS PPS rev.3

GPS OS PPS rev.4

Galileo OS PPS

BDS OS PPS

GOST R 52865-2009. RNF Parameters

GLONASS OS PPS

GPS OS PPS rev.4

Galileo OS PPS

BDS OS PPS

GLONASS OS PPS

Unified GNSS OS PPS (for all GNSS')

GLONASS OS PPS Status

- National Regulations Framework documents harmonization is finalized

- GLONASS OS PPS and GNSS unified OS PPS Template are harmonized

- Parameters calculation methods for GLONASS OS PPS Draft are developed

- Internal approval procedure is undergoing

GLONASS Performance Parameters in Current Russian Regulatory Framework

GLONASS Performance Parameters in GLONASS OS PPS Draft

GLONASS OS PPS Draft Performance Parameters (1/3)

Parameter	GLONASS OS PPS	GPS OS PPS 2008
Constellation Coverage	100% up to 2000km	100% up to 3000 km
Per-slot coverage	100% in cone up to 2000 km	100% in cone up to 3000 km
95% Global Average SIS URE (satellite)	11.7 m	7.8 m
95% Global Average SIS URE (Constellation)	7.8 m	-
99,37% Global Average SIS URE	18 m 99.37%	30 m 99.94%
99,14% Worst Case Single Point Average SIS URE	18 m 99.14%	30 m 99.79%
Global Average Reliability	99.37% 18 m level	-
Worst Case Single Point Reliability	99.14% 18 m level	-
95% Global Average SIS URRE	0.004 m/s	0.006 m/s
95% Global Average SIS URAE	0.005 m/s^2	0.002 m/s^2
95% Global Average UTCOE	40 ns	40 ns

GLONASS OS PPS Draft Performance Parameters (2/3)

Parameter	GLONASS OS PPS	GPS OS PPS 2008
Major Service Failure	$1\cdot10^{-3}$ 75 m level	$1\cdot10^{-5}$ 4,42 URA level
SIS Continuity	0.9995	0.9998
Per-slot Availability	0.99	0.957
Constellation Availability	0.98	0.98
Operational Satellite Count	0.9	0.95
Global PDOP Availability	0.98	0.98
Worst Site PDOP Availability	0.88	0.88

GLONASS OS PPS Draft Performance Parameters (3/3)

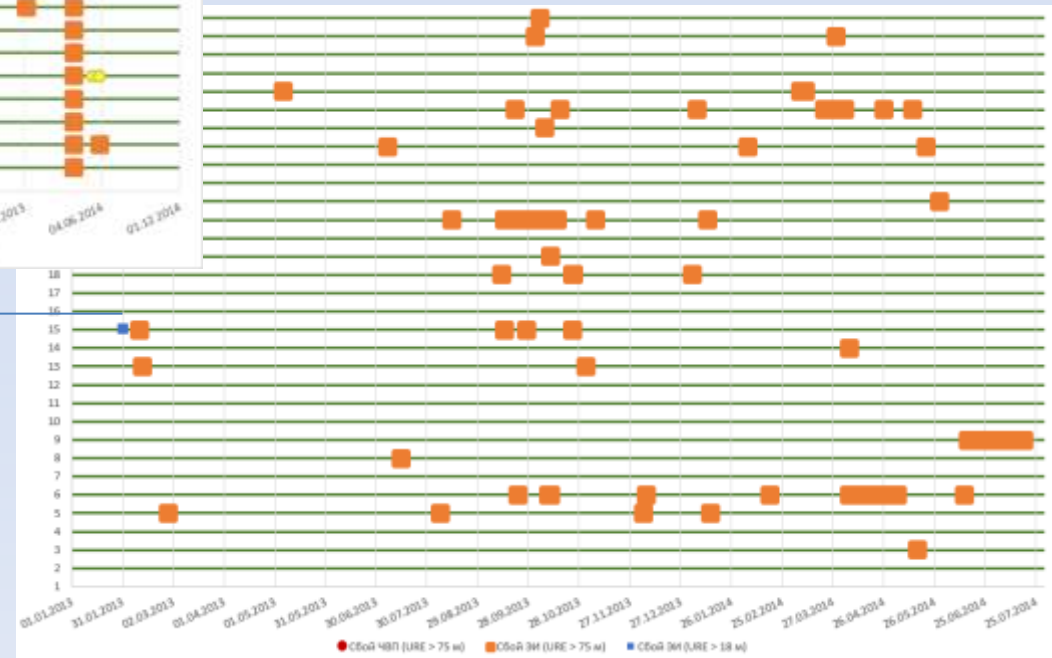| Parameter	GLONASS OS PPS	GPS OS PPS 2008
Global Average 95% Horizontal Positioning error	5 m	9 m
Global Average 95% Vertical Positioning error	9 m	15 m
Worst Site 95% Horizontal Positioning error	12 m	17 m
Worst Site 95% Vertical Positioning error	25 m	37 m
Global Average 95% Time transfer error	40 ns	40 ns
Horizontal Service Availability, average location	99%, 12 m level (95%)	99%,17m level (95%)
Vertical Service Availability, average location	99%, 25 m level (95%)	99%, 37 m level (95%)
Horizontal Service Availability, average location	90%, 12 m level (95%)	90%, 17 m level (95%)
Vertical Service Availability, average location	90%, 25 m level (95%)	90%, 37 m level (95%)

GNSS OS PPS Status

- Now we have:
  - Unified GNSS OS PPS Template
  - BDS OS PPS
  - Galileo OS PPS

- We suggest:
  - Parameters calculation methods in accordance with GPS OS PPS and GNSS OS PS Template

- Challenges

Reference Data
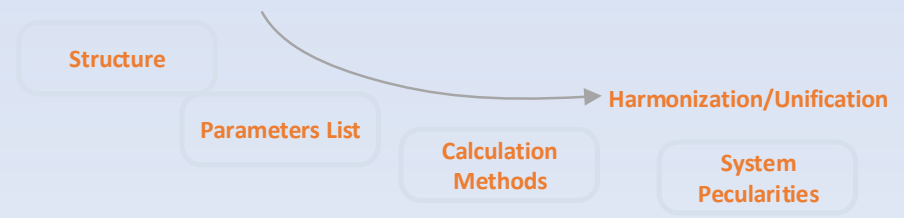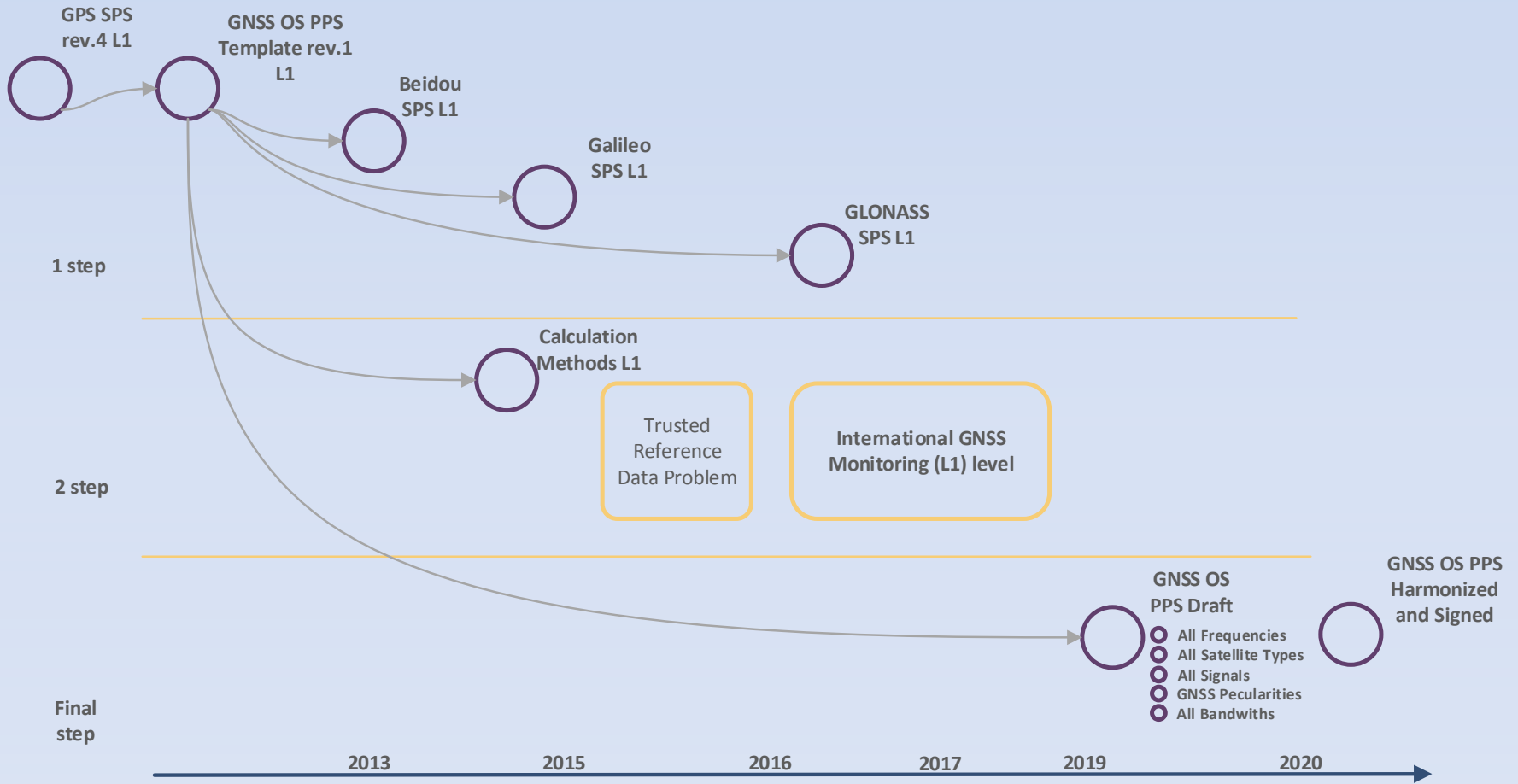# GLONASS and GPS Failures

GLONASS

GPS

Reference Data and Parameters Validation

- Possible problems:
  - Incorrect satellite's orbits and clocks data
  - Reasons – high variety of base stations, receivers and final data formats
- Possible solutions:
  - Using IGS Network if
    - GRIL (or similar) data format capable sub network
    - Business networks participation as sub network
  - National (GNSS') global networks
    - USA - GPS has a network with required coverage
    - European Union
    - Russian Federation – no global network for now, being created now
    - China – network is being created
- International GNSS Monitoring and Assessment System
  - Mutual recognition of national global monitoring networks
  - Creation of IGMAS network somehow
  - Using IGS network with above conditions

GNSS OS PPS Development Roadmap

Summary

- GLONASS OS PPS
  - GLONASS OS PPS Draft is developed
  - Draft version of GLONASS performance parameters values is presented
  - Internal approval procedure is undergoing now

- GNSS OS PPS Template
  - GNSS OS PPS Template Parameters Calculation Methods Draft is proposed
  - Reference Data is one of the most critical aspects of IGMAS functioning. Major challenges are considered and solution options are proposed
  - Development Roadmap on step by step basis aimed on creating of unified GNSS OS PPS Template for multi-GNSS, multi-frequency, multi-signals, multi-satellite types is proposed

- Suggestions for WG Report
  - To add Parameters Calculation Methods to GNSS OS PPS Template, use methods proposed by Russia as a basis
  - To state reference data problem for IGMAS
  - To take into account GNSS OS PPS Template Development Roadmap

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