

IGMA Progress and Plan

ICG WG-S, B, D joint session
IGMA TF

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Current status of IGMA JTP

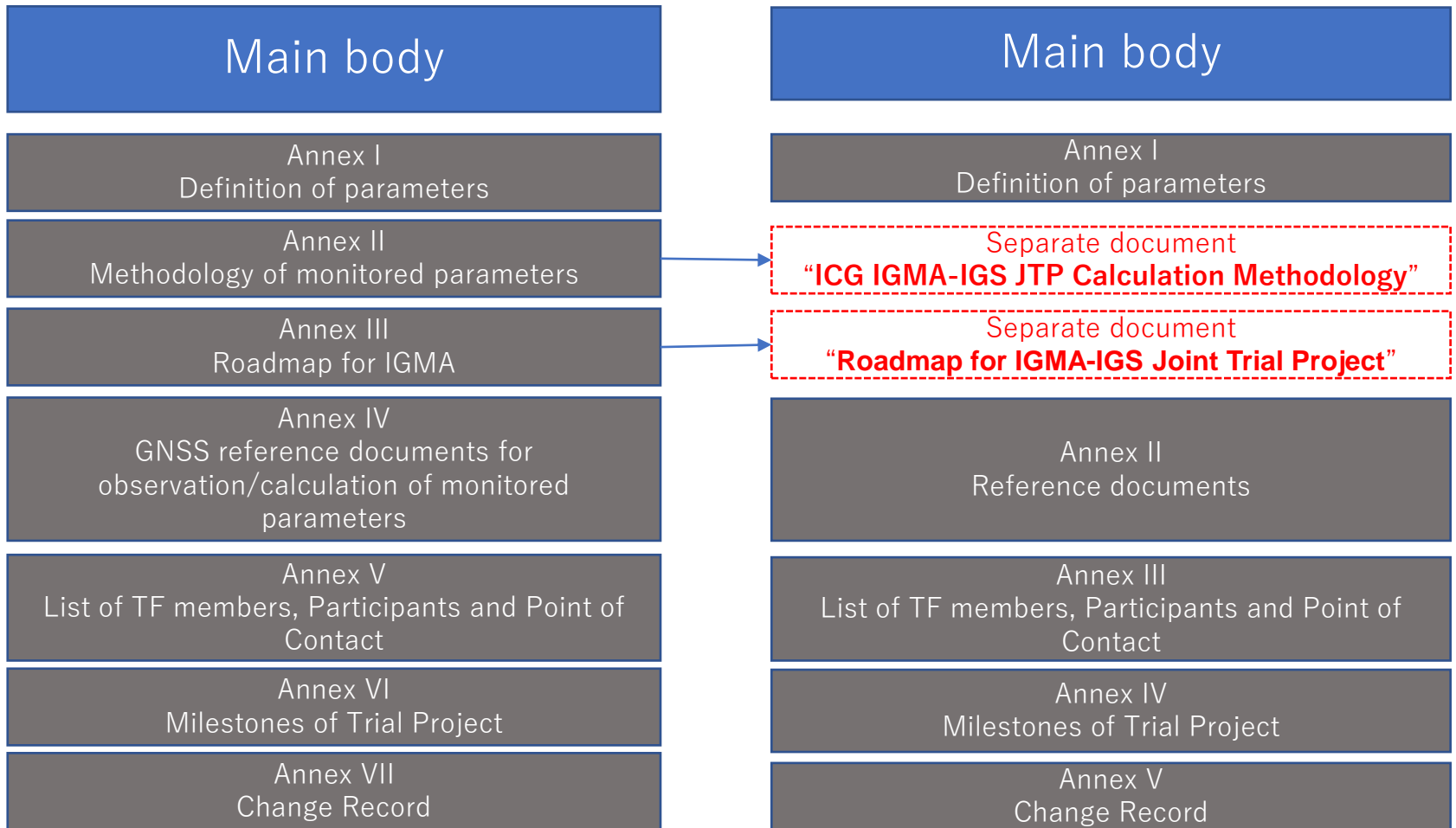
- Initial Joint Trial Project (JTP) is being implemented in collaboration with IGS.
- Four limited parameters were selected, and initial calculation results were reviewed.
- Findings suggested a need of common calculation methodologies before comparing among each participant's calculation.
- General Principles for common calculation methodologies were clarified.
- Work continues on procedural steps for calculating the parameters for each system, and Datafile Specifications for results.

ToR revision status(1/2)

- **Major revised points**

- ✓ Restructuring contents of Terms of Reference (ToR) :
 - The Revised ToR limited to administrative and strategic items. Technical and mathematical details were described in the separate document, “ICG IGMA-IGS JTP Calculation Methodology”.
 - Annex III Roadmap for IGMA was removed and new document was created titled “Roadmap for IGMA-IGS Joint Trial Project”.
- ✓ Adding NavIC to Joint Trial Project
- ✓ Annex I definition of parameters were updated.
 - Mathematical expression in PDOP definition was deleted.
 - Single SIS URE definition was replaced with two precise definition.
- ✓ Revising Annex IV – Milestones of Trial Project.
 - Latest milestones, i.e. “2nd calculation run” and methodologies and data format agreement, were described with target schedule

Structure change of IGMA JTP ToR



ToR revision status(2/2)

- **Line by Line review was conducted**

- ✓ At IGMA Workshop in Rabat, Morocco August 29, 2023.
- ✓ Some texts were amended in accordance with TF members' suggestions and comments.
- ✓ No substantial changes to the revised draft.
- ✓ Review by providers done, no additional comments on it.
- ✓ Ready for approval

- **Review by IGS and confirmation of participants**

- ✓ Under review by IGS Monitoring WG until the end of October 2023.
- ✓ The roster of current IGS participants in the JTP is being refreshed and updated.
- ✓ IGS Monitoring WG chair will report the review results and confirmation of participants to IGS Governing Board in end November 2023.

Common methodologies (1/3)

- ✓ The Calculation Methodology document was agreed to be grouped by parameters instead of by GNSS systems and was reconstructed.
- ✓ The process for calculating orbital and clock errors was agreed to be described by separate sequences of calculation steps. The orbit error should be calculated first and then the clock error.
- ✓ First version of step-by-step calculation procedure for orbit and clock has been collected from GPS, GLONASS, Galileo, BDS and QZSS.
- ✓ It was agreed that URE will be assessed through two methods: “Calculated” and “Measured”. The “Calculated” method is chosen for the first stage of IGMA JTP.
- ✓ Common GNSS PDOP assessment method was agreed inside IGMA TF, including temporal-spatial resolution grid model, statistical methods, observation period, etc.

Common methodologies (2/3)

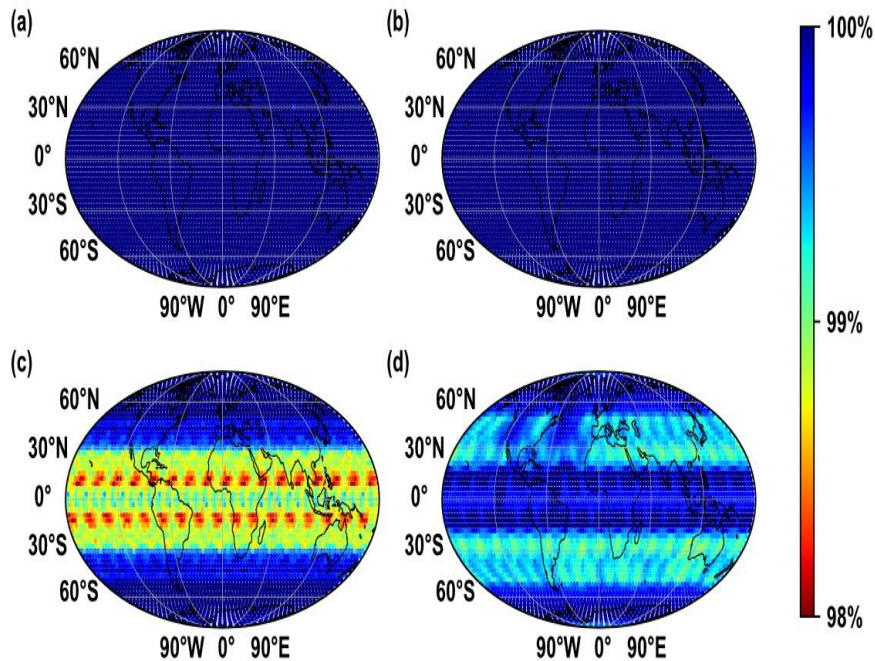
Common PDOP Assessment Method

Issue	Conclusion
Consider precision	Two decimal places
Evaluation metrics	Global average PDOP availability Global 95 th percentile PDOP availability Worst site PDOP availability
Grid model	GRID_EAL (Equal-Arc-Length Grid)
T-S (Temporal-Spatial) resolution	300 seconds – 3 degrees
Statistical method and period	Sliding window, ground track repeat period of each system
Assessment scope	Full latitude span for global systems Partial span corresponding to coverage area for QZSS and NavIC

The grid generating code for GRID_EAL and grid file can be shared for all users.

Common methodologies (3/3)

Global PDOP availability in GRID_EAL Calculation efficiency and storage performance



Grid	T-S resolution	T-S points number	Time cost	Storage cost (Kbit)
GRID_ELL,	5°, 600s	383616	6' 36' "	4774
GRID_EAL	1°, 600s	5941152	96' 20"	67423
GRID_EAL	2°, 600s	1485792	26' 08"	17429
GRID_EAL	3°, 30s	13207680	221' 25"	159731
GRID_EAL	3°, 60s	6603840	110' 11"	79812
GRID_EAL	3°, 180s	2201280	40' 07"	26403
GRID_EAL	3°, 300s	1320768	22' 12"	15778
GRID_EAL	3°, 600s	660384	11' 44"	8003
GRID_EAL	3°, 1200s	330192	5' 45"	3893
GRID_EAL	3°, 1800s	220128	3' 42"	2566
GRID_EAL	3°, 3600s	110064	1' 54"	1239
GRID_EAL	4°, 600s	372384	6' 43"	4668
GRID_EAL	5°, 600s	237888	4' 15"	3082
GRID_EAL	6°, 600s	165312	3' 02"	2215
GRID_EAL	7°, 600s	121392	2' 13"	1687
GRID_EAL	8°, 600s	93024	1' 43"	1338

Global PDOP availability in GRID_EAL (spatial resolution: 3°, temporal resolution: 300s, mask angle: 5°). (a) for GPS, (b) for BDS, (c) for GLONASS and (d) for Galileo. Doy 2021.251-2021.260.

Calculation efficiency and storage performance for BDS PDOP evaluation with different grid models and T-S resolution. The computer hardware is Intel(R) Core (TM) i9-9900 CPU @ 3.10GHz with 64GB RAM.

Next Steps

- ToR revision

- Request approval from ICG (conditional)
 - After IGS review, if no substantial changes are proposed.
 - New recommendation ?

- Complete description of step-by-step calculation methods for clock error, SIS-URE, and UTCOE.

- Finalize data exchange format

- 2nd calculation run in advance of the next workshop

- Prepare for next workshop in the first half of 2024

- Candidate venues in Asian countries, Thailand or China
 - MGA conference 2024, end of January to beginning of February, Chiang Rai, Thailand

Scorecard – IGMA TF (as of August 30, 2023)

Item	Status	Comments
IGMA Workshop 2015	Completed	Hosted by China in conjunction with CSNC in Xian (May 2015) The monitoring and assessment parameter sets were discussed.
Establish Joint Trial Project with IGS	Completed	IGS governing board approved proposal and created GNSS Monitoring WG in Dec 2016
IGMA and PS Workshop 2017	Completed	In Shanghai, hosted by China (SHAO) in 2017. Monitoring and assessment methodology, specification and Data Center for data/results sharing were discussed first time for IGMA.
IGMA and PS Workshop 2018	Completed	In Noordwijk, hosted by EU (GSA) in May 2018. Definition, Methodology, and data format were discussed.
IGMA and PS Workshop 2019	Completed	In Vienna, hosted by US in June 2019. The 1 st Calculation results were exchanged.
Methodology harmonization	In progress	<u>PDOP and orbit error: done</u> SIS RE have almost done. Clock error and UTCOE need further input from providers & IGS
Data exchange format harmonization	In progress	Proposed template format will be shared.
IGMA Joint Trial Project ToR revision	In progress	<u>Line-by-line review has been done. Review in IGS Monitoring WG is on going.</u>
Monitoring site specifications	In progress	Draft will be distributed in November teleconf.
2 nd Calculation Run	Under discussion	Depending on the next workshop Calculation periods and parameters have been agreed
Planning the next IGMA and PS Workshop	Under discussion	In person Workshop is desired. <u>To be discussed during ICG-17. First half of 2024 is a current target date, candidate locations are in Asian countries, Thailand or China</u>

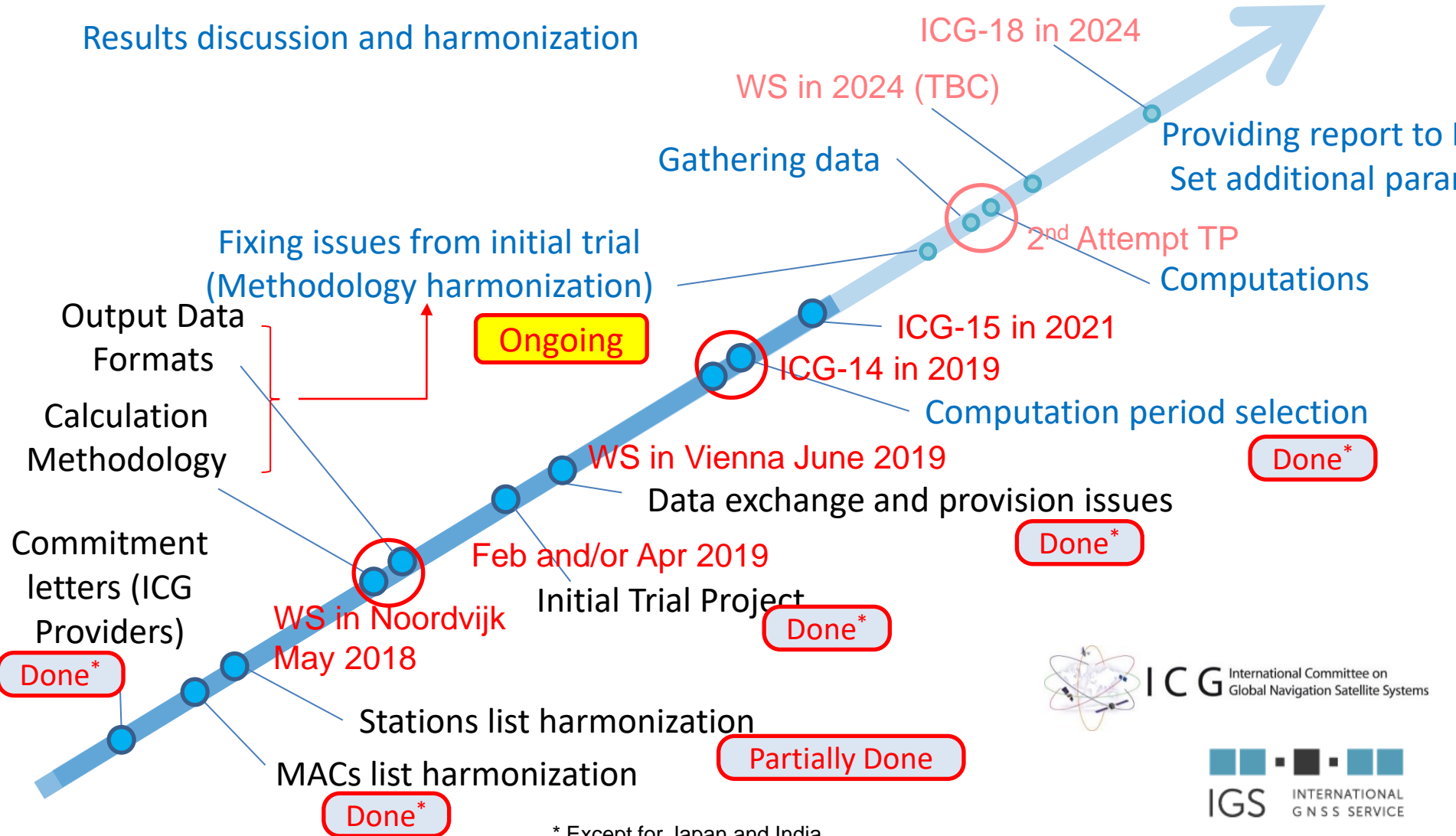
IGMA JTP Roadmap

Updated as of Oct. 2023

Short term goal: Proof of IGMA concept

- Four params (system level) for each single constellation
- Post processing
- Consistent output with harmonized methodologies

Results discussion and harmonization



* Except for Japan and India



ICG International Committee on Global Navigation Satellite Systems

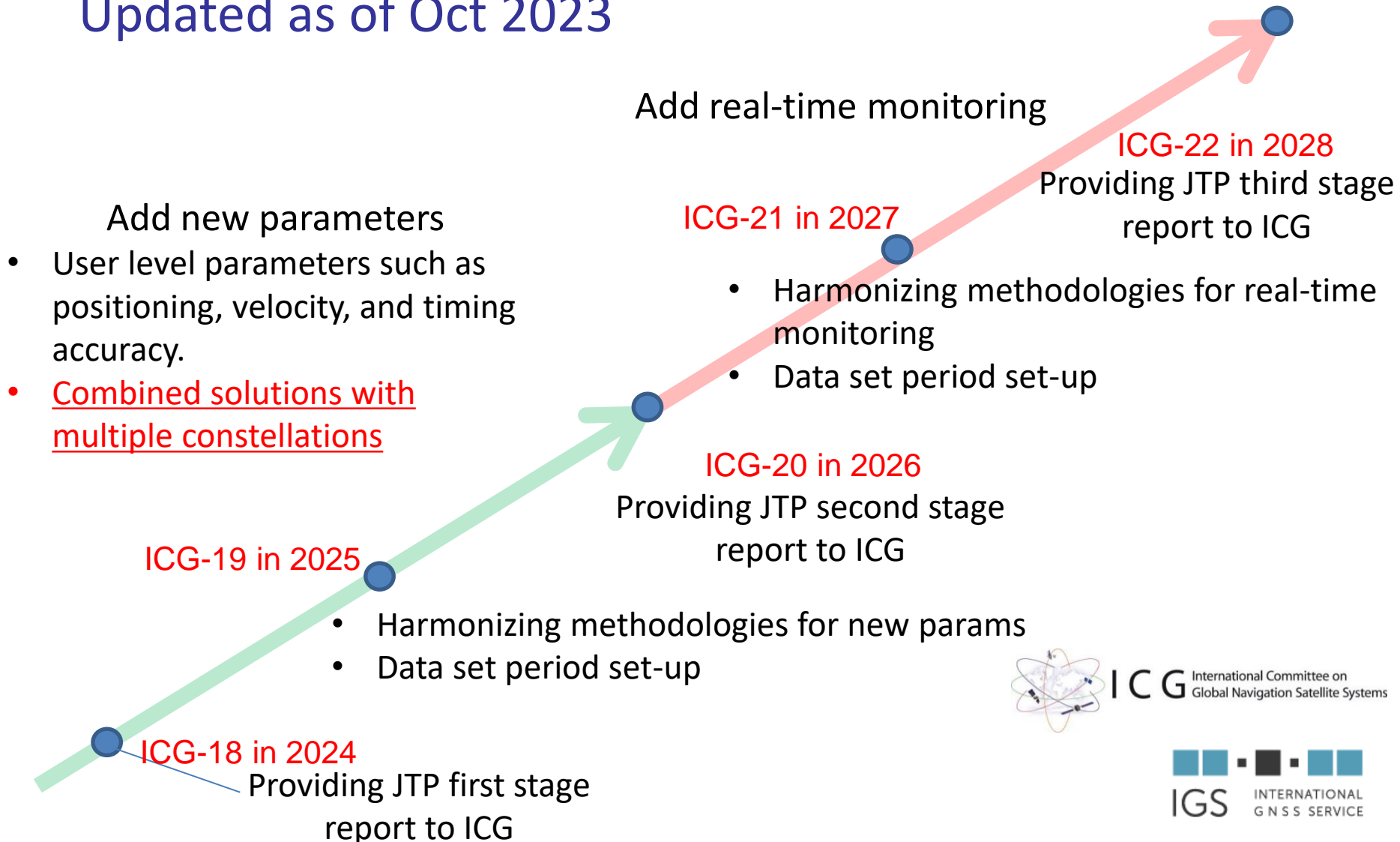


IGMA JTP Roadmap Beyond 2024

Updated as of Oct 2023

Long term goal:

- Proof of real-time performance monitoring and evaluation result dissemination



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