ICG Working Group on Systems Signals and Services (WG-S)
ICG-13 Meeting

2018 Timing Workshop Summary
Held on 20 June 2018

Xi'an, China
06 November 2018

ICG-12 RECOMMENDATION 12S-3
2nd System Time Workshop

- The workshop participants concluded that all System Providers should continue to improve the alignment of their individual system times with UTCk to benefit users

- It was also recognized that currently, the only GNSS to GNSS system time offsets (G2GTOs) that are being broadcast are relative to GPS system time

- The participants identified a number of possible approaches for system time interoperability, including:

  1. System time offsets are calculated at the user receiver level – No Action from System Providers

  2. System Providers broadcast additional GNSS to GNSS system time offsets (G2GTOs)

  3. The development of a GNSS Ensemble time, such as the MGET proposal, with the broadcast of individual system time offsets relative to the ensemble time

- *Recommendation: Conduct a second System Time Workshop in 2018 in coordination with WG-D*

SUCCESSFULLY COMPLETED – 20 JUNE 2018

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WORKING GROUP ON SYSTEMS, SIGNALS & SERVICES (WG-S)
and
WORKING GROUP ON REFERENCE FRAMES, TIMING AND APPLICATIONS
(WG-D)
JOINT TIMING WORKSHOP
Wednesday, 20 June 2018
1000-1800 CET
United Nations Vienna International Centre
Room M7, Ground floor, M-building
Vienna, Austria

Final Agenda

1. Opening Remarks

    Co-Chairs: Xiaochun LU, Jeff AUERBACH

2. Review Background and Workshop Recommendation

    Co-Chairs: Xiaochun LU, Jeff AUERBACH

3. Presentations

    a. Specific Proposals

        i.   Presentation: "Multi-GNSS Time Offset – Concept and Initial Analysis Results"

             D. BLONSKIi, European Space Agency

        ii. Presentation: "GNSS Time Offsets and Interoperability"

             I. SESIA, Istituto Nazionale di Ricerca Metrologica (IT)
             and Royal Observatory of Belgium

        iii. Presentation: "ESA/ESOC Proposal for Multi GNSS Ensemble Time – MGET"

             W. ENDERLE, European Space Agency

        iv. Presentation: "Analysis of GNSS Time Interoperability Methods Suggested by ESA Specialists"

             A.   DRUZHIN, Russia

        v.   Presentation: "The BIPM support to the GNSS interoperability"

             G. PETIT, BIPM

    b. Reports on GNSS System Times

        i.   Presentation: "The Current State of Studies on the Issue 'The Future of the UTC Time Scale' within the ITU"

             E. ZHELTONOGOV, Russia

    c. GNSS to GNSS System Time Offsets (G2GTOs)

        i.   Presentation: "VNIIFTRI Proposals for GGTO Traceability and Uncertainty"

             A.   NAUMOV, Russia

        ii. Presentation: "Update of GNSS Time Offsets Monitoring and BDS Time Transfer Experiment"

             H. YUAN, China

4. Discussion

    All Subgroup Members

5. Review Potential Recommendations/Actions and Presentation to WG-S

    All Subgroup Members

End of document ■

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Multi-GNSS Time Offset Concept and Initial Analysis Results
Daniel BLONSKI

Conclusions and Way-forward

Encourage GNSS providers to conduct joint experiments and trials in producing "xGTO" as generated by Multi-GNSS receivers or other experimental devices.

Eventually, encourage all GNSS providers to broadcast their "xGTO" in their navigation message

Encourage GNSS providers to steer their individual time scales as close as possible to UTC (mod 1 sec). This reduces the "xGTO" offset.

GNSS providers to evaluate the different possibilities also with an open discussion addressing BIPM, IGS and the timing community to avoid controversial choices and to work together pro-actively for the best solution.

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GNSS Time Offsets and Interoperability
I. Sesia, G. Signorile, T.T. Thai, P. Defraigne, P. Tavella

Conclusions

CASE 1 - common reference = GNSSTmean
Results are in agreement at ns level with the GGTO@user level, but here considered only OPTIMISTIC case => differences in averaging and prediction algos among GNSS and use of different receivers to be considered in next steps

CASE 2 – common reference = (GNSST- UTC) prediction as broadcast in the Navigation Messages
Results based on current status include errors due to the different GNSST-UTC predictions, but the difference remains at the level of ~5 ns in case of GGTO and no changes at system level needed => which is the user target for XYTO?

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ESA/ESOC Proposal for Multi GNSS Ensemble Time – MGET

Werner Enderle Erik Schoenemann

- **The Multi GNSS Ensemble Time (MGET) would be a paper time, linked to UTC and readily available**

- **The MGET would be a common time scale, but system independent**

- **MGET would enable true GNSS interoperability at receiver level while keeping independence between systems**

- **MGET reduces the need to make significant GNSS System changes**

- **MGET would provide ensemble clock accuracy and stability**

- **MGET would support PVT, POD and PPP calculations at end user level**

- **A Trial Project is proposed to develop and provision MGET**

- **Detailed assessment required to assess benefits on PVT and POD**

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Analysis of GNSS Time Interoperability Methods Suggested by ESA Specialists

A. Druzhin, P. Bogdanov, T. Primakina

Conclusion.

Advantages:

- The need to broadcast only one correction for both new methods;

- XGTO - GNSS remains independent.

Disadvantages:

- Changes are required at the system level and at the user level as well;

- Disturbances of any GNSS will affect all the others;

- Navigation message change is required for backward compatibility;

- XGTO conception requires identical measurement and calibration;

- MGET - independence of each GNSS disappears… And providers are to broadcast data that they can't be responsible for

Apparently both new proposed methods *won't give any noticeable increase in accuracy* as compared with the methods, based on currently broadcast information, *but require significant efforts*.

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The BIPM support to the GNSS interoperability

G. Petit and P. Tavella, BIPM Time Department

▪Both proposed types of solutions have potential to solve the problem.

▪In Solution 1 (using a calibrated multi-sytem receiver) the « average of GNSS times » should be considered as a necessary step to compute GGTO, not as a new timescale. This solution requires developments by GNSS providers.

▪Solution 2a is readily available, as the offset UTC-GNSStime already exists in the nav message, with uncertainty to be assessed.
   The BIPM can help evaluate the interest of using UTCr in solution 2b, which can complement 2a.

▪But the first need is to specify the required uncertainty on GGTO!

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VNIIFTRI Proposals for GGTO Traceability and Uncertainty
Kosheliaevskii N. and Naumov A.

✓ The GGTO problem is one of the key issues for GNSS interoperability;

✓ We would like to thank our colleagues from ESA for initiating discussion on GGTO problem;

✓ Basing on delivered analysis we consider that there is no need to introduce any other time reference scale to solve GGTO problem but UTC;

✓ Proposals to refer to UTCr does not look correct because of only UTC ensure world wide time scale traceability. UTCr looks like a prompt in a class room.

✓ Current traceability to UTC obtained through its local real-time realizations UTC(k) of leading laboratories enabling GNSS ST continuously improved and right now does not exceed 2-3 ns (1σ);

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The current state of studies on the issue "The Future of the UTC Time Scale" within the ITU

Dr. D. Aronov and E. Zheltonogov, Geyser-Telecom, Ltd., Russian Federation

Status of related activities in ITU regarding the issue "The Future of the UTC Time Scale"were reported. WP 7A in ITU started developing of the Working document towards a preliminary draft new Report ITU-R TF.[UTC] «Content and structure of time signals to be disseminated by radiocommunication systems and various aspects of current and potential future reference time scales, including their impacts and applications in radiocommunication».

Given the fact that in ITU at this time this issue involves a large number of systems and applications in telecommunications, the active participation of a wide range of organizations is necessary in this issue.

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Update of GNSS Time Offsets Monitoring and BDS Time Transfer Experiment

Wei Guang、Haibo Yuan

Consideration on Multi GNSS Ensemble Time

-- Advantage

User side. Low cost of the Multi-mode receiver producer, Improving positioning service.

Provider. reduce the content of the message broadcast and save the navigation message field.

-- Need to Consider

Differences in time keeping capabilities of GNSS systems.

need to fully explain the necessity of increasing the time scale, As UTCr has been published with similar functionality

Related products can be also published by other agency such as IGS. Provider do not have to do everything.

-- Need to Confirm：

Detailed method of MGET implementation;

  -- Who will take charge of the calculation of MGET,

  -- What type of clock data should submitted (Clocks on board? Clocks in Control center and Monitor station? and so on).

  -- does it also require that each GNSS ground control center establish a time comparison link and submit link data?

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Workshop Conclusion

Participants are encouraged to reach consensus on a summary of the outcomes from the 20 June 2018 Timing Workshop and present the findings to the WG-S at its next meeting.

Discussed at WG-S Intersessional Meeting in July 2018

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Proposed Time Interoperability Actions

2. [ESA is invited to consolidate their MGET and xGTO concepts into one proposal for consideration by System Providers]

3. System Providers are invited to consider the [ESA MGET and xGTO proposal]

   - [Seek further information from ESA as necessary regarding the technical details of the concepts]

   - Assess implementation feasibility, taking into account the necessary accuracy of providing GNSS-to-GNSS Time offsets to multi-GNSS users and backward compatibility with the existing user equipment

4. Based on the outcome of the first three actions, the WG-S Interoperability Subgroup will prepare a proposal for the testing of Multi-GNSS time interoperability

   - Incorporating Multi-GNSS time monitoring into the ICG-IGS IGMA Trial Project is an option to consider

5. WG-S [will ask WG-D] to endorse a recommendation for interested members of the BIPM Consulting Committee for Time and Frequency to prepare a recommendation for national time laboratories to improve the accuracy of synchronization of UTC-UTC (k) and to reduce the publication delay of UTC-UTC (k) data

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