ESA Proposal for Multi GNSS Ensemble Time – MGET

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Overview

- Introduction - Multi GNSS Ensemble Time (MGET)
- Impact on User - PVT and POD
- Impact on System Level
- Who could provide Multi GNSS Ensemble Time
- Summary

Introduction – Current Situation

- Each GNSS has it's own System Time
- Each individual GNSS System Time is linked to UTC
- To generate a multi-constellation PVT it is mandatory to know the relative time offsets between the GNSS
- GNSS time offsets are provided as relative offsets between GNSS (e.g. GGTO)
- To calculate PVT, the receiver time is referred to a time realisation of a single GNSS time

Introduction – ICG Initiatives

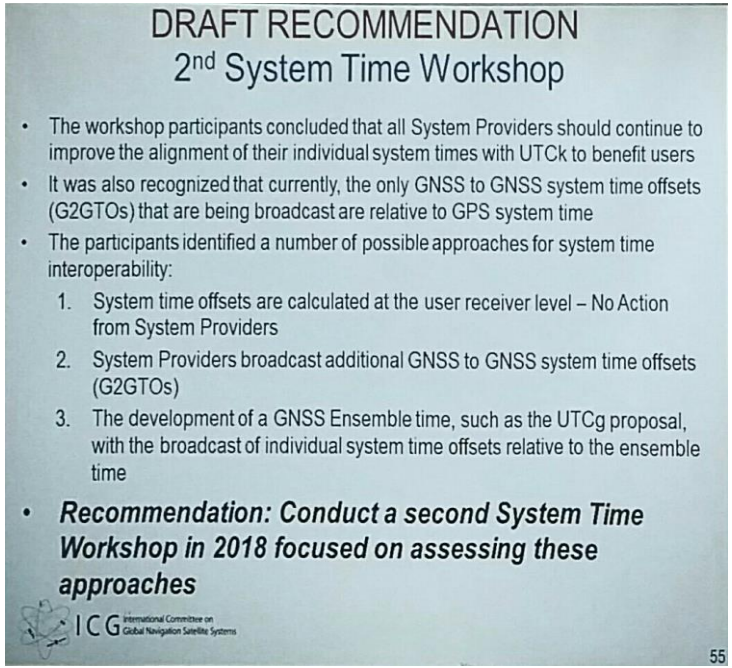
One of the key Requirements for computation of interoperable PVT solutions is **Intersystem Timing**

At the 2nd interim WG-S meeting (Paris, July 2017) the EC presented an ESA idea "UTCg", now renamed:

Multi **G**NSS **E**nsemble **T**ime (MGET).

Other possible name option:

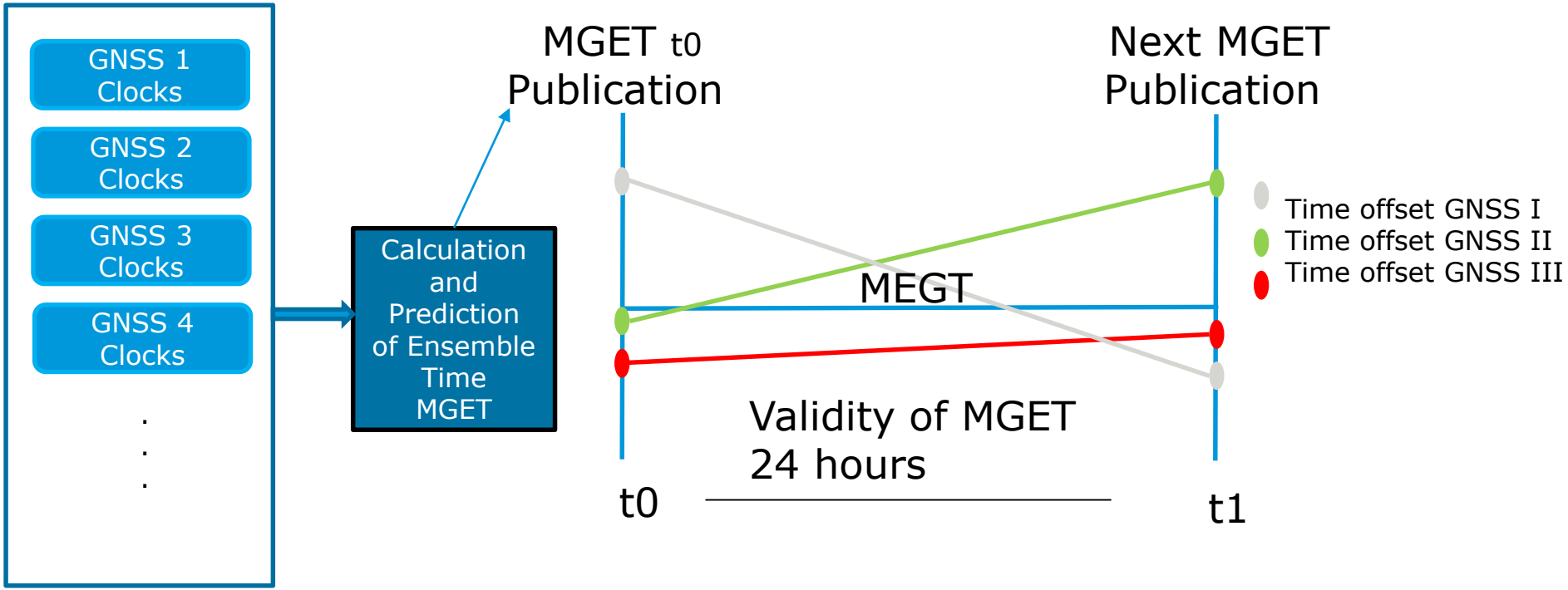
GNSS **T**ime **C**oordinated (GTC)



Introduction - Basic Concept

- All GNSS providers have committed to steer their system time towards UTC
- MGET is proposed to be common, but system independent time reference
- MGET is proposed to be an ensemble paper time, generated based on contributions from the different GNSS, predicted and valid for a specified time period, e.g. 24 hours
- GNSS Systems Time offsets against MGET is considered to be known in advance with a certain accuracy
- Each GNSS Service Provider would provide the respective time off-set between MGET and their GNSS System Time in the navigation message
- Each GNSS Service Provider would be solely responsible for computing their offset to the common time scale - MGET

Introduction - Basic Concept



Impact on User - PVT and POD

- **PVT Calculation**
  - Receiver can directly use MGET to process all GNSS data
  - Offset between GMET and individual GNSS System Time is provided in the navigation message of the respective GNSS
  - potential benefits in challenging environments (urban canyons)
- **Precise Orbit Determination - POD**
  - Reduce complexity of GNSS data processing
  - Possibility to process each constellation individually, no need to include all constellations in a single solution -> Reduce impact on overall solution in case one constellation has a problem

Impact on System Level

Example

- Galileo-GPS Timing Offset (GGTO)
- Galileo transmits this timing offset in its signal to achieve tighter interoperability
- It took considerable resources to implement at EU and US level
- Individual timing offsets, non-trivial and costly
- No other intersystem timing offsets planned for Galileo
- These changes impact the system, depending on the method selected

Who could provide Multi GNSS Ensemble Time

Different potential options are possible

- A single institution could provide the MGET
  - IGS, BIPM
- MGET computation by each individual GNSS provider with an agreed algorithm and weighting
- Closer steering of all GNSS timescales to UTC mod 1 sec
- ….

Potential way forward (subject to ICG and IGS approval)

- ICG initiates together with IGS a Trial Project (similar to the IGMA)
- ICG/IGS Task Force defines the ToR and Work Plan for MGET
- IGS generates MGET based on existing infrastructure and new partners which would like to be involved
- Based on progress of Trial Project, ICG/IGS decide on evolution

Summary

- **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**