# Time Management Working Group Minutes

2022-05-13 teleconference meeting
14:00 – 16:00 UTC

## Attending

* Jon Hamkins
* Beau Blanding
* Stan Cooper
* Eric Pitts
* Greg Kazz
* Yukio Yamamoto
* Christian Stangl
* Juan Crenshaw – GSFC, nav branch (Cheryl) TDM working group
* Lu Lan
* PeiNan
* Sinda Mejri

## Agenda:

* Introduction and review of the agenda
* Review of the draft Green book
* Discussion of possible standards to develop
	+ IOAG service catalog anticipates these standards:
		- Clock Correlation procedures Magenta Book
		- Time Synchronization Blue Book
		- Time Transfer Blue Book
* Conclusion/wrap up

The working group met virtually 2022-05-13, 14:00 – 16:00 UTC. Documents related to the meeting are stored in CWE, in the “Meet Materials/2022/2022-05-13 Spring meeting” folder.

## Minutes

## Green Book status

### GPS

Beau Blanding presented new material in the GPS section, relating to future evolutions of GPS satellites and LuGRE, and updates. This will be provided after a clearance process, and Jon will incorporate into the Green book.

The Moon and Mars sections, currently present in the GPS section are useful but not really related specifically to GPS. These may be moved to a section outside of the GPS section.

Beau also provided a new section on science activities, section 7.1. It is available for review. Jon will incorporate the references and fix figure labeling.

### Latest draft Green Book edits

Jon Hamkins reviewed major edits to the draft Green Book since the last time we me:

* Flagged all unused references
* Deleted large block of duplicate references, being careful to handle properly in text
* Identified all unused references and deleted them

In addition, the time synchronization input from Lee Pitts was recognized as useful in describing many of the fundamental concepts relating to time management. These inputs did not relate specifically to time synchronization, and the material was reorganized and distributed throughout other sections, primarily in the overview section that defines key terms and concepts.

The working group discussed accuracy, stability, and resolution.

Sinda Mejri took an action to add material in section 2.1 to describe precision, accuracy, stability. Add resolution.

Sinda Mejri took an action to provide Section 3.7 describing the national and international organizations.

Action: Add examples or application for time synchronization. Remote clock synchronization for ground segment for Galileo, for example.

Discussion of time synchronization. Take gradient of the clocks into account.

Christian. There are differences in the clock count per second, when you do an estimation of the time correlation packets. LEO orbiters take time from GPS. GEO satellites do measurements of the ground clock vs. onboard clock. And we have two different approaches to do this measurement and determine the gradient. Should mention oscillator.

## Working Group charter update: discussion of what standards to develop

The working group discussed next steps after the green book, relating to what is appropriate to standardize. Jon Hamkins presented an overview of the IOAG service catalog #2, which suggests the following structure for time management standards:

* Blue Book for time transfer
* Magenta Book for time correlation (IOAG calls it clock correlation)
* Blue Book for Time Synchronization

The working group agreed that, hierarchically, time transfer is needed for time correlation, which in turn is needed for time synchronization.

Jon Hamkins suggested that time transfer and time correlation be standardized in one Blue Book. Sinda Mejri and Stan Cooper agreed that this is a promising approach. Yujio Yamamoto expressed the need for these functions, in order to maintain proper measurement timing for onboard instruments. One section relating to time transfer could describe all of the signaling needed relating to timestamping and forming time packets for transfer, as well how ranging signaling can be used for time transfer, including PN ranging, GMSK+PN ranging, telemetry ranging, and optical ranging signals. Another section could describe standardized algorithms used in time correlation and a standard format for expressing the time correlation tables for exchange between agencies.

Christian Stangl began outlining the information that would need to be in such a book, including the time correlation pairs on the ground, using certain data structures relating to Earth time and spacecraft time. Some current ways that DLR and ESA do things may impact what can be agreed to for a standard. The working group also discussed frequency considerations (RF, optical).

The need for standardizing time synchronization was not yet established.

## Review of action items

There was not sufficient time at the meeting to review the action items. Jon Hamkins updated these as best as he could based on known information. Old, closed items were removed from the list. New action items were added. Existing status was updated when known.

## Action items

Open action items are listed in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **AI#** | **Action** | **Assignee** | **Due Date** | **Status** |
| AI\_20\_03 | Complete mission survey | NA~~SA: Carlyn~~~~ESA: Sinda (in spring meeting folder)~~JAXA: Yukio (1 more coming) | ~~May 2021~~~~Sep 2021~~~~Dec 2021~~June 2022 | OpenNASA: closedDLR: closed |
| ~~AI\_21\_01~~ | ~~Prepare Green Book draft for initial WG review~~ | ~~Jon Hamkins~~ | ~~March 2021~~ ~~Oct 2021~~~~May 2022~~ | ~~Open. Section 5-6 left to do.~~Closed: May 2022 |
| ~~AI\_21\_02~~ | ~~Draft section on BEIDOU (section 4.4)~~ | ~~Sinda Mejri~~ | ~~March 2021~~~~June 2021~~~~May 2022~~ | ~~Open.~~~~Nan Pei and Lan Lu will provide this section.~~Closed, May 2022. |
| AI\_21\_08 | Write new section 4.1.2, “GPS Evolution” | Beau Blanding to provide.Jon Hamkins to incorporate and edit labels and references | ~~Sep 2021~~~~May 2022~~June 2022 | Open. Material complete, but awaiting clearance. |
| ~~AI\_21\_09~~ | ~~Edit Section 6, removing or moving material to other sections.~~ | ~~Jon Hamkins~~ | ~~May 2022~~ | Closed May 2022 |
| AI\_22\_01 | Add material in section 2.1 to describe precision, accuracy, stability. Add resolution. | Sinda Mejri | June 2022 | Open |
| AI\_22\_02 | Provide Section 3.7 describing the national and international organizations | Sinda Mejri | June 2022 | Open |