**SYSTEM ENGINEERING AREA**

**Time Management Working Group Charter**

**February 2019**

**DRAFT**

**Approved:**

**Erika Sanchez\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

### BoF Chair Date

### Peter Shames\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Area Director Date

### Leadership

Proposed chair: TBD

Proposed deputy chair: TBD

### Scope of activity

The Time Working Group will concentrate on creating and maintaining standards relating to time transfer, time correlation, and time synchronization. The activities will be coordinated under the Systems Engineering Area (SEA).

### Rationale for activity

Space agencies need to manage time on their spacecraft for the effective execution of maneuvers, scientific observations, ranging, docking or other robotic collaboration, and scheduling of communications links or other activities. CCSDS member agencies see value in standardizing parameters and protocols for accomplishing time correlation/synchronization, so that agencies can offer cross support for their timing needs.

### Goals

Standards shall be developed to promote common understanding of time correlation/synchronization approaches and facilitate cross support of time management on space assets. The Working Group has the following goals:

1. Collect and analyze the technical literature, and codify it into specific time correlation/synchronization methods that can be analyzed and compared, in preparation for developing a Green Book as described next. As part of this, the requirements for time correlation/synchronization for emerging mission domains/enterprises will be determined.
2. Green Book on applications and methods used for time correlation/synchronization. Applications include maneuvers, scientific observations, ranging, docking or other robotic collaboration, and scheduling of communications links or other activities. The book will describe methods time correlation/synchronization, including those for near Earth, cislunar, and deep space regimes. The book will address separately applications in which a Global Navigation Satellite Service (GNSS) is or is not available. A multitude of time transfer, correlation, and synchronization methods will be described, including those involving ranging methods (telemetry ranging, PN ranging, and GMSK+PN ranging), one way data delay coupled with trajectory data, two-way range signaling similar to that used by the Tracking and Data Relay Satellite System (TDRSS)), the use of local aera time zones (e.g., rovers and orbiters around Mars), and methods using or not using explicit time code format representations in the signaling. Error sources will be identified, including limitations in orbit knowledge, calibration, and time tags.
3. Blue Book describing protocols for time correlation/synchronization. This book will describe the signaling of time correlation data (signaling containing time code formats) or time-bearing signals (telemetry/PN/GMSK+PN ranging) needed to accomplish time correlation/synchronization.

### Survey of similar standards efforts undertaken in other bodies and elsewhere in CCSDS

CCSDS has developed standards for Time Code Formats (CCSDS 301.0-B-4), Pseudo-Noise (PN) Ranging Systems (CCSDS 414.1-B-2), GMSK+PN Ranging, and telemetry ranging (in CCSDS 401.0-B-28). Each of these standards relates to the representation of time, or the measurement of elapsed time useful in determining the range between a reference point on the ground and a reference point on a spacecraft.

A series of IETF RFCs (RFCs 778, 781, 956, 958, 1059, 1305, 5905, 7822) describes the Network Time Protocol (NTP) and its extensions, for time synchronization over the Internet. NTP is one of the oldest Internet protocols in current use.

NIST maintains an atomic clock standard, and has established standard definitions for much of the terminology involved. BIPM also maintains an atomic clock standard and uses the same standard definitions.

These various standards and standard definitions will be utilized in formulating a time transfer protocol.

### Patent licensing applicability for future standards

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|  | The current WG participants know of no limitations at this stage on usage of the planned technologies as far as patent restrictions or licensing requirements are concerned. |

### Technical risk mitigation strategy

No technical risks have been identified by the BOF at this stage.

### Management risk mitigation strategy

Schedule relies upon the support of multiple CCSDS Agencies and on the allocation of adequate Agency resources to the WG. This work involves coordination between SLS area and the SE area. Coordination will also be required between this WG and the MOIMS SM&C WG when they work on MO Time Services. Coordination will also be required between this WG and the SOIS App WG when they work on electronic data sheets for onboard clocks to provide time access services for MO Time Services and for other applications. A formal risk management approach will be used to formulate a risk management plan and identify risks other than schedule and resources.

Note: JPL has been testing telemetry ranging and PN ranging and the next generation Transponder has accepted the requirement to time tag their Clock in association with a specified bit in the PN. Bepi-Columbo is currently building a transponder that performs regenerated ranging using the PN but they have no requirement to use the PN correlation to time tag the PN with the transponder clock.

### Schedule

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| **Date** | **Milestone** |
| May 2019 (Spring meeting) | BoF conclusion to AD and WG charter submitted to SE Area |
| 1st July 2019 | WG Charter Adopted by CESG and CMC |
| 1st July 2019 | (Green)Book organization prepared and work delegated |
| 15 september 2019 | First Draft of the (Green) Book before the fall meeting 2019 |
| October 2019 | First Draft Deadline for comments |
| August 2020 | Second draft of the (Green) book (before the fall meeting of 2020) |
| November 2020 | Final Green Book after the fall meeting 2020 |
| September 2019 | White Book on recommended approaches for time correlation/synchronization protocols based for various operational environments. (Blue book track) |
| November 2020 | Final White book submitted to AD for further processing |