Time Management WG teleconference  
11/21/2019

**Agenda**

* Announcements
  + 34th European Frequency and Time Forum
    - <https://atpi.eventsair.com/QuickEventWebsitePortal/eftf2020/web>
    - 21-23 April 2020
    - Noordwijk, Netherlands – ESA/ESTEC
    - Abstract submission deadline extended: now 26 November 2019
* Minutes of face-to-face meeting
* Definitions for review/discussion (Pitts)
* Survey results (Pitts)
* Time correlation (Sank)
* Green book status/inputs
* To discuss in January: meeting dates/times for March and April 2020

Attending:

Jon Hamkins  
Lee Pitts  
Beau Blanding  
Christian Stangl  
Yukio Yamamoto  
Brent Andres  
Zhang Cuitao  
Sinda Mejri  
Victor Sank  
Brent Andres

* Definitions (presentation by Lee Pitts)
  + Definitions shown. Some had been previously discussed in group.
  + Lee took action to merge previous terms discussed by the group with the list he presented today. The goal will be to use terms with standard definitions from NIST/BIPM, and add additional terms as needed
* Mission survey (presentation by Lee Pitts)
  + Mission survey from 2007
  + Topics: mission name, objectives, destination, comm modes, time precision, navigation precision, time correlation
  + Reached out to 180 spacecraft, winnowed down to 48 missions – NASA, ESA, JAXA
  + Working group agreed to include mission survey in Green Book
  + Lee to work on updated survey to discuss at next meeting
* Maintaining UTC on the spacecraft (presentation by Victor Sank)
  + Wanted to avoid counter roll-over issue.
  + Math needed to resolve time drift and offsets was described; clock correlation by frequency adjust

**Discussion on Green Book outline**

Actions for Jan or Feb teleconference noted in red.

Editor/book construction – J. Hamkins

* Definitions – L. Pitts (present at January teleconference; coordinate with others as appropriate)
* Background –
  + Frequency standards, x-ray pulsars, clocks, etc. (general knowledge about time/time management)
    - NTP – P. Shames
    - Terrestrial timing standards / atomic clocks across world – S. Mejri (present in Jan.)
    - Leap seconds, epochs, time scales, etc. – S. Mejri (present in Jan.)
    - Network considerations – Earth receive time, network delay, DTN, etc. – V. Sank (status/partial in Jan., but Vic not present in Jan.)
  + GNSS systems
    - GPS (E. Pitts/B. Blanding) – (present in Jan.; will coordinate with V. Sank)
    - Galileo (M. Rovatti) – (status in Jan.)
    - BEIDOU (Z. Yuxia) -
    - GLONASS (S. Mejri (TBR)) – (present in Jan.)
  + References to time code formats, coding, ranging, etc.
* Mission survey of time requirement (Lee Pitts)
* Time distribution and correlation for space applications
  + Concept
    - Architectural considerations
    - Spacecraft design (time calibration system design)
    - Ground design
  + How it is done
    - Method 1 a, b, c (NASA – DSN, SN, NEN) – J. Hamkins – (present in Jan.)
    - Method 2 (ESA) – S. Mejri/M. Rovatti – (present in Feb.; coordinate with C. Stangl)
    - Method 3 (CAST) – Z. Cuitao
    - Method 4 (DLR) – C. Stangl – (present Jan. or Feb.)
    - Method 5 (JAXA) – Y. Yamamoto
* Time Synchronization for space applications
  + Concept
  + How it is done
    - Method 1 a, b, c (NASA – DSN, SN, NEN) – J. Hamkins
    - Method 2 (ESA) – S. Mejri/M. Rovatti
    - Method 3 (CAST) - Zhang
    - Method 4 (DLR) – C. Stangl
    - Method 5 (JAXA) – Y. Yamamoto
* Applications (draw on existing documentation)
  + Science activities
    - Enumerate examples as they relate to timing accuracy/resolution needed
  + Entry/Descent/Landing (Lunar, Mars, etc.)
  + Docking
  + Commanding of spacecraft actions (comm, antenna pointing, heaters, etc.)
  + Ranging / Doppler
  + Spacecraft maneuvers
  + Multiple spacecraft coordination
* SANA, and patent considerations – J. Hamkins – (complete with first draft of GB by May 2020)