MINUTES OF NAVIGATION WORKING GROUP FALL 2019 WORKSHOP   27-Oct-2019
David S. Berry / Chair

The CCSDS Fall 2019 Meetings were conducted at the Darmstadtium in Darmstadt, Hesse, Germany, during the week of 21-Oct-2019 through 24-Oct-2019. The European Space Agency (ESA) hosted the meetings. This is a summary of the activities of the Navigation Working Group (WG) during the week. The Navigation WG is an element of the Mission Operations and Information Management Services (MOIMS) Area in the CCSDS organization.

ON-SITE PARTICIPANTS

David Berry (NASA/JPL), Marc Blanchet (Viagenie/SANA), Margherita di Giulio (ESA/ESOC), Frank Dreger (ESA/ESOC), Tim Flohrer (ESA/ESOC), Cheryl Gramling (NASA/GSFC), Julie Halverson (NASA/GSFC), Hideaki Hinagawa (JAXA), Ralph Kahle (DLR/GSOC), Alain Lamy (CNES), Stijn Lemmens (ESA/ESOC), Alexandru Mancas (ESA/ESOC), Francisco Martinez (GMV/ESA/ESOC), Mario Merri (ESA/ESOC), Klaus Merz (ESA/ESOC), Vincent Schaeffer (CNES), Brian Swinburne (Airbus/UKSA), Patrick Zimmerman (NASA/JSC).

TELECON PARTICIPANTS

Dan Oltrogge (NASA (AGI, SDC, ISO TC20/SC14))

AGENDA

The final agenda for the WG meetings is available on the Navigation WG CWE at: https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Meeting%20Materials/2019/Fall/navwg-agenda-fall-201910-final.pdf . In the meeting proceedings below, the detailed agenda for each meeting day (as realized) is included in the minutes to provide context.

CURRENT ACTION ITEMS

The following action items were produced during the meetings. They are also available on the CWE at https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Meeting%20Materials/2019/Fall/navwg-action-items-201910.pdf . The action items and due dates below reflect the status as of the end of the meetings; the list on the web page will be updated periodically between now and the next meeting series and will thus reflect relative completion progress and any new action items added after the face-to-face meetings. The list also includes any items from prior meetings that had not yet been completed.

New Action/Outstanding Action Items

If "Status" = "Open", then "Date" = "Target Date"
If "Status" = "Complete", then "Date" = "Completion Date"
If "Status" = "Cancelled", then "Date" = "Cancellation Date"
Sort by "Status" (Descending), "Date" (Ascending)

##	Action Item	Actionee	Status	Due Date (Original)	Date
91	Submit Spacecraft Body Reference Frames data for SANA Registry	David	Open	03-Dec-2018	27-Oct-2019
17	Update Navigation Terms in CCSDS Glossary	Secretariat	Open	31-Aug-2019	31-Oct-2019
34	Inquire of Tom Gannett regarding Nav WG Glossary requests	David	Open	01-Nov-2019	01-Nov-2019
74	Prepare Navigation references for SANA Registry	David	Open	31-Oct-2018	01-Nov-2019
81	Request addition of RDM Terms to CCSDS Glossary	David	Open	30-Sep-2019	01-Nov-2019
93	Submit Corrigenda to SANA Registry Data	David	Open	07-Jan-2019	01-Nov-2019
29	Request addition of "GMST", "MET", "MRT" to Time Systems Registry	David	Open	03-Nov-2019	03-Nov-2019
30	Fix Guidelines document #17 (full text)	David	Open	03-Nov-2019	03-Nov-2019
96	SANA implementation of Nav References	SANA	Open	31-Jan-2019	10-Nov-2019
35	Add "TRACK_ID" keyword to TDM V.2	David	Open	15-Nov-2019	15-Nov-2019
36	Switch order of references 1.6.1 and 1.6.2 in NDM/XML P1.0.2	David	Open	15-Nov-2019	15-Nov-2019
38	Request addition of "OID" column for CCSDS Navigation Standards Normative Annexes registry	David	Open	15-Nov-2019	15-Nov-2019
14	Produce ODM P2.39 review draft	Dan	Open	07-Aug-2019	20-Nov-2019
21	Request addition of "Re-Entry Data Message Originator" to ESOC and DLR "Organization" roles	David	Open	30-Sep-2019	20-Nov-2019
27	PRM Corrigendum	Fran / Frank	Open	20-Nov-2019	20-Nov-2019
28	ICS for OPM, OEM, OMM	David	Open	20-Nov-2019	20-Nov-2019
31	Respond to MP&S Questions regarding the PRM	Fran	Open	20-Nov-2019	20-Nov-2019
33	Request OID move to separate column in "CCSDS Navigation Normative Annexes" registry	David	Open	20-Nov-2019	20-Nov-2019
39	Inquire regarding implementing a way to print a SANA registry out to PDF.	David	Open	20-Nov-2019	20-Nov-2019
40	Inquire regarding restricting the usage of some registry entries in certain standards (e.g., restricting CDM users to choosing ITRF, EME2000, or GCRF for the reference frame).	David	Open	20-Nov-2019	20-Nov-2019
42	Inquire of SANA regarding provision of some kind of "What's New?" indication for users.	David	Open	20-Nov-2019	20-Nov-2019
41	Produce ADM P1.9	Alain /	Open	07-Sep-2019	20-Nov-2019

##	Action Item	Actionee	Status	Due Date (Original)	Date
		Julie			
68	Produce NDM/XML P1.0.2	David	Open	20-Dec-2018	20-Nov-2019
78	Combine events lists and distribute to WG	Alain	Open	15-Dec-2018	20-Nov-2019
92	Submit Revised Orbit Centers Registry data for SANA Registry	David	Open	17-Dec-2018	20-Nov-2019
98	Produce Navigation Events Message initial draft	Alain	Open	31-Jan-2018	20-Nov-2019
32	Discuss response to comments on ADM P1.8 Sections 8.2, 8.3	Fran / David	Open	30-Nov-2019	30-Nov-2019
37	TDM V.2 Test Case #3, Test Case #4	Ralph	Open	30-Nov-2019	30-Nov-2019
16	Prepare ADM section 6.8 (ACM XML)	David	Open	15-Sep-2019	31-Dec-2019
26	XML Section for ODM (update)	David	Open	08-May-2018	31-Dec-2019
44	Create draft "Atmosphere Models" registry material	Dan	Open	15-Jun-2019	31-Dec-2019
45	Create draft "Gravity Models" registry material	Dan	Open	15-Jun-2019	31-Dec-2019
46	Create draft "Orbit Types" registry material	Dan	Open	15-Jun-2019	31-Dec-2019
47	Create draft "Orbit Averaging" registry material	Dan	Open	15-Jun-2019	31-Dec-2019
59	Produce ODM V3 Test Plan/Report Draft	Dan	Open	15-Mar-2019	31-Dec-2019
64	Produce CDM P1.0.1	Brian / Dan	Open	30-Sep-2019	31-Jan-2020
25	Identify RDM Terms to add to CCSDS Glossary	Alexandru	Complete	24-Oct-2019	25-Oct-2019

WORKSHOP PROCEEDINGS

DAY 1, MONDAY 21-Oct-2019

0815   0845   Registration
0845   1030   CCSDS Opening Plenary
1030   1120   MOIMS Opening Plenary
1120   1200   Admin: Agenda, Intro to Nav WG, Guidelines, Prev Action Items
1200   1205   Navigation Data Messages Overview Status
1205   1215   Navigation Data - Definitions & Conventions Status
1215   1230   Re-Entry Data Message Status
1230   1330   Lunch
1330   1730   Orbit Data Msg V.3 (P2.39 draft, Prototyping Plan + Project Schedule)
1830   ????   Nav WG RDM Ceremony @Grohe Darmstadt (https://www.grohe-bier.de/start.html)

0845 1030 CCSDS Opening Plenary

The CCSDS Fall 2019 Meeting series started with a CCSDS Opening Plenary attended by all participating CCSDS members. Steve Townes (CCSDS General Secretary) provided a very brief welcome to the meetings. Margherita di Giulio (CESG Chair) chaired the meeting and provided a few opening remarks covering the agenda.

Information on the traditional set of various logistical matters and items of general interest was provided by Michael Blackwood of the CCSDS Secretariat (e.g., wireless access, details of start/stop times, break times, lunch, security, future meeting schedule, etc.).

Rodney Grubbs from NASA/MSFC briefly described arrangements for the Spring 2020 Meetings which will be sponsored by NASA and held at Huntsville, Alabama, USA. Since NASA/MSFC is on a US Army base, the meetings will be held at a nearby hotel. He cited Huntsville as one of 10 best places for STEM work in the USA.

We had three guest speakers:

1. Nicolas Bobrinsky, ESA/ESOC. Spoke of 4 large programmatic pillars at ESA: Science & Exploration, Safety & Security, Applications, Enabling & Support. The ESA budget is >4B Euros annually. Mission operations often involves international cooperation, thus interoperable standards are imperative. He stated that we must respond to the needs of the projects.
2. Michael Schmidt ESA/ESOC, Chair of IOAG. Discussed IOAG, a forum for identifying common needs across multiple international agencies for coordinating space comm policy, high level procedures, technical interfaces, and other matters related to interoperability and space communications. The IOAG reports to the "Interoperability Plenary" every 4-5 years. Works with frequency coordination group. A key partner is the CCSDS. Requirements from the space community are provided to CCSDS, which is supposed to develop the standards infrastructure allowing interoperability. There is regular interaction between the CCSDS and IOAG. The "ICPA" (IOAG-CCSDS Product Agreements) is the formal agreement between CCSDS and IOAG; it contains work which is necessary from the IOAG standpoint, currently 16 agreed work items, 16 not agreed.
3. Walt Downing Chief Operating Officer of the Southwest Research Institute (SWRI). He noted that San Antonio is a "Sister City" of Darmstadt. He delivered a presentation called "Conquering Space with CCSDS" which highlighted the implementation of CCSDS standards at SWRI. It is a non-profit, independent entity (not government or university) created in 1947. They chiefly work in physical sciences and engineering areas. They have a broad technology base including special laboratories and equipment, and is therefore a capital-intensive operation. He illustrated a broad range of missions in which CCSDS standards have been used/implemented. Upcoming are 4 missions in 2020, and 8 more for future. He noted that SWRI hosted the CCSDS Meetings in 2013 and 2017.

There were some important announcements made in this meeting, as follows:

1. The CCSDS is planning the following upcoming meetings:
a) Spring 2020 hosted by NASA at Marshall Space Flight Center, Huntsville, Alabama, USA, dates 04-May-2020 through 08-May-2020
b) Fall 2020 hosted by CNES at Toulouse, France, Mercure Hotel & Novotel Hotel, 26-October-2020 through 30-October-2020
c) Spring 2021 hosted by NASA at TBD, USA, dates TBD
d) Fall 2021 hosted by ESA at TBD, dates TBD
e) Spring 2022 hosted by NASA at TBD, dates TBD
f) Fall 2022 hosted by UKSA at TBD, dates TBD

2. The "Boot Camp" session will be on Thursday from 0845-1230. It was pointed out that those who are editing CCSDS documents must attend the Boot Camp (at least once).

3. The number of missions that have used CCSDS standards in some respect is now up to 1,149.

4. Margherita gave some updates from the perspective of the CESG (Margherita's presentation is available on the Navigation Working Group CWE at https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Meeting%20Materials/2019/Fall/F19-Opening-Plenary.pdf):
- There have been 9 CMC polls, 5 Agency Reviews, and 15 new projects approved since May 2019 (Spring Meetings)
- The allocation of Chairs, Deputy Chairs, Lead Editors, prototype 1, and prototype 2 across the member agencies was shown (eye chart).
- The CESG meeting on Friday 25-Oct-2019 will discuss topics such as deployment of MO Services, interactions and boundaries with SOIS, reflections on the scope and boundaries of SANA registries... what is exactly the scope of the registries? Glossary: potential synergies between SC13, SC14, and ECSS. RID Template for Agency Review (update... various prototypes have not been acceptable). MIB files and data formats for various CCSDS domains... a uniform way to express relationships between Areas.

5. The number of people registered for the meetings is nearly 250.

6. There are 164 currently active CCSDS documents (103 normative, 61 informative).

After these announcements and opening proceedings, the final portion of the General Plenary involved the Directors of the six CCSDS Areas presenting the detailed plans for the week for their respective areas.

The System Engineering Area report was interesting in a couple of respects. Peter Shames, the Area Director, mentioned that the SANA Steering Group would be discussing specifications for SANA registries (he didn't give detail, but it may be germane to the Navigation WG). He also mentioned that there is a new working group in the Area; it was previously a BOF, but is now a working group. The topics are time-related: time distribution, time correlation, time synchronization. They have named the group "Time Management", which sounds more like a personal management topic rather than a technical topic. He noted that SANA has been in existence about 15 years, and described the principle of SANA: instead of putting all details of variable items into a document, the document cites a registry which allows the WG to add new things without having to change the standard. He noted that there is a registry engineering process which describes in 3 Yellow Books how to use the registries in practice. However, he acknowledges that it is now necessary to make the process clearer. The SEA will attempt to do that over next "short time".

Note: The following information is from an email that Margherita di Giulio sent to David: The CESG has discussed the matter of long Plenaries, and during that discussion it turned out that the majority of the participants did not share the opinions expressed from the Navigation WG. In other words, they were in favor of keeping the Plenary as is. Also, she stated that she did not receive similar complaints from other Working Groups. Therefore, although fully understanding the reasons behind the concerns, the CESG had decided to keep the structure of the Plenary as a kind of "conference", consisting of the welcome address by the hosting Agency (which includes also an insight into their vision and horizons), as well as speeches by one or two invited speaker(s). She stated that she had paid special attention to the contents of this year's presentations in order to make sure that they contained CCSDS-pertinent information, like the adoption of standards by missions, technological aspects, and the like. These are all topics that are of general interest for the CCSDS community. She did not, however, address the matter of

the Area Directors going into detail about each and every book in their areas. (BTW, the Opening Plenary ran 45 minutes over schedule.)

1030 1120 MOIMS Opening Plenary

The overall CCSDS Plenary was followed immediately by the MOIMS Opening Plenary meeting, which was chaired by Area Director Mario Merri. Mario gave an overview of the status of the MOIMS working groups, as follows:

- DAI (Data Archive Ingest) has good momentum, active WG with Long Term Data Preservation (LTDP) and archive architecture in discussion. The have a new ESA member.

- Navigation has high momentum; it is a very active WG with a lot of ongoing work.

- SM&C (Spacecraft Monitor & Control): Focusing on Mission Operations (MO) services. A good momentum, very active WG with an ambitious work plan. Very strong potential for the WG in context of the Lunar Operations Platform Gateway and Boots on the Moon. Requires promotion efforts from all sites, but especially from NASA. Need to resolve eternal discussions: services vs. formats, MO services onboard/relations with SOIS Electronic Data Sheets (EDS).

- MP&S (Mission Planning & Scheduling): High momentum, very active. This is the youngest WG in MOIMS. A Green Book has been finished, and they are working on a Blue Book.

- Telerobotics: No momentum. The WG is basically on hold. The Blue Book project has been demoted to a draft project. CMC has removed it from the CWE... but Mario says that he still believes in it.

Mario started by asking about duration of Opening Plenary... he thinks it is a good opportunity to see what other WG's are doing. "This is why we come together. We could each meet anywhere if not for the Plenary."

- Mario reported on a meeting conducted 03/04-April-2019 at ESTEC regarding the Lunar Gateway. This was also reported at greater length at Mountain View Spring 2019.
- He also reported on an ISS Ground Segment Control Board multilateral workshop on MO Services 30-July-2019 teleconference. They reviewed the potential utilization of existing MO standards in Gateway Ground Systems. They offered access to online documentation and virtual training sessions to all partners. Action Items they received: Consider the ISS MCC/H-ESA ICD and identify which MO Services can be utilized, 2. Propose a roadmap for MO Services adoption.
- SM&C will initiate an activity to adapt NASA Core Flight Software to MO Services.
- MO Services are considered an IOAG priority, and a 3-party demonstrator (CNES, ESA, NASA) is ongoing.
- There are also ongoing discussions with the SOIS WG on Common Operational Interfaces.
- The MO Services may be included in Catalog 3 of the IOAG Approved (Services)

Mario concluded by requesting that WG Chairs keep Mario and Brigitte involved and let them know if there are any meetings they should attend. Keep CCSDS the forum where space enthusiasts meet to identify and discuss space issues. In closing, Mario announced that the MOIMS Dinner would be held on the evening of Tuesday 22-Oct-2019 at 1900 hours.

1120 1200 Admin: Agenda, Intro to Nav WG, Guidelines, Prev Action Items

The Navigation WG meeting was started immediately after the close of the MOIMS Opening Plenary. In attendance this day were David Berry, Frank Dreger, Tim Flohrer, Cheryl Gramling, Julie Halverson, Hideaki Hinagawa, Ralph Kahle, Alain Lamy, Stijn Lemmens, Alexandru Mancas, Fran Martinez, Vincent Schaeffer, Brian Swinburne, Patrick Zimmerman. Dan Oltrogge joined us via telecon for the afternoon session.

We reviewed outstanding Action Items from the Mountain View meetings. Because the Opening Plenary had run so long we only reviewed items that had been closed since the last telecon on 11-Oct-2019. Five items had been closed between the 11-Oct-2019 telecon and the first day of the Fall Meetings.

Review of the action items from Mountain View showed that as of the start of the meetings, 37 of 62 were completed (60%), 23 remained outstanding (37%), and 2 had been cancelled (3%). Several of the outstanding action items had been added during the period between the Spring and Fall meetings. Overall, the percentage of action items completed was quite good (last time was 54% completion rate).

David distributed an updated version of the WG guidelines; there was a new one that was an action item. During that discussion, Frank mentioned a PRM corrigendum that was necessary that we need to follow up. Fran and Frank have an action item to craft the corrigendum and send to David.

1200   1205   Navigation Data Messages Overview Status

David indicated that we need to wait for the CESG/CMC polls. According to Tom Gannett, the book is all ready to go, but he limits the number of concurrent polls. This document should be in the next batch of polls.

1205   1215   Navigation Data - Definitions & Conventions Status

David noted that the CESG Poll of this document had completed with a condition (a rather weak one), specifically, has the WG ever considered making this a Magenta Book? The answer to that is "no", but there are reasons. Later in the week (Wednesday morning), David reviewed a response to the condition with the WG and sent it to Peter.

1215   1230   Re-Entry Data Message Status

David noted that the CESG Poll of this document had completed with a condition to which we need to respond. It related to tampering of the messages and how to get a measure of comfort that a message is genuine. Although tampering is a potential issue, there are checksum issues that are also troubling. For example, is there a standard procedure to generate the checksum? Couldn't someone that tampered with the message then run a checksum on it (so the tampering could not be detected)? What if the checksum doesn't match? Would the checksum be valid in the event of XML conversion to KVN via XSLT? etc.

1330   1730   Orbit Data Msg V.3 (P2.39 draft, Prototyping Plan + Project Schedule)

Dan joined via telecon from Washington, DC. He noted that he had met with Cheryl last Friday to work on OCM material. He went over some material that he is still waiting for (in particular, ICS for OPM, OEM, OMM). David has the action item to provide this material to Dan. The ICS for the OCM will wait until the content has finalized. During the course of the telecon we focused on several items in the P2.38 CRM that had not yet reached resolution.

Much time was spent on Cheryl's proposal for adding min/max/avg/sigmas of residuals by data type for the Orbit Determination section in the OCM, an apparent major expansion of the OD section. It will add

more time to the development of the document, prototyping, etc. In order to accommodate it, 4 keywords would need to be added for each of the 7 data types currently handled. We considered a composite keyword with 4 values, but after discussion this proposal was ultimately rejected. Cheryl suggested removing the OD Section from the OCM and adding an Orbit Determination Message project, which seemed like a possible solution, but after discussion the idea seemed less attractive than it had at first. Ultimately Cheryl agreed that it would be acceptable to leave the OCM OD Section as is, but the current content is "necessary but not sufficient" for understanding the quality of the orbit determination. We will ultimately need to consider extending the section. In further discussion, it was noted that even with 28 keywords, if there are multiple sensors of different types the resultant may not be useful. David suggested that we publish the ODM V.3, and then consider a corrigendum with the requested material. There was a comment to the effect that this would be almost like its own new section of the ODM... a whole new construct, but the corrigendum could be constructed so as to replace the entirety of the ODM Section when we do it. It was stated that we will need to consider a way to make it work. Cheryl agreed to go with what we currently have and expand later.

In other topics, Dan had made some changes in the P2.39 XML section per Fran's review comments. Some of these will need to be factored into the sections on XML representations in the ADM, CDM, and TDM revisions currently in progress.

Given that we ran out of time on the ODM discussion, we did not have an opportunity to begin discussing the prototyping plan or the project schedule. The schedule was addressed later in the week; the prototyping plan will need to be addressed either in telecons or delayed until the 2020 Spring Meetings.

1830   ????   Nav WG RDM Ceremony @Grohe Darmstadt (https://www.grohe-bier.de/start.html)

After the day's meetings, we all met at the Grohe Brewery to commemorate the occasion of the quasi-completion of the RDM. We celebrated as if the document were final regardless of the fact that we still have a bit of work to get the book published (resolution of CESG Poll conditions, CMC Poll). Nevertheless, this was a good instance of the WG's "new tradition" suggested by Dan.

DAY 2, TUESDAY 22-Oct-2019

0845	1045	Tracking Data Message V2 (Prototyping Plan & Report + Project Schedule
1045	1230	Attitude Data Message V2
1230	1330	Lunch
1330	1530	Navigation Data Messages XML Spec update + Project Schedule
1530	1730	Joint Meeting Mission Planning & Scheduling
1900	????	MOIMS Area Dinner @ Darmstädter Ratskeller Hausbrauerei

In attendance this day were David Berry, Frank Dreger, Cheryl Gramling, Julie Halverson, Hideaki Hinagawa, Ralph Kahle, Alain Lamy, Alexandru Mancas, Fran Martinez, Vincent Schaeffer, Brian Swinburne, Patrick Zimmerman. Mario Merri (AD) and Margherita di Giulio joined us for the post-lunch session.

0845 1045 Tracking Data Message V2 (Prototyping Plan & Report + Project Schedule

David showed the various changes that had been introduced in the TDM P1.4 to incorporate the use of the SANA Registry. During the preparation of P1.4, David checked all of the entries in the Annex B of the TDM Time Systems to ensure that they were in the Time Systems registry; he found that "GMST" was in Annex B, but not in the SANA Registry. Cheryl checked and it is in the Green Book. We decided to add

"GMST" to the Time Systems registry. David has the action item to request GMST be added to the registry.

Ralph presented a discussion of his proposal to add a "TRACK_ID" metadata item. He showed pictures from SmartNet telescope that motivated the addition of the new keyword. The group agreed that this would be OK to add because it is not used in actual processing, but rather effectively acts as an identification comment. Ralph will modify the TRACK_ID description a bit based on commentary from the group.

After looking through the TDM document we looked through the TDM Test Plan & Report to assess status on a case-by-case basis.

Test Case #1: Cheryl mentioned that there had been no recent progress. Substantial work was done previously, but ran into some issues that are still being resolved. Cheryl anticipates a successful result.

Test Case #2: During discussion of the Phase Counts test, Fran's note about lack of DOPPLER_MODE (coherent, non-coherent) inspired Cheryl to add it to the V.3 list. Should it be in Version 2 instead? Would we have to do an additional Agency Review since this is not something that is just a pseudocomment? In later discussion Cheryl felt it was not necessary to add at this point, but would be a good thing to add to V.3.

Test Case #3: Ralph indicated that DLR would perform its part of Test Case #3 in November

Test Case #4: Ralph indicated that he could help out with the Radar Cross Section (RCS) test (so it will be ESA/ESOC + DLR instead of ESA/ESOC + JPL).

Test Case #5: David stated that he had prepared an XML schema update for V.2 but it has not yet been added to the SANA Registry. David and Fran will conduct this test but it has not yet been done.

The CWE schedule for the TDM was modified slightly to extend the dates for prototyping and the final Secretariat processing. The target date around the time of the Spring 2020 Meetings still seems achievable. David emphasized that this is an opportune time to focus on and prioritize TDM completion since the Green Books and the RDM are effectively complete, and the Lead Editors of the ODM and ADM are still preparing new versions for review.

1045   1230   Attitude Data Message V2

In order to accommodate some travel plans, we split the ADM discussion into 2 parts. In this first session, Alain went over various items from the CRM and issues that had arisen in the internal review of ADM P1.8 (he said there were 230 comments on P1.8). The P1.9 version anticipated soon will contain the resolutions of these items. There was a lot of discussion on the purpose and need for the "CENTER_NAME" keyword; ultimately it was decided that the text would be improved to clarify that this was the body about which a spacecraft was orbiting and that in general it had nothing to do with the attitude (though there are special cases). Julie pointed out that the Spacecraft Body Reference Frames registry had not yet been uploaded to SANA... David indicated that this is almost ready, but he got sidetracked by the necessity to prioritize the effort required for the RDM registries.

1330   1530   Navigation Data Messages XML Spec update + Project Schedule

David explained the overall strategy for this document: move material to constituent standards, minimize the need for future updates, remove support for ODM V.1 (since it is a silver book). It is a general

strategy for this document to avoid as much as possible updating it. Alexandru came up with the great idea of switching the order of references 1.6.1 and 1.6.2, which will further reduce the need to update the document in the future. Patrick inquired if the document would go away after all the discussion is moved into the constituent standards; David responded that the "combined instantiation" would still exist (it may ultimately provide the kernel concept for the future modular message). In the Version 2 update, only the TDM material will be removed. Originally it was thought that the ODM, ADM, and TDM 5 year revision tasks might complete close to each other and only one update would be necessary, but that no longer appears to be the case. In the Version 3 update, the XML formulations for the ADM, the ODM, or both will be removed, depending on the progress of those two documents (probably ODM first, since the ACM is modeled on the OCM and may be published later).

1530   1730   Joint Meeting Mission Planning & Scheduling

We had a joint meeting with MP&S to discuss how they were planning to utilize the Pointing Request Message (PRM) in their information model. Fran, as the lead of the PRM development, was the primary participant in the session from the Nav WG, although several other members of the Working Group attended. Fran responded verbally to all of the points raised by the MP&S presenter Peter van der Plas. Fran has an action item to respond to further MP&S questions that could not be resolved during the meeting.

DAY 3, WEDNESDAY 23-Oct-2019

0845   0930   Responses to Conditions from CESG Polls
0930   1045   Attitude Data Message V2 + Project Schedule
1045   1230   Navigation Events Message White Book + Project Schedule
1230   1330   Lunch
1330   1730   Conjunction Data Message V2 Continued Discussions + Project Schedule
1900   ????   ESA Sponsored Dinner @ Restaurant Sitte

In attendance this day were David Berry, Frank Dreger, Tim Flohrer, Cheryl Gramling, Julie Halverson, Hideaki Hinagawa, Ralph Kahle, Alain Lamy, Alexandru Mancas, Fran Martinez, Klaus Merz, Vincent Schaeffer, Brian Swinburne, Patrick Zimmerman. Dan Oltrogge joined us via telecon for the afternoon session.

0845   0930   Responses to Conditions from CESG Polls

Although this was not initially scheduled in the official agenda for the day, the group took the time to wordsmith a couple of emails to Peter Shames regarding the conditions placed on the Navigation Data - Definitions and Conventions Green Book and the Re-Entry Data Message. It was desirable to do this with everyone present rather than do it on a telcon (have to schedule special telecon or wait a month, harder to communicate, etc.). After discussion the two emails (one for each book) were sent to Peter.

0930   1100   Attitude Data Message V2 + Project Schedule

Alain and Julie continued discussion of the ADM P1.8 CRM and preparations for ADM P1.9. Some action items were assigned during this discussion: David and Fran should discuss the proper response to comments on ADM P1.8 sections 8.2 and 8.3. Also, David has an action item to request the addition of GMST, MRT, and MET to the Time Systems registry (GMST was already raised during the TDM discussion).

Much discussion of how to deal with tables in Annex B that deal with "Attitude and Rate Types" and "Estimator Types", specifically, how to organize them. Should these tables remain in an annex? or should they be placed in SANA, etc. There is currently an "Attitude & Spacecraft Conventions" registry that is organized somewhat differently than analogous registries created for the ODM. After much discussion and at least two divergent opinions, Julie offered that she would propose a method in P1.9 for the group to review since the ADM will still be in development for a while. Also, many of Dan's comments on the ACM in the P1.8 CRM have been rendered inapplicable due to changes in the OCM which Julie is using as a model for the ACM. Accordingly, we didn't discuss these in detail. Julie proposed to wait for the ODM P2.39 and use that to address the affected portions of the ADM that were cited in the P1.8 CRM. Once Alain has completed making his edits in the ADM P1.9, he will send the draft to Julie for ACM changes based on ODM P2.39.

The contradictory approaches to the phenomena of "nutation" and "precession" arose again. In the ADM a corrigendum was in place that states one thing. In the SANA Glossary, the two terms are presented as applying to different phenomena. This may have to be a special topic at the Spring 2020 meetings if we cannot resolve it sooner.

We looked at the ADM project schedule but decided not to update it. While it likely needs revision, we won't be able to make informed changes until after we are able to review ODM P2.39 material and assess the impact on the ADM schedule.

1100   1230   Navigation Events Message White Book + Project Schedule

Alain started his presentation by remarking that the NEM was not moving very fast. One issue he cited: should it be KVN? XML? He showed a few examples that suggested a KVN format might not be able to convey the information smoothly; it might not be the right format for the information. Clearly, we've seen examples of how an XML implementation could be used (e.g., Fran's and Frank's prototype at Gaithersburg). Alain explained that he was leaning towards a definition of the NEM similar to the approach taken for the PRM, though that might be "disturbing" for some. In this approach, he would lay out the required information content, with instructions how to present that information in various formats (we've already had some expressed interest in JSON, for example). Fran noted that the Abstract Event Definition is modeled in UML, so Alain's approach could be feasible. The NEM could apply to multiple objects and would use a single time scale. As Alain explained the NEM, he displayed an early (undistributed) draft of a first NEM White Book, so there is good progress on this front (later in the day, Alain asked about the availability of templates; David said he could get a fresh template on the CWE in the CESG section). During the NEM discussion, Fran reminded us that we were now rejecting some of the features we had asked Colin Haddow to put into the Abstract Event Definition model. Since that book has just completed Agency Review, it's officially "too late" to submit comments, but Fran had spoken with Colin earlier in the week and mentioned that he would send some after the fact comments. Specifically, the rejected feature involved placement of an absolute time followed by a relative time in a KVN line; this approach seemed unnecessary. Fran indicated he would suggest that Colin remove that particular feature in the UML model.

1330   1445   Conjunction Data Message V2 Continued Discussions + Project Schedule

Brian led the discussion of the CDM. Dan joined us via telecon and displayed the slides over GoToMeeting (slides are available on the CWE at https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Draft%20Documents/Conjunction%20Data%20Message%20(CDM)/CDM-v2-20191023.pdf)

Brian explained that there is no draft yet of the CDM Version 2... they have been surveying users for desired modifications to the standard (telecon with 18SPCS, AFSPC, NASA (via email)). Brian's material

listed a set that is tentatively targeted for implementation in Version 2, a set for future consideration, and some user defined material. One of the design principles of the CDM update is that the changes be useful, but don't take "too long" in order to be responsive to the user community. Brian is targeting a first draft by end of January 2020. A first step is that Brian will send the slides out to users and solicit feedback within 2 weeks, and proceed from there.

Before Dan dropped off the telecon, David took the opportunity to poll him regarding the ODM V.3 schedule (he had forgotten to on Monday).

1445 1540 Tracking Data Message V3 Discussion

Because the CDM discussion was short relative to the amount of time that had been allocated, we rearranged the agenda to move the TDM V3 discussion from Thursday into Wednesday. Cheryl led the group discussion of her compilation of initial ideas for the TDM V.3. Her most recent update, as presented to the WG, is on the CWE at https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Draft%20Documents/Tracking%20Data%20Message%20(TDM)/TDM%20v3%20Thoughts%2023 Oct2019.pdf . The material outlines 4 basic thrusts for the TDM V.3 update: new (or improved precision) measurement types, improved accommodations for relay tracking, greatly enhanced flexibility, and updates suggested from operational use of the TDM.

1540 1700 Update project schedules, miscellaneous discussion

After the coffee break we had a few miscellaneous activities. In particular, we updated a few CWE schedules that had been overlooked during the previous discussions. First the NEM schedule was updated. Alain indicated that he would be interested in getting Frank's assistance as much as possible; Frank stated that he liked the approach that Alain is planning to take with the NEM. After updating the NEM schedule (first draft end of December, then all others had to be adjusted), we looked at the TDM V.2 and TDM V.3 schedules. These schedules constitute the basis for the 5 Year Plan discussed Thursday.

DAY 4, THURSDAY 24-Oct-2019

0845	1030	Annex Migration=>SANA Status (with Marc Blanchet of SANA Operator)
1030	1145	Future: Fragmentation Data Message, Launch Data Message
1200	1230	Future: NDM/KVN Topics (aka "Frankenstein Message")
1230	1330	Lunch
1330	1445	Prep Closing Report, Action Items, Five Year Plan, Set Next Telecons
1445	1600	Free
1600	1715	MOIMS Closing Plenary

In attendance this day were David Berry, Marc Blanchet, Frank Dreger, Tim Flohrer, Cheryl Gramling, Julie Halverson, Hideaki Hinagawa, Ralph Kahle, Alain Lamy, Alexandru Mancas, Vincent Schaeffer, Brian Swinburne, Patrick Zimmerman.

0845   1030   Annex Migration=>SANA Status

We were joined by Marc Blanchet of the SANA Operator (Viagenie) to continue discussion of the migration of material from Navigation WG normative annexes into SANA registries.

We inquired about the possibility of the SANA Team creating a "work queue" similar to that prepared by the CCSDS Editor; such a queue gives a working group a confirmation that their request has been received and logged, and also gives some sense of how long it might be before any given request will be implemented. Marc didn't say whether or not they might implement such a queue, but did explain that one reason why the SANA may have been slow to implement requested changes is that they have been spending a lot of time on the Spacecraft identifier registry. The set of identifiers is relatively small, and they have a very tight verification process. He noted that they have spent about 1.5 years scrubbing the data in the frequency bins for this registry. This has pretty much swamped the team and thus the response time to new requests has been slow. Marc did explain that they had in the past implemented a work ticket system, which could provide information from which to generate a queue report, but they phased it out due to a few issues related to email thread cascades that made the system infeasible.

We inquired about a representation that reflects the hierarchy of registries. Marc indicated that the SANA team was indeed working on such a representation; it just has not yet been a priority. It's still on the "to do" list.

We inquired about sortability via the OID. He showed the "References" registry, in which the OID is a separate column that can be sorted, and the Navigation Annexes registry, which cannot. After looking at the "mockup" of the registries, David recognized his mistake... he had included the OID right after the title of the registry, instead of in a separate column; consequently it cannot be sorted by OID. The SANA team had implemented exactly what was shown in the mockup. David will request an update to this registry.

We inquired about updates to the CCSDS Glossary in the SANA Registry, Marc explained that the SANA team had set up Tom Gannett with access to the SANA Glossary, so he can edit the terms in the Glossary. He added that the SANA is planning an authorization framework that would allow others to update their own entries, but this is a very big job. David took an action item to check with Tom Gannett regarding the status of recent Nav WG Glossary requests.

At David's request, Marc described the SANA registry structure (beta, candidate, "production"). The beta concept is essentially identical to most software development projects: there is no guarantee that work appearing in the beta will persist for any given period of time.

Marc explained that the SANA Operator basically provides an administrative function for "the community". In this case, the community is CCSDS Working Groups and the users of the standards they produce. He explained that Viagenie (his company) also provides a similar function for the larger internet community via the Internet Assigned Number Authority (IANA). The function of the operator is administrative; they don't make decisions about the content. Decisions about the content are referred according to the "policy" for the given registry as expressed in the SANA annex in CCSDS documents.

After Marc left, discussion continued. In particular, there were a few interesting topics, e.g., implementing a way to print a registry out to PDF, restricting the usage of some registry entries in certain standards (e.g., restricting CDM users to choosing ITRF, EME2000, or GCRF for the reference frame... at present there is no such restriction), providing some kind of "What's New?" indication for users. At least for Nav WG registries, a notification could be provided to the moims-nav@mailman email list (the broader general interest list, not the internal working group member list). David took action items to address these questions to the SANA Operator.

1030   1145   Future: Fragmentation Data Message, Launch Data Message

Alexandru made a presentation of the proposal for the Fragmentation Data Message (FDM). Prior to Alexandru's proposal, as motivation for the message, Tim Flohrer provided a brief presentation describing the increasing number of fragmentation events in HEO/GEO orbit regimes; there have been several recently, a level that Tim characterized as "unprecedented". Afterwards, Alexandru made a case for tying the development of the FDM to the modular message concept we have been slowly working towards; he envisions the FDM as a first step towards implementing such a modular message (e.g., re-use of structures such as state vectors, ephemerides, covariance matrices, orbit determination section, physical properties, etc.). He recently updated the Concept Paper (originally written in 2015), however, the concept paper for the FDM was written mainly for a stand-alone message (same as the CDM and RDM) because the idea of the modular message has not yet been proposed in a Concept Paper. Format-wise, the current concept consists of both KVN and XML versions, similar to most Navigation WG messages. However, there is some possibility of creating an XML-only message re-using structures from existing XML NDMs. In response to a question from Alain as to the possible users of such a message, Tim provided a use case example: a fragmentation event is detected and announced, within minutes he receives queries from missions "what does this mean for my mission?". At first the information is very sparse, preliminary rough estimates can be provided that are improved as more data is collected and input to "explosion models". Over time, the larger pieces of the fragmentation event are cataloged, and at some point, once all the main pieces have been cataloged and tracked, the need for a fragmentation message for a particular event diminishes. There seems to be a case for moving forward with such a message. Given that the RDM (for which Alexandru was the Lead Editor) is complete and is therefore available to work on such a product, we could propose the FDM at this time. After discussion, the group did not approve moving ahead with a project proposal, but left open the possibility of doing so in the next 6 months (see "Navigation Working Group Closing Report, Further Resolutions Anticipated in the Next 6 Months" later in these minutes).

We did not discuss the Launch Data Message given that (a) it was Dan's proposal and he is therefore the best person to lead any such effort, (b) he wasn't at the meeting due to schedule conflicts so couldn't participate in the discussion, and (c) the Orbit Data Message needs to be the top priority for the time being. Tim Flohrer did relay some interest in the concept on Klaus Merz' behalf, however.
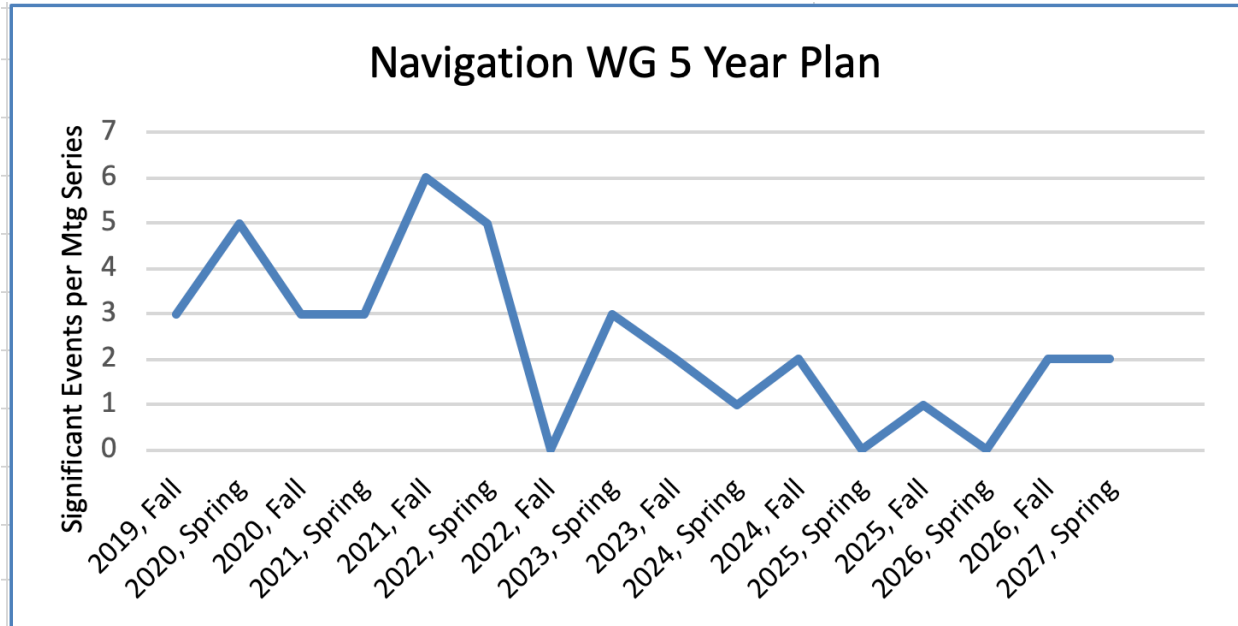
1145   1230   Future: NDM/KVN Topics (aka "Frankenstein" Message)

Julie raised a good question as to when we will start working in earnest on the future message (known by several names currently, NDM/KVN, Hybrid Message, Modular Message, "Frankenstein" Message etc.). If, as she pointed out, we keep pushing it out into the future, we will never work on it. David explained that we need to finish some of the things we have in our program before we can start on Frankenstein. We have 10 projects in the CWE Framework at the present time, and we need to finish some of them before we can make a good case to the CESG and CMC that we have the resources to work on Frankenstein. This isn't so bleak, however, because we have 3 books about to finish, and the TDM V.2 and NDM/XML update should be close by Spring 2020. This will improve things considerably, potentially reducing the number of active projects by 50%. The ones we really need to finish are the ODM V.3 and ADM V.2... these will take a while yet but should be able to provide some of the components of Frankenstein. In some ways we can see Frankenstein taking shape in the NDM/XML schemas because insofar as possible structures are re-used across the schemas. David did wonder if there is a forum within the CCSDS where such a future-oriented concept could be presented; the Full Plenary is not appropriate, and working groups are not allowed to attend the CESG Meeting (which might actually be the logical place). It also could be presented at the MOIMS Plenary in Spring 2020. David committed to adding a note introducing the Frankenstein concept in the Closing Report (see "Navigation Working Group Closing Report, NAV WG Upcoming New Work Items" later in these minutes... it's very indirect, but does give a clue). During this discussion Brian inquired whether or not we are bound to backward compatibility (e.g., in the CDM version 2); we are not bound to it, but it's very desirable. Cheryl inquired about how the Frankenstein

concept can be worked into new items such as the TDM V.3 and CDM V.2. Fortunately these projects are still in the formative stages so it's conceivably possible to incorporate the Frankenstein concepts into them.

1330   1445   Prep Closing Report, Action Items, Five Year Plan, Set Next Telecons

We worked through and updated the Working Group's 5 Year (+) Plan after David explained the basic methodology. The final result can be viewed in the following plot of significant events per meeting. The full plan is on the CWE at https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Meeting%20Materials/2019/Fall/navwg-5-year-plan-201910.pdf .

David reviewed the draft Final Report with the remaining members of the WG (a few members had had to leave early due to travel plans). We worked through the draft Final Report, making modifications as applicable. David showed the list of potential action items that had arisen through the week; these had been augmented by the action items still open from Spring 2019. For some action items David had already assigned target dates if they came up in the course of earlier discussion; for other items we set target dates in this session.

As a last item, David showed a proposed plan of WG telecons between the Fall 2019 Meetings and Spring 2020 Meetings (to be found at the end of these minutes); in principle this plan was adopted, though things like this announced so far in advance are usually subject to some changes.

All materials from the meetings (agenda, introductory presentation, action items, report, 5 Year Plan, and these minutes) are available on the CWE at the following link:

https://cwe.ccsds.org/moims/docs/Forms/AllItems.aspx?RootFolder=%2Fmoims%2Fdocs%2FMOIMS-NAV%2FMeeting%20Materials%2F2019%2FFall&FolderCTID=0x012000C8EEDFBFAD59894AB84FF1AF9485D0AB&View={72CC1C3E-EFA9-498B-BEA5-C88E7DEE0C54}

Draft documents reviewed during the meetings are in their respective directories on the CCSDS CWE:

https://cwe.ccsds.org/moims/docs/Forms/AllItems.aspx?RootFolder=%2Fmoims%2Fdocs%2FMOIMS-NAV%2FDraft%20Documents&FolderCTID=0x012000C8EEDFBFAD59894AB84FF1AF9485D0AB&View={72CC1C3E-EFA9-498B-BEA5-C88E7DEE0C54}#InplviewHash72cc1c3e-efa9-498b-bea5-c88e7dee0c54=FolderCTID%3D0x012000C8EEDFBFAD59894AB84FF1AF9485D0AB-RootFolder%3D%252Fmoims%252Fdocs%252FMOIMS%252DNAV%252FDraft%2520Documents-SortField%3DLinkFilename-SortDir%3DAsc

1445   1600   Free

As we had completed our closing work well before the start of the MOIMS Closing Plenary, we officially concluded the Navigation WG meeting. Those still in attendance bid each other safe return travels, and we started making plans for the next meetings in Huntsville in May 2020. Several members indicated that they planned to attend the MOIMS Closing Plenary at 1600.

1600   1715   MOIMS Closing Plenary

In attendance at this meeting were Mario Merri (MOIMS AD), Brigitte Behal (MOIMS DAD); David Berry, Frank Dreger, Alain Lamy, Vincent Schaeffer, and Hideaki Hinagawa (NAV); Steve Hughes (DAI); Mehran Sarkarati (MP&S); and a few other members of the other MOIMS working groups.

The reports of the Navigation, Spacecraft Monitor & Control (SM&C), Digital Archive Ingest (DAI), and Mission Planning & Scheduling (MPS) WGs were presented; the Telerobotics WG did not meet during this meeting series so there was no report. David presented for Navigation; the report is shown immediately below (it is also available on the CWE at https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Meeting%20Materials/2019/Fall/navwg-report-201910.pdf).

NAVIGATION WORKING GROUP CLOSING REPORT

Achievements for this Meeting Cycle
- Completed internal WG review of revisions to drafts of the Orbit Data Messages, Attitude Data Messages, Tracking Data Message V.2, Navigation Data Messages XML Specification
- Completed responses to conditions levied by the CESG on the Re-Entry Data Message and Navigation Data Defs/Convs
- Continued discussion of Navigation Events Message in preparation for first WB (getting closer!)
- Continued discussion of Prototyping Plans/Results for the Tracking Data Message V.2
- Continued discussion of prospective revisions to the Conjunction Data Message and Tracking Data Message V.3
- Completed review/update of CWE project schedules for all documents
- Completed update of WG 5 Year Plan
- Continued discussion of structure and content of Navigation data on the SANA Registry
- Continued discussion of prospective new project: Fragmentation Data Message

Working Group Status
- Active, "High Momentum"

Interaction with Other WGs
- Completed joint meeting with MP&S WG regarding their plans to use the PRM in their process; suggestions for clarification and potential corrigendum were submitted by MP&S.
- Completed joint meeting w/SANA Operator regarding continued migration of material from document annexes to SANA (Glossary Terms, registry hierarchy, work queue, authorization framework, etc.)

Environmental Report
- The Darmstadtium is a fantastic facility!
- Room size was perfectly matched for the size of our group, and could be locked at lunchtime, eliminating security concerns
- WiFi service was excellent, our 2 telecons worked great
- Room was cool at the beginning of the week; Secretariat spoke with environmental team
- Cakes and snacks at afternoon break were delicious!

Resolutions Agreed Upon this Meeting:
- NAV-1: The Navigation WG thanks ESA/ESOC for their excellent hosting of this CCSDS Meeting series.

Further Resolutions Anticipated in the Next 6 Months:
- NAV-2: Request to perform CESG Poll and CMC Poll to approve publication of the Tracking Data Message Version 2.
- NAV-3: Request to Initiate new project "Fragmentation Data Message". Concept paper has been provided; charter application has been filled out.

Planning (Only Approved Projects)

Area and WG name	CCSDS Ref Nr	Document Title	Status / Comments	Start and / or Target Publication Date	
MOIMS NAV	500.0	Navigation Data—Definitions and Conventions (Update)	Completed CESG Poll with conditions. Prepared resolution to conditions, reviewed w/WG, submitted to reviewer and Secretariat. Awaiting response.	Start date End date	09-Nov-2015 30-Nov-2019
MOIMS NAV	508.1	Re-Entry Data Message	Completed CESG Poll with conditions. Prepared resolution to conditions, reviewed w/WG, submitted to reviewer and Secretariat. Awaiting response.	Start date End date	03-Jul-2016 30-Nov-2019
MOIMS NAV	500.2	Navigation Data Message Overview (Update)	Document is in the hands of the Secretariat, ready for polling, waiting for start of poll.	Start date End date	25-Apr-2018 31-Jan-2020
MOIMS NAV	503.0	Tracking Data Message (TDM) 5 Year Review Revision	Moderate progress. Showed results of SANA migration of text; continued prototyping discussion.	Start date End date	09-Oct-2013 15-May-2020
MOIMS NAV	505.0	Navigation Data Messages XML Specification 5 Year Review Revision	Minimal progress.	Start date End date	13-Jul-2016 31-Oct-2020
MOIMS NAV	504.0	Attitude Data Message (ADM) 5 Year Review Revision	Good progress. Continued internal draft reviews.	Start date End date	16-Apr-2015 30-Apr-2021
MOIMS NAV	502.0	Orbit Data Message (ODM) 5 Year Review Revision	Moderate progress. Continued disposition of comments rendered during ODM P2.39 internal review	Start date End date	16-Apr-2015 31-Aug-2021
MOIMS NAV	TBD	Navigation Events Message	Good progress. Many questions related to scope remain. Productive discussion of many options.	Start date End date	07-Nov-2017 30-Nov-2021
MOIMS NAV	508.0	Conjunction Data Message 5 Year Revision	Good progress. A set of extensions and data additions for V.2 has been identified in meeting with customers and stakeholders.	Start date End date	14-Jan-2019 31-Dec-2021
MOIMS NAV	503.0	Tracking Data Message (TDM) Version 3 Revision	Good progress. Continued discussion of possible extensions and data additions.	Start date End date	07-Jan-2019 30-Sep-2024

NAV WG Upcoming New Work Items

- NONE...
- ... but the Working Group is exploring some "strategic" options related to modularity, re-usability and interoperability that will likely introduce some key changes.

NAV WG Issues for CESG / CMC

Suggestions for Improvement
- Project schedules in the CWE Framework have dates in the "American" date format (mm/dd/yyyy), however, many CCSDS WG members are more comfortable with a different date format (dd/mm/yyyy). These two formats are ambiguous for a high percentage of each year. It is suggested that the project schedules use a standard format that is not ambiguous (e.g., dd-Mmm-yyyy, where "Mmm" is the 3-letter abbreviation of the month name, for example, 24-Oct-2019).
- Several Lead Editors have experienced a variety of issues related to the back leveled version of MS Word used for CCSDS documents. There should be a plan to address this.
- ~~The consensus of the Nav WG is that Opening Plenaries should be shorter. The Area Director summaries are not broadly useful, and should be moved out of the full Plenary and into the Area Plenaries.~~ (Removed from "suggestions" due to its having been discussed at CESG, and effectively denied.)

Navigation Working Group Fall 2019

DAY 5, FRIDAY 25-Oct-2019

No Working Group Meetings. The CESG met on Friday.

NEXT TELECON(S):

The WG established Wednesday 20-Nov-2019 at 1400 UTC as the next telecon date. A meeting invitation will be sent. Tentative agenda:

1. Approve Fall 2019 Meeting Minutes
2. Green Books status, RDM status
3. SANA Registry Status
4. TDM Testing Status
5. Action Item Update & Other Document Status

Additionally, a full schedule of monthly meetings until the Spring 2020 Meetings was proposed, as follows:

- 20-Nov-2019 14:00 UTC
- 18-Dec-2019 14:00 UTC
- 22-Jan-2020 14:00 UTC
- 26-Feb-2020 14:00 UTC
- 01-Apr-2020 13:00 UTC
- 22-Apr-2020 13:00 UTC
- Spring 2020 Meetings 04-May-2020 to 08-May-2020