

**MINUTES OF NAVIGATION WORKING GROUP FALL 2018 WORKSHOP**      **20-Nov-2018**  
**David S. Berry / Chair**

The CCSDS Fall 2018 Meetings were conducted at the Deutsches Institut für Normung (DIN) in Berlin Germany during the week of 15-Oct-2018 through 19-Oct-2018. DLR 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**

James Afarin (NASA/HQ), Brigitte Behal (CNES), David Berry (NASA/JPL), Frank Dreger (ESA/ESOC), Cheryl Gramling (NASA/GSFC), Julie Halverson (NASA/GSFC), Ralph Kahle (DLR), Alain Lamy (CNES), Alexandru Mancas (ESA/ESOC), Francisco Martinez (ESA/ESOC/GMV), Mario Merri (ESA/ESOC), Dan Oltrogge (NASA (AGI, SDC, ISO TC20/SC14)), Nikolay Ryabogin (Spacecorp Russia), Brian Swinburne (UKSA/Airbus), Dezheng Xu (BITTT), Patrick Zimmerman (NASA/JSC).

**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/2018/Fall/navwg-agenda-201810.pdf> . In the meeting proceedings below, the detailed agenda for each meeting day 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/2018/Fall/navwg-action-items-201810.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 a few items from prior meetings that had not yet been completed.

**New Action/Outstanding Action Items**

<b>##</b>	<b>Action Item</b>	<b>Actionee</b>	<b>Due Date (Original)</b>	<b>Due Date (Current)</b>
61	Produce TDM Test Plan/Report V1.5	David Berry	24-Oct-2018	24-Oct-2018
60	Produce RDM Test Plan/Report draft	Alexandru Mancas	26-Oct-2018	26-Oct-2018
70	Prepare review assignments for all new draft documents	David Berry	26-Oct-2018	26-Oct-2018
72	Update WG Guidelines document	David Berry	26-Oct-2018	26-Oct-2018
74	Prepare Navigation references for SANA Registry	David Berry	31-Oct-2018	31-Oct-2018
75	Speak w/Peter Shames re having SANA Registry schedule available to WGs	David Berry	31-Oct-2018	31-Oct-2018

##	Action Item	Actionee	Due Date (Original)	Due Date (Current)
25	Produce ODM P2.38	Dan Oltrogge	15-May-2018	15-Nov-2018
76	Prototype SANA implementation of Nav References	David Berry	15-Nov-2018	15-Nov-2018
65	Review NDM/XML P1.0.1	As assigned	19-Nov-2018	19-Nov-2018
67	Produce NDMO G1.0.3	Patrick	20-Nov-2018	20-Nov-2018
69	Review Nav Data D&C 3.5.5 Section 6	All	20-Nov-2018	20-Nov-2018
79	Review & update Nav Data D&C 3.5.5 Attitude equation section 5.3.2, 5.3.3	Julie, Alain	20-Nov-2018	20-Nov-2018
71	Submit events lists to Alain	All	30-Nov-2018	30-Nov-2018
26	XML Section for ODM (update)	David Berry	08-May-2018	15-Dec-2018
66	Produce ADM P1.8 (including ACM)	Alain Lamy	15-Dec-2018	15-Dec-2018
78	Combine events lists and distribute to WG	Alain	15-Dec-2018	15-Dec-2018
68	Produce NDM/XML P1.0.2	David	20-Dec-2018	20-Dec-2018
72	Advise WG when CSS/SMWG "Planning Information Format" document reaches Agency Review	David Berry	31-Dec-2018	31-Dec-2018
98	Produce Navigation Events Message initial draft	Alain Lamy	31-Jan-2018	15-Jan-2019
100	Produce Navigation D&C Green Book 3.6	Cheryl Gramling	01-Mar-2018	15-Jan-2019
28	Review Navigation D&C Green Book 3.6	All	27-Jun-2018	15-Feb-2019
58	Produce ODM P2.39	Dan Oltrogge	15-Feb-2019	15-Feb-2019
7	Request CESG Poll for Navigation D&C Green Book 3.6	David Berry	13-Apr-2018	28-Feb-2019
59	Produce ODM V3 Test Plan/Report	Dan Oltrogge	15-Mar-2019	15-Mar-2019
83	Navigation Data Messages KVN Structural Requirements	All	30-Sep-2017	01-May-2019
64	Produce CDM P1.0.1	Brian / Dan	30-Sep-2019	30-Sep-2019
63	Complete CCSDS Editor Boot Camp	Brian Swinburne	19-Oct-2018	19-Oct-2018
77	Respond to LeoLabs re CDM	David Berry	20-Oct-2018	20-Oct-2018
80	Next available number	N/A	31-Dec-2035	31-Dec-2035

**COMPLETED Action Items**

##	Action Item	Actionee	Status	Completion Date

**CANCELLED Action Items**

##	Action Item	Actionee	Reason

## **WORKSHOP PROCEEDINGS**

### **DAY 1, MONDAY 15-OCT-2018**

0730 0815 Registration  
0815 1015 CCSDS Opening Plenary  
1015 1120 MOIMS Opening Plenary  
1120 1230 Admin: Agenda, Intro to Nav WG, Guidelines, Previous Action Items  
1230 1330 Lunch  
1330 1730 Orbit Data Msg V.3 (P2.38 draft, Prototype Plan, Project Schedule)

#### **0815 1015 CCSDS Opening Plenary**

The CCSDS Spring 2018 Meeting series started with a CCSDS Opening Plenary attended by all participating CCSDS members. Margherita di Giulio (CESG Chair) chaired the meeting. Margherita and Osvaldo Peinado (DLR) provided opening remarks.

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

We had some guest speakers:

- Cal Ramos, NASA HQ / CCSDS Secretariat, spoke regarding the Spring 2019 meetings to be held at NASA Ames Research Center.
- Rutiger Marquardt, Member of the DIN Executive Board. DIN is the German HQ for national standards, though it is a private organization rather than governmental. They are leaving the current building at end of October, and moving to another building; the current building will be refurbished for 2 years, then they will come back. DIN is a neutral platform for standardization in Germany and worldwide. It is comprised of 35000 experts, 69 committees, 450 staff members, and 2500 members. Over 34000 standards have been developed. Some of the best known are the "A" paper sizes (e.g., DIN A4) DIN EN ISO 216. Two or three countries (including the USA) don't use this standard. Another well known standard is the ISO Container standard for freight containers... ISO 668. DIN EN ISO/IEC 27000 lays down standard terminology for IT security. \$17B Euros are saved each year by German industry thanks to standardization. Benefits of Standardization: cost savings, expert knowledge, trade, quality. Principles of Standards: Voluntary, Open to Public, Consensus, CONSISTENT. DIN publishes 2000 standards per year! (both revisions and new).
- Karsten Becker, PTScientists (Part Time Scientists), with a "Mission to the Moon". They hope to be the first private mission to land on the Moon. The mission involves non-traditional partners. They plan to conduct scientific experiments on the Moon, and carry out tech demonstrations for lunar surface communications. Partners: Audi, Vodafone, Omega, ESA, DLR, Scisys, Riedel, Universität Würzburg, Red Bull Media House. Motto: "Space Belongs to Everyone". Goal: Make space boring. Alina spacecraft, Audi lunar quattro. They want to go to the Apollo 17 site and examine the Lunar Roving Vehicle left on the Moon in 1972 (it has had over 46 years of space exposure). They want to analyze the multi-composite structure and materials used in the rover. Several missions are outlined for 2019, 2021, 2023, 2024+, and 2030 (the "Moon Village").

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

1. The CCSDS is planning the following upcoming meetings:
  - a) Spring 2019 hosted by NASA at Ames Research Center (4-day), USA, dates 06-09 May
  - b) Fall 2019 hosted by ESA/ESOC at Darmstadt, Germany (4-day), dates 21-24 October

- c) Spring 2020 hosted by NASA at TBD, USA, dates TBD
- d) Fall 2020 hosted by CNES at TBD, France, dates TBD
- e) Spring 2021 hosted by NASA at TBD, USA, dates TBD
- f) Fall 2021 hosted by ESA at TBD, dates TBD

2. The "Boot Camp" session will be on Friday from 0845-1230, Room R087. 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 1,111.

4. Margherita gave some updates from the perspective of the CESC (Margherita's presentation is available on the CWE):

- There have been many polls since April 2018 (Spring Meetings)
- Delta DOR has a new chair: Jim Border
- There is a new ICPA registry. A number of the services listed in the ICPA have no related CCSDS Draft Project (NOTE: none are related to Navigation WG)
- Many books due for review (Chairs should check the list). All WG's should determine whether or not works need to be reconfirmed, retired, or revised. If revising, make a Draft Project, marshal resources, and get a Resolution from the applicable AD.
- Margherita discussed the Rules for "New Work Items"
- She instructed WGs to consult the CCSDS Glossary of terms on the SANA Registry before making them up from scratch
- Use Section 1.6 for normative terms used in the document.

5. The number of people registered for the meetings is 225.

6. There are 154 currently active CCSDS documents (95 normative, 59 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.

### **1015 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. New members from ESA.
- 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, slow implementation. Need to promote more usage within user community.
- MP&S (Mission Planning & Scheduling): High momentum. This is the youngest WG in MOIMS. A Green Book has been finished, and they are working on a Blue Book. Deputy Chair position is open.
- Telerobotics: No momentum. The WG is basically on hold. The Blue Book project has been demoted

to a draft project. Mario is reluctant to disband the WG because he sees its domain as part of the future of space exploration. He still believes in it...

As a refresh of the LOP-G topic, a diagram of telemetry exchanges was presented; this covered lunar orbiting, Earth<=>Moon, lunar outposts, rovers, astronauts, cubesats, international partners. It showed the large number of point-to-point telemetry exchanges that could presumably be reduced via standardization. Mario stated that there is a need to discuss interoperability from the beginning. New Deep Space Interoperability Standards are currently being discussed between ISS Agencies... can we do better with the LOP-G? A White Paper was produced by Mario based on the results of Gaithersburg queries and discussion. No response has yet been received from NASA. Mario is looking to enlist NASA personnel in MOIMS to press the topic. It was suggested that it would likely be more effective if this topic were discussed at the CESG meeting, and maybe even the CESG/CMC meeting.

A course on MO Services will be offered at ESA. If interested, let Mario or Mehran Sarkarati (MP&S Chair) know.

Mario concluded by requesting that WG Chairs keep Mario and Brigitte involved and let them know if there are any meetings they should attend. Mario announced that the MOIMS Dinner would be held on the evening of Wednesday 17-Oct-2018 at 2000 hours.

### **1120 1230 Admin: Agenda, Intro to NavWG, Guidelines, Previous 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, Cheryl Gramling, Julie Halverson, Ralph Kahle, Alain Lamy, Alexandru Mancas, Dan Oltrogge, Brian Swinburne, Dezhen Xu, Patrick Zimmerman.

We launched into a review of the agenda for the week. Given that we had no new members with us in the pre-lunch session, the presentation of the "Introduction to the Navigation WG" material focused on progress since the last meeting series and priorities for this meeting series; details of the publications were not discussed. David refreshed everyone on the Working Group Guidelines, and the group discussed a few new potential guidelines: Alain suggested having a guideline regarding comments in the CRM... the page and section numbering critical to locating the comments should be consistently from either the changes tracked version or the changes accepted version; it is difficult for the Lead Editor if some use the changes tracked and others use the changes accepted as the source of this essential information. Another Guidelines suggestion related to how soon before a meeting Lead Editors should strive to distribute material to the WG... two weeks was suggested. This allows a bit of time for meeting participants to prepare for discussions in advance of the meetings; documents distributed too close to the meeting dates are not likely to have had much review, and the discussion thereof is not typically very productive. David took an action item to update and re-distribute the WG Guidelines.

Similar to the guidelines was the suggestion of a standard template that would have agreed text for material that appears in all of our documents (a good example was made of the conventions for multiplication, division, and exponentiation of units).

We reviewed outstanding Action Items from the Gaithersburg meetings. Three items had been closed between the 02-Oct-2018 telecon and the first day of the Fall Meetings: Alain had distributed ADM P1.7, Patrick had distributed the Navigation Data Messages Overview G1.0.2, and Cheryl had distributed the Navigation Data - Definitions and Conventions Green Book 3.5.5. There are also several action items that were scheduled to be updated during the meeting week.

Review of the action items from Gaithersburg showed that as of the start of the meetings, 26 of 42 were

completed (62%), 14 remained outstanding (33%), and 2 were cancelled (5%... these were "omnibus" action items that were split into several components). Overall, the percentage of action items completed was quite good.

Given a few minutes before lunch time, we completed the pre-lunch portion of the meeting with a quick overview by Dan of the Global VSAT Forum's document "Endorsement of Best Practices for Sustainability of Space Operations". This document, currently out for review by the general public, is intended to provide guidance to current and future operators to ensure the long-term sustainability of the space environment. Signers of the document endorse, and will promote and strive to implement within their respective organizations, the best practices identified and described in the document as a valuable advancement towards the sustainability of space operations.

### **1330 1730 Orbit Data Msg V.3 (P2.38 draft, Prototype Plan, Project Schedule)**

Dan indicated that he had not been able to complete the P2.38 draft prior to the meetings. He indicated that he could have delivered a partial draft immediately prior to the meetings, but knew that no one would have time to review it, and if a second document came out shortly after the meetings people might review the wrong version. This was a good decision given that several other documents had been distributed shortly before the meetings, so WG members already had plenty to do. Dan started with a brief presentation of progress made on the ODM document, and focused on several important changes. Some of the major changes involved:

- Modification of the handling of relative time
- Addition of an option to use an absolute time stamp in the OCM
- Migration of document annexes to SANA registries (some registries still in progress)
- Reordering of OCM sections
- Addition of "MESSAGE\_ID" to all ODM message types
- Elimination of multiple comments in data blocks
- Modification of specifications regarding uniqueness conditions on multiple representations (from "shall" to "should")
- Added crosslinks to other message files
- Updated ODM changes annex (was ODM V1 to ODM V2 changes, will be ODM V2 to ODM V3 changes, support for ODM V1 referred to ODM V1 Silver Book).

After the overview presentation, Dan spent the rest of the discussion time working through the unresolved comments provided on ODM P2.36 and P2.37. Many of these topics required a fair amount of discussion. Three of the most notable were the discussion of the mixture of absolute/relative time, the ephemeris compression section, and the topic of ordering the logical blocks in the OCM.

In the case of absolute/relative time, there were some concerns as to parsing the time stamp of the data (in some cases a number of seconds, in others an ISO formatted time value).

In the case of the ephemeris compression, there is some sentiment in the Working Group that it is perhaps the weakest section, least familiar, and thus the most potentially error prone. Dan had added it to respond to some genuine use cases (e.g., compressing entire catalogs of space objects for efficient distribution). The option of producing ODM V3 without ephemeris compression and adding it later was discussed (there is precedent for this approach, e.g., the CCSDS 401 document has averaged nearly one Blue Book version per year since first publication).

In the case of the logical block ordering, there was a lot of discussion regarding the relationships of sections to each other so that they could be logically ordered (there are many plausible ways of doing it).

The group finally settled on an ordering of orbit states, physical characteristics, covariance matrix, state transition matrix, maneuvers, perturbations, orbit determination, ephemeris compression, and user defined.

We closed the ODM discussion by adjusting the ODM schedule on the CWE. The project had to be extended by 6 months given that the nearly completed document ("second draft" in the CWE Framework) was overdue with respect to the prior plan. Dan felt that P2.38 would not be that "second draft", but the P2.39 could potentially be advanced to Agency Review. The plan was updated based on this assumption.

## **DAY 2, TUESDAY 16-OCT-2018**

0845 1045 Re-Entry Data Message (RIDs, Prototyping Plan, Project Schedule)  
1045 1215 Tracking Data Message (V.2 RIDs, Prototyping Plan, Project Schedule)  
1215 1230 Tracking Data Message V3 Initial Thoughts (initiate new project?)  
1230 1330 Lunch  
1330 1545 Navigation Data: Definitions & Conventions Green Book + Project Schedule  
1545 1630 Conjunction Data Message 5 Year Revision: prep "new project" resolution  
1630 1730 Navigation Data Messages XML Specification update + Project Schedule

In attendance this day were David Berry, Frank Dreger, Cheryl Gramling, Julie Halverson, Alain Lamy, Alexandru Mancas, Francisco Martinez, Dan Oltrogge, Brian Swinburne, Patrick Zimmerman. We also had a visitor Nikolay Ryabogin.

### **0845 1045 Re-Entry Data Message (RIDs, Prototyping Plan, Project Schedule)**

After several minutes dealing with projection equipment issues, Alexandru presented the latest RDM status. Some details of the presentation included:

- Agency Review completed on 28 August 2018
- Comments were received only from ESA
- Alexandru has implemented results of the comments in a Red Book 1.1; a Red Book 1.2 with further refinements/fixes has been distributed. The ESA reviewers have been informed and are OK with the changes.
- Some keywords were added (all optional):
  - DRAG\_PARAMETERS\_SOURCE, DRAG\_PARAMETERS\_FLOW\_REGIME, and REENTRY\_UNCERTAINTY\_METHOD were added to the Metadata Section
  - MASS was separated into WET\_MASS and DRY\_MASS
  - HAZARDOUS\_SUBSTANCES was added to object physical parameters

Alexandru noted that there are already two SANA candidate registries relevant to the RDM: Time Systems and Orbit Centers. He inquired whether or not the Reference Frames registry will be available in time for the RDM; David noted that this is very likely to be the next registry that will be created. Alexandru noted some work yet forthcoming:

- Add a "Re-entry Data Message Originator" to the Organization Roles registry
- Refer N\_BODY\_PERTURBATIONS to the Orbit Centers registry (there are some barycentres in that list)

Based on Alexandru's preparatory work, an RDM R1.3 version will soon be forthcoming, ready to prototype. Small tweaks have been made to the Red Book, the XML schema, and ESOC's Re-Entry

Prediction System (RPS) application. To the question "Is there a need for a second Agency Review?", the WG agreed that a second Agency Review would not be necessary. The various tweaks and adjustments introduced by Alexandru have not sufficiently changed the technical content of the document so as to require further review. During Alexandru's presentation, we had occasion to discuss a few technical terms that had been introduced in the RDM (e.g., "long term re-entry prediction"). Per Margherita's advisement from Monday's presentation, we checked in the CCSDS Glossary on the SANA to determine that the terms were not already in the glossary. We concluded that the terms could be defined in the RDM, but it raised the question as to what is the mechanism for adding terms to the glossary. David queried Margherita and Tom Gannett for instruction; the response basically indicated that the terms should be added to the "Nomenclature" subsection in Section 1 of the document and later coordinated with the SANA Operator. After Alexandru's presentation, we looked through the CRM that he had prepared summarizing the RIDs received during Agency Review and the response. Many of the RIDs were editorial, and have already been incorporated into the RDM Master Red Book 1.1. We discussed the impending prototype plan. Alexandru has an action item to draft a Test Plan/Report document for the RDM. He noted that the ESOC Space Debris Office Re-Entry Prediction System (RPS) already basically comprises a prototype of the RDM, and that the Red Book 1 has been implemented in 2 modules of the DLR re-entry prediction application. According to the current CWE schedule, the prototyping is planned to finish before the end of January 2019. We reviewed the RDM schedule on the CWE; we are pretty much right on track, and should be easily able to meet the planned publication target prior to the Darmstadt meetings in Fall 2019.

#### **1045 1215 Tracking Data Message (V.2 RIDs, Prototyping Plan, Project Schedule)**

David showed the statistics of the TDM Agency Review, which ended in July 2018. We dispositioned the RIDs from the Agency Review. Most of the RIDs were quite minor, and were accepted. There was one RID rejection, and one for which the statement of the RID is true, but the proposed mitigation is not necessary (it will be corrected automatically at the time of TDM V.2 publication). We agreed that adding a "MESSAGE\_ID" keyword would be a good thing; this was essentially an "internal RID", but it is consistent with the overall direction in the WG and strengthens our satisfaction of the existing requirement that messages be uniquely identified (currently the uniqueness factor is only the combination of ORIGINATOR and CREATION\_DATE). David also showed some CRM comments submitted by Alexandru that had slipped through the cracks; the group dispositioned those as internal RIDs as well. David has an action item to produce a TDM R1.2 that contains the RID dispositions. We reviewed the in-progress version of the TDM Test Plan/Report version 1.5. Alexandru has already provided some test results for the MAG and RCS keywords; David had added them to the report.

#### **1215 1230 Tracking Data Message V3 Initial Thoughts (Initiate New Project?)**

In the few minutes available prior to the lunch break, we started working on creating a draft project for the planned TDM Version 3. Cheryl is Lead Editor; NASA and ESA/ESOC have volunteered for prototyping. We did not complete the required draft project schedule, but plan to complete it on Friday if not before.

#### **1330 1545 Navigation Data: Definitions & Conventions Green Book + Project Schedule**

Cheryl led the discussion of the Navigation Data: Definitions and Conventions Green Book using the recently distributed version 3.5.5 document. One of the outstanding issues (long-standing and outstanding) was what to do about the Glossary. Checks of the CCSDS Glossary on the SANA provided compelling evidence that Tom Gannett had populated the glossary on SANA using the Green Book Glossary as a source. This implies that the glossary can be removed from the Green Book and maintained directly on the SANA. Cheryl made such a suggestion, and the WG approved the deletion. Cheryl will



add a note in the Green Book that many terms are defined on the SANA and will remove the Glossary from the Green Book. Patrick inquired about the status of the Glossary in the Navigation Data Messages Overview Green Book, and the group agreed removing that Glossary too would be consistent (they are essentially identical, with perhaps a few differences). Prior to deleting the Glossary from the Green Books, Cheryl and Patrick will check the CCSDS Glossary on the SANA and ensure that all the Green Book glossary terms are present.

One other issue Cheryl raised was whether or not all references needed to be in the public domain. In particular, the "NASA Ground Network Tracking and Acquisition Data Handbook" is referenced in the Green Book, and there are copies in the public domain, but none that are deemed "permanent". Cheryl inquired whether or not such reference needed to be deleted from the Green Book reference list. Upon checking the CCSDS Publications Guide, it was found that there are different rules for Normative Track documents and Non-Normative Track documents such as the Navigation Data Definitions and Conventions Green Book. For Normative Track documents, the references need to be publicly available; for Non-Normative Track documents, there is no such requirement. The Publications Guide merely states that "The list shall include all documents referenced in the text of the document". This probably also resolves another issue, specifically, the inability to find a definitive source for the 19 second difference between GPS time and TAI. Cheryl is still trying to resolve an issue with the comparison of time systems that appears in the Green Book; one of the experimentally determined "constants" in the diagram has changed. Cheryl indicated that she would inquire about using an updated diagram from the Montenbruck text. Towards the end of the discussion, Cheryl and David spontaneously shared a potential future for this Green Book... specifically the potential to migrate all of the material to the SANA Registry. With the CCSDS Glossary and some expansion of the CCSDS Normative Annex Registries, a high percentage of the material currently in the Green Book could potentially be hosted on the SANA. This cannot be done at this time, as we need to publish Version 4 of the Green Book, but it is possible that there might never be a Green Book version 5. NOTE: Cheryl noted that the 3.5.5 version of the Green Book is an interim draft meant to show progress and raise issues for resolution. It is not intended to be reviewed. We intend that the Version 3.6 Green Book will become the last reviewed draft of the Book prior to submitting it to the Secretariat for the obligatory pre-publication polls.

#### **1545 1630 Conjunction Data Message 5 Year Revision: Prep "New Project" Resolution**

The preparation of a draft project for the CDM Version 2 (Five Year Review Revisions) was planned for later in the week, but after Cheryl completed the Navigation Data Definitions and Conventions discussion, the opportunity presented itself. We created a draft project for the CDM revisions, completed a schedule, and requested the obligatory CMC review. Brian Swinburne will be Lead Editor with support from Dan Oltrogge. NASA and ESA will prototype the revision. Mario Merri (MOIMS AD) and Margherita di Giulio (CESG Chair) both approved the new project. The required CMC Poll is in progress.

#### **1630 1730 Navigation Data Messages XML Specification update + Project Schedule**

For the last hour of the day, we discussed an item that had originally been scheduled for Friday morning, specifically an overview of the Navigation Data Messages XML Specification P1.0.1. This document had been recently distributed. David shared the history of the document (it's now documented in the P1.0.1) and key components of the revision philosophy. Specifically, these involve (a) continuing with the migration of material guiding instantiations to the underlying standards, (b) greatly limiting the number of places in the document where specific messages are identified, (c) removing direct support for historical silver books, (d) making allowance for "elementFormDefault="qualified" schemas, and (e) combining the two common schemas into a single common schema. Fran reminded David that we also want to make it

simpler to validate a single standalone message (currently one must have 13 schemas, even if one only wants to validate a single message type).

### **DAY 3, WEDNESDAY 17-OCT-2018**

0845 1240 Navigation Events Message, XML "Boot Camp", Project Schedule  
1240 1340 Lunch  
1340 1740 ADM Pink Book Updates+"Attitude Comprehensive Msg" + project sched  
2000 ???? Mario's MOIMS Area Dinner

In attendance this day were James Afarin, Brigitte Behal, David Berry, Frank Dreger, Cheryl Gramling, Julie Halverson, Ralph Kahle Alain Lamy, Alexandru Mancas, Francisco Martinez, Dan Oltrogge, Brian Swinburne, Patrick Zimmerman.

### **0845 1240 Navigation Events Message, XML "Boot Camp", Project Schedule**

Alain explained that there was not yet a Navigation Events Message (NEM) White Book. He explained that this was largely due to the fact that the intended contents are not yet completely clear. For example, should the events be listed in the book? or in a SANA registry? Should the format be KVN? or XML? or both? Alain noted that the objective of today's meeting is to resolve these and other unknown questions. Alain went over the working version of the NEM requirements, which have been supplemented with ideas contributed by both Frank and Fran.

It was reiterated that an "event" is composed of a name plus parameters. The parameters should be named rather than positional. Parameter definitions should include data type and units. We want extensibility (because we cannot necessarily define every possible event), with "boundaries" (a framework). The number of potential events was acknowledged to be potentially quite large (though the CSS/SMWG has narrowed the list of communications related events in which they are interested to a fairly small set in their Planning Information Format document, soon to be out for Agency Review). The notion of a "style guide" for how to name events was raised. Frank had some suggestions here that included naming using Upper Camel Case for the name; having the names be brief but comprehensive; using English language terms in the names; avoiding uncommon abbreviations; and identifying bounding events with trailing "Start" and "Stop" terms.

The question of how to standardize events generated a fair amount of discussion. Ultimately the WG agreed that we would like to use the SANA for a registry of events and their parameters, with the idea that there would be a single SANA registry for the event definitions. There was some notion of restricting events in the registry to a set of "recommended events" (perhaps "the most commonly used"), with adopters being able to define events outside those recommendations by using an ICD. Also discussed was the potential for adding an event "category" (though this name was not firmly established) given that multiple CCSDS working groups could be interested in such a registry of events. Potential values for this attribute in the registry included "Navigation", "Communication", "Scheduling", etc. The scope of the NEM was discussed, specifically, are we developing a standard that could be used by other working groups?, or focusing only on navigation messages with an apparatus that could be adopted by other working groups? This question is precisely why the ownership of "events" was elevated to the System Engineering Area several years ago. This discussion was not resolved definitively, and it seemed it could have gone on for quite a while.

After the time allocated for the NEM was completed, we reviewed the CWE schedule and modified the target date for the first White Book because the existing date was in the past. Other dates in the schedule

were over a year from now, so we left them intact since they could be modified at either of the 2019 meetings if necessary.

Following a break, Fran led a requested discussion of XML fundamentals that we had christened the "XML Boot Camp". This request arose at the Spring Meetings during discussion of the NEM due to some of the ideas that had been expressed for automating the development of an NEM schema. At the outset of the session, Fran noted that he had originally intended to develop special material for the session, but opted instead to use pre-prepared materials from the website <https://www.w3schools.com/>, which has tutorials on many topics. Accordingly, the XML tutorial material at this site was used to guide discussion. There were many questions from the working group members and in general this session was appreciated. In fact, we went over the appointed lunch time by 10 minutes.

### **1340 1740 ADM Pink Book Updates + "Attitude Comprehensive Msg" + Project Sched**

Alain went through the CRM of comments he had received on the ADM P1.6. He commented that he felt that the material in the P1.7 version of the document was mainly stable for the APM and AEM. The XML material had also been added to the P1.7 update. During the discussion of the CRM, Alain created an ADM P1.8 so as to be able to make changes to the recently distributed ADM P1.7. For this reason, Alain suggested that the WG not review the ADM P1.7, rather, to wait for the forthcoming ADM P1.8, which should also include the ACM material.

When discussion of the suggestions listed in the ADM P1.6 CRM had been completed, Julie initiated discussion of the Attitude Comprehensive Message (ACM). The ACM is being added to the ADM as an attitude analog to the Orbit Comprehensive Message (OCM) being developed for the ODM. The version of the ACM presented was based on version 2.37 of the OCM, David had done a preview of the draft, and Julie had updated the ACM material. The essential design point of the ACM is to mirror for attitude data what the OCM does with orbit data, insofar as it is possible. This presentation was the first time the ACM had been presented to the WG other than in an email attachment, so there was a lot of discussion of the ways in which the concepts of the OCM had been transferred into the ACM. Going forward, there is intent to keep the OCM and ACM as technically aligned as possible. The OCM/ACM parallel development keeps us going forward into the modular message era. As we ran out of time in the day, the discussion of the ACM was scheduled to continue and complete first thing Thursday morning.

### **DAY 4, THURSDAY 18-OCT-2018**

0845 1000 Attitude Comprehensive Message + ADM Project Schedule  
1000 1230 Annex Migration=>SANA (Ref Frames, Covariances, Attitude Info,etc)  
1230 1330 Lunch  
1330 1530 Annex Migration=>SANA (Ref Frames, Covariances, Attitude Info,etc)  
1530 1730 Nav Data Messages Overview update (post-PRM/TDM)+Project Schedule

In attendance this day were David Berry, Frank Dreger, Cheryl Gramling, Julie Halverson, Ralph Kahle, Alain Lamy, Alexandru Mancas, Francisco Martinez, Dan Oltrogge, Brian Swinburne, Patrick Zimmerman. We had guest Julien Bernard of the SANA Operator.

### **0845 1000 Attitude Comprehensive Message + ADM Project Schedule**

We completed discussion of the ACM that had started Wednesday afternoon. Julie proposed, and the WG agreed, to delay addition of the ACM Sensor Descriptions and Sensor Data sections, which have echoes of the discontinued Navigation Hardware Message project. Julie pointed out that there is no analog to the

sensor data in the OCM. This decision also better positions us for the NDM/KVN modular future given the functional similarity to the TDM. It should also reduce the complexity of the ADM V2 and allow us to complete it more rapidly. There were some sticky points regarding potential differences between the description of maneuvers in the OCM and ACM; Julie, Cheryl, and Dan discussed and agreed on a way to manage the issue.

**1000 1230 Annex Migration=>SANA (Ref Frames, Covariances, Attitude Info,etc)**  
**1330 1445 Annex Migration=>SANA (Ref Frames, Covariances, Attitude Info,etc)**

We were joined by Julien Bernard of the SANA Operator (Viagenie) to discuss the proposed migration of material from Navigation WG normative annexes into SANA registries. This was a very productive session. We discussed and as applicable agreed to the following:

- Break entries in the "Nomenclature" for Orbital Elements at commas to make the column narrower, thus making the "Description and Reference" column wider and more easily readable.
- We agreed to not display OIDs (we learned a lot about OIDs in this session). OIDs are assigned because they represent something of a key into a database, and therefore they are unique, but there is no requirement to display them.
- We can put our navigation references into the "References" SANA registry. We discussed various ways to do this. Ultimately we decided to have one "Navigation References" OID, with a subordinate OID for each individual reference. Then the last nodes of the OID can be used as a linking mechanism between the "annex" registries and the applicable references.
- There are some registries that require authorization (e.g., the registry of antenna apertures). If you need to access it, you just need to request of the SANA Operator.
- Julie had a few questions for Julien as to what she needed to provide for one of the attitude registries that has been prepared in LaTeX.
- Although there is no current way for the SANA to implement a default sort of elements, we can provide links to users that include the desired sort attribute, e.g., [https://sanaregistry.org/r/time\\_systems?sort=name](https://sanaregistry.org/r/time_systems?sort=name) allows the registry to be displayed in a "natural" order.
- For "Time Systems", we can delete the "Nomenclature" and "Default Units" columns to increase the breadth of the description.
- We can delete the "Default Units" from the Reference Frame registry since there are no units applicable.
- Julien noted that they are working on support of images (but it is not supported yet... coming soon). Some of the relative reference frames are illustrated and will benefit from this forthcoming new feature.
- We informed Julien that the Covariance Matrix elements registry will have much material that can be re-purposed from the Orbital Elements registry.
- Julien mentioned that it is now possible to download the entire NDM/XML schema set at once, which was a wish that David had expressed in April. David said he was aware of this and it was a big improvement. As a future idea for better version control of the NDM/XML schemas on the registry, David suggested that we could put a zipped tar file that contains a consistent set of the schemas on the registry. For example, we are currently on Revision B of the schemas. If someone needs to download a set of Revision A schemas for example, there is no way to do that now.

David indicated that within the next few weeks we would be providing more material to the SANA Operator to continue our implementation in the SANA (we are apparently one of the most aggressive users of the SANA). Julien suggested that we could provide him a priority for the implementation and he

would be able to use that. The WG was interested in the plan and schedule for future SANA features, and David suggested that Julien speak with Peter Shames about having a schedule posted so people could consult it (e.g., similar to the Document Editor Queue or the Project Schedules on the CWE). Julien said that he would discuss with Peter Shames. Note that once all of our registries have been created, it is likely that we will need to have Corrigenda retroactively applied to the various documents (ODM, ADM, CDM, RDM) to remove the relevant annexes and refer to the SANA registries. After Julien departed, the WG continued working on the material destined for SANA that had not yet been finalized, and several changes were introduced. We discussed the fact that MET, MRT, GMST, and GPSZ had been left out of the SANA Time Systems registry, and ultimately agreed that they would not be in the Registry.

Titles for several of the Registries were discussed:

Title = Covariance Matrix Types

Title = Spacecraft-Centric Orbit Reference Frames

Title = Local Spacecraft Body Reference Frames

Regarding references: David will send a few to Julien so he can create our single Nav OID, the sub-OIDs for individual references, and links to those references. This will show us how it will work in practice before we send everything.

#### **1445 1545 Message Formats: KVN, XML (existing); JSON, others (future)?**

Due to the fact that Fran was leaving the meetings early, but was interested in the future standards format question, the topic was moved from Friday morning into Thursday PM. Points:

- Per Fran, anything in XML can be easily converted to JSON
- The conversions will cause no loss of astrodynamic content (we will lose the capability of validation but not astrodynamic content)
- There was mention of JSpOC producing CDMs in JSON. Cheryl was checking with CARA.
- David expressed concern about how much work would be involved given work already on the plate.
- We discussed Alain's 2009 idea, which expressed briefly, involved identifying only the astrodynamic material required in the standard and allow the format to be flexible (e.g., decided between exchange participants). (NOTE: The logical extreme of this concept is "everything but the kitchen sink", i.e., essentially any format one could conceive).
- Ultimate decision: If we adopt a new format, pick ONE (not a bunch), and pick it carefully. The "everything but the kitchen sink" method is bad for standards.

David took an action item to respond to LeoLabs with the outcome of our discussion given that this topic had arisen based on an inquiry from them. The following response was provided on 20-Oct-2018: "Thank you for your inquiry, and my apologies for a delayed response. Frank and I decided to add the JSON topic to our semi-annual working meetings series that just concluded yesterday. Specifically, we discussed your question of extending the standard formats to JSON (though we did expand a bit to consider other potential formats in a general sense). This was a very interesting discussion, but given the work we currently have on our plate and other factors, we concluded that we don't plan on adding a new format at this time. However, given your question and the discussion it inspired, we have opened our minds to considering the topic. There was a suggestion during our meeting that a comprehensive study of the advantages/disadvantages of JSON and other formats should be conducted before coming to a final conclusion."

#### **1545 1730 Nav Data Messages Overview Update (Post-PRM/NHM)+Project Schedule**

Patrick led us through the combined CRM for the Navigation Data Messages Overview (NDMO) G1.0.1 Green Book. We discussed and resolved all the remaining issues. Patrick pointed out that there are some diagrams that need to be updated, which complicates matters a bit. He started work on G1.0.3 which will reflect the outcomes of the discussion. We will not review the G1.0.2 draft, which came out immediately prior to the meetings. We updated the schedule on the CWE consistent with the remaining work to be done.

### **DAY 5, FRIDAY 19-OCT-2018**

0845 1015 Tracking Data Message V3 Initial Thoughts (initiate new project?)  
1015 1230 Prep Closing Report, Action Items, Five Year Plan, Set Next Telecon  
1230 1330 Lunch  
1330 1500 MOIMS Closing Plenary  
1500 1720 Free

In attendance this day were David Berry, Frank Dreger, Cheryl Gramling, Julie Halverson, Alain Lamy, Alexandru Mancas, Dan Oltrogge, Patrick Zimmerman. Brian Swinburne had attended the CCSDS Editor's Boot Camp session at the beginning of the day and joined us towards the end.

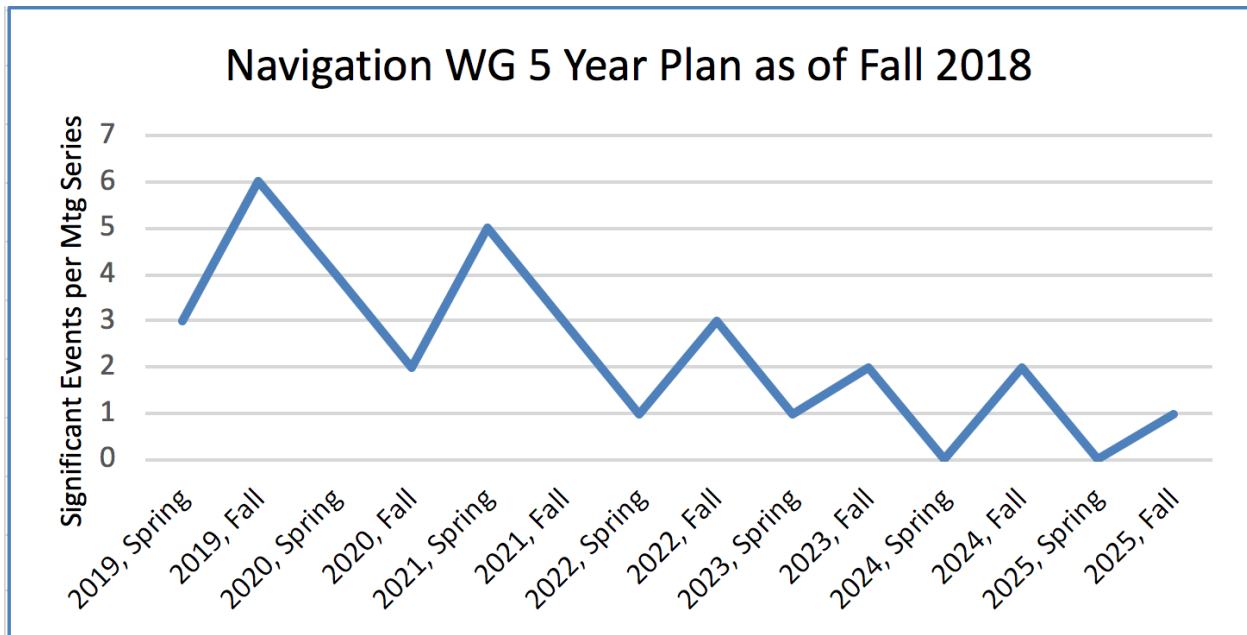
### **845 1015 Tracking Data Message V3 Initial Thoughts (Initiate New Project?)**

During this session, we completed a Draft Project for the TDM Version 3 and requested a CMC Poll to approve the new project (NASA will provide the Lead Editor; NASA and ESA will be prototypers). Shortly after the CMC Poll was requested, automatic emails went to Mario Merri (MOIMS AD) and Margherita di Giulio (CESG Chair) seeking their approval. After the new project request was submitted, Cheryl led group discussion of her compilation of initial ideas for the TDM V.3. During this discussion, Julie inquired whether or not the TDM V.3 would be open to data from attitude sensors given that they had been removed from the ACM and there is no equivalent for these in the OCM. This seems like a reasonable idea. David expressed the concern that we would need to keep the NHM lessons learned in mind if we decide to add attitude sensors to the TDM. Given the WG's developing plan for a modular message, Cheryl also raised the question as to how we might go about creating a such a message incorporating elements of tracking data. There were questions as to how much metadata is common between the TDM and other messages. The potential value of use cases was raised. We also had some discussion regarding what can be termed the "granularity" of the modular message (aka "NDM/KVN"). Cheryl and Dan have been viewing the granularity as rather coarse (e.g., similar to the NDM/XML, where combined instantiations are at the full message level), and David has been viewing the granularity as somewhat finer (e.g., extracting just one or more states from an OEM/OCM). David agreed that the coarser granularity is likely more readily achievable, and that it would reduce the probability of creating a message that is "nonsense" from an astrodynamics standpoint. This granularity aspect of the NDM/KVN will be important as we move forward. While Cheryl was going through her list, Mario came to the Nav WG meeting room with questions as to the logic for starting a V.3 when V.2 has not yet been published. David explained the rationale to Mario's satisfaction, and both Mario and Margherita subsequently approved the request for CMC Poll. The required CMC Poll is in progress.

### **1015 1230 Prep Closing Report, Action Items, Five Year Plan, Set Next Telecon**

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 2018. 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. David showed a proposed plan of WG telecons between the Fall 2018 Meetings and Spring 2019 Meetings (to be found at the end of these minutes); in principle this plan was adopted, though things like this are usually subject to some changes. Finally, we worked through and updated the Working Group's 5 Year Plan. As we proceeded, David described his method for populating it. Several simplifications are utilized in order to keep the detail in the plan manageable. For example, there is a focus on the face-to-face meetings (restricted to April=Spring, October=Fall, other months are "rounded" to the closest meeting). There is a focus on 4 major events (initial white book, Red Book/Agency Review complete, Blue Book complete, 5 Year Review), so many of the items in the full Framework schedule are ignored. A simple prioritization scheme is used (Blue Book=1, Red Book=2, White Book=3 or 4). David had pre-populated the plan by roughly synchronizing the plan with the schedules on the CWE Framework that had been updated through the week. After these basic changes were made, we reviewed the number of significant events in each time frame, and an attempt was made to "smooth out" the number of significant events in near term meetings. 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/2018/Fall/navwg-5-year-plan-201810.pdf>.



After discussing the 5 Year Plan, there were still a few minutes available prior to lunch. Dan had earlier requested a few minutes to discuss a vision for Spacecraft Traffic Coordination (STC). This concept is being developed as a public/private partnership and it is heavily dependent on a robust suite of international standards (several of which are yet to be developed).

After completing all the closing matters, the Navigation WG meeting was concluded. Those still in attendance were thanked for a productive meeting week, we bid each other safe travels, and we started making plans for the next meetings in Mountain View in May 2019.

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%2F2018%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>

### **1330 1500 MOIMS Closing Plenary**

In attendance at this meeting were James Afarain (CMC Chair), Nestor Peccia (former CESG Chair), Mario Merri (MOIMS AD), Brigitte Behal (MOIMS DAD); David Berry and Frank Dreger (Nav); Dan Smith, Roger Thompson, and Stefan Gärtner (SM&C); John Garrett and Mike Kearney (DAI); Mehran Sarkarati (MPS); and a number of other members of the various working groups.

The reports of the Mission Planning & Scheduling (MPS), Digital Archive Ingest (DAI), Spacecraft Monitor & Control (SM&C), and Navigation 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. Due to the MPS interest in "events", Mehran and David raised the possibility of a Joint Telecon and/or a Joint Meeting in the Spring between the WGs. After the Plenary, the Technical Meeting week concluded.

## **MOIMS CLOSING PLENARY / NAVIGATION WORKING GROUP REPORT**

### **Achievements for This Meeting Cycle:**

- Completed internal WG review of revisions to drafts of the Orbit Data Messages, Attitude Data Messages, Navigation Data Definitions & Conventions, Navigation Data Messages XML Specification, Navigation Data Messages Overview
- Continued discussion of Navigation Events Message in preparation for first WB
- Completed RID disposition and continued discussion of Prototyping Plans for the Re-Entry Data Message
- Completed RID disposition and continued discussion of Prototyping Plans for the Tracking Data Message
- Initiated draft project for Conjunction Data Message 5 Year Review Revisions and requested CMC Poll.
- Initiated draft project for development of 503.0 Tracking Data Message V3 and requested CMC Poll.
- Completed requested "XML Boot Camp" for Nav WG members
- Completed review and update of CWE project schedules for all documents
- Initiated discussion of potential alternative format for standards besides KVN, XML
- Completed update of WG 5 Year Plan
- Continued discussion of structure and content of Navigation data on the SANA Registry

### **Interaction with Other WGs**

- Joint meeting w/SANA Operator regarding plans to migrate material from document annexes to SANA (Ref Frames (various flavors), Covariance Matrix Elements, Attitude, References)



**Working Group Status:**

- Active, "High Momentum"

**Resolutions Agreed Upon This Meeting:**

- Resolution 1: The Navigation WG thanks DIN and DLR for their excellent hosting of this CCSDS Meeting series.
- Resolution 2: Request to create new project for revision of CCSDS 508.0 Conjunction Data Message (outcome of 5 Year Review was "Revise").
- Resolution 3: Request to create new project for development of 503.0 Tracking Data Message V3 (new use cases have emerged)

**Further Resolutions Anticipated in the Next 6 Months:**

- Resolution 4: Request to perform CESG Poll and CMC Poll to approve publication of the Navigation Data – Definitions and Conventions Green Book V4

**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)	Good progress (new Lead Editor effectively addressing issues).	Start date 09-Nov-2015 End date 31-May-2019
MOIMS NAV	500.2	Navigation Data Message Overview (Update)	Good progress. 2 updated white books distributed.	Start date 25-Apr-2018 End date 15-Apr-2019
MOIMS NAV	502.0	Orbit Data Message (ODM) 5 Year Review Revision	Good progress. Continued internal draft reviews. Continued prototyping discussion.	Start date 16-Apr-2015 End date 15-Oct-2020
MOIMS NAV	503.0	Tracking Data Message (TDM) 5 Year Review Revision	Good progress. Agency Review completed. Continued prototyping discussion.	Start date 09-Oct-2013 End date 15-Sep-2019
MOIMS NAV	504.0	Attitude Data Message (ADM) 5 Year Review Revision	Good progress. Continued internal draft reviews.	Start date 16-Apr-2015 End date 30-Apr-2021
MOIMS NAV	505.0	Navigation Data Messages XML Specification 5 Year Review Revision	Good progress. Revision strategy devised. 1st Pink Book discussed.	Start date 13-Jul-2016 End date 15-Oct-2019
MOIMS NAV	508.1	Re-Entry Data Message	Excellent progress. CESG Agency Review poll completed, RIDs dispositioned. Continued prototyping discussion.	Start date 03-Jul-2016 End date 30-Sep-2019
MOIMS NAV	N/A	Navigation Events Message	Good progress. Many questions related to scope remain. Productive discussion of many options.	Start date 07-Nov-2017 End date 30-Nov-2019

**Navigation WG Upcoming New Work Items**

Area and WG Name	CCSDS Ref Nr	Document Title	Target Start / Publication Date	Resources Needed (total, Editor, Proto 1, Proto 2)				What if not started?	
				TOTAL	EDITOR	PROTO1	PROTO2		
MOIMS NAV	508.0	Conjunction Data Message 5 Year Review Revision	1/7/2019 10/15/2021	2019	.25	.25	0	0	The document will not reflect changes desired by key customers
				2020	.25	.25	0	0	
				2021	.45	.25	.10	.10	

### **Observations**

- Very pleasant meeting environment
- Facilities and Hospitality
- Room size was satisfactory on Days 1 & 2, fabulous on Days 3,4, & 5
- Room environments were comfortable
- WiFi service was excellent
- Projector image quality was excellent ("Clickshare" a very nice feature)
- Access to room keys was excellent
- Lunches were very generous and very convenient... Thank You DLR!
- Some facilities presented minor challenges
- Projector instructions in room didn't match the physical equipment, so we had engage the services of Tech Support on Day 1... Problem solved in 2 seconds.

### **Suggestions for Improvement**

- Project schedules in the CWE Framework have dates in the "American" format (mm/dd/yyyy), however, many CCSDS WG members are more comfortable with an alternate format (dd/mm/yyyy). It is suggested that the project schedules use a standard format that is not ambiguous (e.g., dd-**MMM**-yyyy, where "MMM" is the letter abbreviation of the month, such as 19-Oct-2018).
- The consensus of the Nav WG is that Opening Plenaries should be shorter.

### **NEXT TELECON(S):**

The WG established Wednesday 14-Nov-2018 at 1400 UTC as the next telecon date. A meeting invitation will be sent. Tentative agenda:

1. Approve Fall Meeting Minutes
2. RDM Status
3. TDM Status
4. SANA Registry Status
5. Action Item Update & Other Document Status

Additionally, a full schedule of monthly meetings until the Spring 2019 Meetings was proposed, as follows:

12-Dec-2018 14:00 UTC

23-Jan-2019 14:00 UTC

20-Feb-2019 14:00 UTC

03-Apr-2019 13:00 UTC

24-Apr-2019 13:00 UTC

Spring Meetings 06-May-2019 to 09-May-2019