

**MINUTES OF NAVIGATION WORKING GROUP SPRING 2015 WORKSHOP 07-May-2015**  
**David S. Berry / Chair**

The CCSDS Spring 2015 Meetings were conducted at the California Institute of Technology (Caltech) in Pasadena, California, USA, during the week of 23-Mar-2015 through 27-Mar-2015. The United States National Aeronautics and Space Administration (NASA) 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**

Kyohei Akiyama (JAXA), David Berry (NASA/JPL), Jürgen Fertig (ESA/ESOC), Joseph Hashmall (NASA/GSFC/a.i. Solutions), Reinhard Kiehling (DLR), Alain Lamy (CNES), Byoung-Sun Lee (ETRI), Francisco Martinez (ESA/ESOC/GMV), Dan Oltrogge (NASA (AGI, SDC, and ISO TC20/SC14)), Patrick Zimmerman (NASA/JSC).

**TELECON PARTICIPANTS**

Juan Carlos Raymond (NASA/GSFC).

**AGENDA**

The final agenda for the WG meetings is available on the Navigation WG CWE at: <http://cwe.ccsds.org/moims/docs/MOIMS-NAV/Meeting%20Materials/2015/Spring/navwg-agenda-201503.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 <http://cwe.ccsds.org/moims/docs/MOIMS-NAV/Meeting%20Materials/2015/Spring/navwg-action-items-201503.pdf> . The 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.

**New Action/Outstanding Action Items**

<b>##</b>	<b>Action Item</b>	<b>Actionee</b>	<b>Due Date (Original)</b>	<b>Due Date (Current)</b>
01	Organize follow through to establish candidate SANA registries for NHM	David Berry	27-Mar-2015	27-Mar-2015
02	Submit ADM 1.0 Corrigendum to Secretariat	David Berry	27-Mar-2015	27-Mar-2015
03	CDM Corrigendum for element form default on schema (done as part of general change from 'elementFormDefault="unqualified"' to "qualified" for all NDM/XML schemas	David Berry	31-Mar-2015	31-Mar-2015

##	Action Item	Actionee	Due Date (Original)	Due Date (Current)
04	Update NHM XML sections	David Berry	31-Mar-2015	31-Mar-2015
05	Check with JPL Planetary Ephemeris team regarding body numbers in the ephemeris (for PRM)	David Berry	31-Mar-2015	31-Mar-2015
06	Send ODM/ADM keyword consistency recommendations to Alain	Karen Richon	03-Apr-2015	03-Apr-2015
07	Prepare NHM WB 12	Joe Hashmall	07-Apr-2015	07-Apr-2015
08	Determine FDF use of spacecraft parameters provided by JSC in OEM comments.	Karen Richon	10-Apr-2015	10-Apr-2015
09	Correct moims-nav-exec email list problems	David Berry	15-Apr-2015	15-Apr-2015
10	Review TDM P1.0.2 Section #n	As assigned	15-Apr-2015	15-Apr-2015
11	Review Green Book vol. 1 version 3.8 Section #n	Lead editors only, as assigned	24-Apr-2015	24-Apr-2015
12	Produce Green Book vol.1 version 3.9	Juan Raymond	30-Apr-2015	30-Apr-2015
13	Produce ODM Pink Book 2.30	Dan Oltrogge	30-Apr-2015	30-Apr-2015
14	Design SMM Maneuver Planning (MPM) logical block	Karen Richon	30-Apr-2015	30-Apr-2015
15	XSLT converter for TDM	David Berry / Fran Martinez	30-Apr-2015	30-Apr-2015
16	Take a GRO maneuver example and factor into MPM logical block; correlate to requirements	Karen Richon	15-May-2015	15-May-2015
17	Extend consistency study to NHM, PRM	Karen Richon	29-May-2015	29-May-2015
18	Prepare PRM WB 2.6	Fran Martinez	15-Jun-2015	15-Jun-2015
19	Produce NDM/XML P1.1	David Berry	30-Jun-2015	30-Jun-2015
20	Publish ADM Pink Book 1.1	Alain Lamy	01-Jul-2015	01-Jul-2015
21	Update recommended rules/guidelines for Nav WG lead editors	David Berry	01-Jul-2015	01-Jul-2015
22	Produce TDM P1.0.3	David Berry	01-Jul-2015	01-Jul-2015

**Completed Action Items**

##	Action Item	Actionee	Status	Completion Date
N/A	N/A	N/A	N/A	N/A

**Cancelled Action Items**

##	Action Item	Actionee	Reason
N/A	N/A	N/A	N/A

**WORKSHOP PROCEEDINGS**

**DAY 1, MONDAY 23-MAR-2015**

0800 0845 Registration  
0845 0945 CCSDS Opening Plenary  
0945 1045 MOIMS Opening Plenary  
1045 1130 Admin: Agenda, Intro to Nav WG, Prev Action Items  
1130 1230 Discussion of Issues with Standards Overlap, Editor Guidelines  
1230 1330 Lunch

1330 1530 Tracking Data Message (TDM) Version 2  
1530 1730 Navigation Hardware Message (NHM) WB 11

### **0845 0945 CCSDS Opening Plenary**

The CCSDS Spring 2015 Meeting series started with a CCSDS Opening Plenary attended by all participating CCSDS members. Nestor Peccia chaired the meeting; he opened the meeting with a moment of silence in commemoration of our fallen comrade Lindolfo Martinez who passed away in February. Nestor then announced a number of changes that have occurred in the personnel in the CESG and CMC; there have been several changes including the replacement of Mike Kearney by James Afarin as CMC General Chair and a number of changes in Area Directors (AD) and Deputy Area Directors (DAD). The MOIMS Area is one that had changes in both AD (Mario Merri for Nestor Peccia) and DAD (Brigitte Behal for Roger Thompson). We had a few opening remarks from Peter Shames of JPL (workshop hosts) and General Larry James (Deputy Director of JPL). After the opening remarks, the meeting turned to the traditional set of various logistical matters and items of general interest (e.g., details of upcoming meetings, break times, lunch logistics, wireless access, social activities, etc.). There were some important announcements made in this meeting, as follows:

1. The CCSDS is planning the following upcoming meetings (with plans farther out fuzzier than those close in:
  - a. Fall 2015 hosted by ESA at Darmstadt/Darmstadt (09-Nov-2015 through 13-Nov-2015, 4 day meeting)
  - b. Spring 2016 hosted by NASA at Cleveland, Ohio, USA (04-Apr-2016 through 08-Apr-2016, 5 day meeting)
  - c. Fall 2016 hosted by ASI at TBD, Italy
  - d. Spring 2017 hosted by NASA at TBD, USA
  - e. Fall 2017 hosted by ESA at TBD, Europe
  - f. Spring 2018 hosted by NASA at TBD, USA
2. There will be two "Boot Camp" sessions for CCSDS book editors this week (Monday/Friday PM).
3. The CCSDS now has 141 publications, of which 86 are normative.
4. Nestor reported that the number of missions that have used CCSDS standards in some respect is now up to 751.
5. Nestor stated that the CCSDS now has 21 working groups, 4 BOFs, and 1 SIG (down a little due to closure of some working groups given that they have fulfilled their charters).
6. Of several CCSDS organizational/technical overlaps that have been identified over the years, 3 have been resolved and 4 are yet to be resolved.
7. There has been a change of units in the resource forecasts; the new unit will be "work months".
8. There are 109 projects in the CWE Framework; of these 72 have been approved and 32 are pending.
9. There were 23 books published in 2014 (9 Blue, 4 Magenta, 8 Green, 1 Orange, 1 Yellow). (NOTE: In talking with Tom Gannett at the break, this count doesn't include 6 other books that went from White to Red in 2014).

10. There are 10 WG's with no Co-Chair (not necessarily good or bad, but areas should be consistent per Nestor).

11. All WGs were urged to review their charters, five year roadmaps, and project schedules.

12. The number of people registered for the meetings is quite high (193).

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. Prior to their presentations, each AD and DAD were asked to introduce themselves and provide a brief bio given that there have been so many changes in the CESG.

### **0945 1045 MOIMS Opening Plenary**

The overall CCSDS Plenary was followed immediately by the MOIMS Opening Plenary meeting, which was chaired by Nestor Peccia (the last time given that the new AD is Mario Merri). During the MOIMS Plenary, Nestor confirmed the upcoming week's program with each WG Chair. Nestor suggested that the MOIMS Area Dinner would be held on Tuesday 24-Mar-2015 or Thursday 26-Mar-2015 since he is not available on Wednesday. Finally, it was announced that the MOIMS Closing Plenary would be held Friday at 1300 (three hours earlier than the nominal schedule).

### **1045 1130 Admin: Agenda, Intro to Nav WG, Prev Action Items**

The Navigation WG meeting was started immediately after the close of the MOIMS Opening Plenary. In attendance this day were Kyohei Akiyama, David Berry, Jürgen Fertig, Joseph Hashmall, Reinhard Kiehling, Alain Lamy, Byoung-Sun Lee, Dan Oltrogge, Patrick Zimmerman.

David started the session by reviewing the agenda for the week. Given that there was a new attendee to the meetings in this meeting series (Byoung-Sun), the "Introduction to the Navigation WG" presentation was presented in full (but the backup materials containing document details were not gone over in detail, rather, David sent the presentation slides to Byoung-Sun). This presentation highlighted the progress since the last meetings and set the priorities for the week. Note that the priorities had to be adjusted due to the fact that Juan Carlos Raymond was unable to travel due to MMS commitments, and trying to complete the Green Book Volume 1 was one of the top priorities. We will also not be discussing the SMM during the week due to Karen Richon's inability to travel to this workshop.

There was brief discussion of Jürgen's impending retirement in June 2015. There was a suggestion that the group take Jürgen out to dinner during the week, however, Jürgen preferred to do this at Darmstadt in the fall. He noted that this would also give him the chance to personally introduce his successor, Frank Dreger.

Review of the action items from London showed that as of the start of the meetings, 21 remain outstanding (60%), 14 were completed (40%), and 0 were cancelled (0%). David noted that the duration since the start of the London meetings was only 133 days, whereas the number of days between Noordwijkerhout Spring 2014 and London Fall 2014 was 224 days; this helps explain the lower number of action items completed. The remaining outstanding action items were reviewed, with the result that a few more were judged to have been completed since the most recent telecon.

### **1130 1230 Discussion of Issues with Standards Overlap, Editor Guidelines**

In the hour remaining before lunch, the group discussed David's document containing guidelines for

Navigation WG document editors and Joe's proposed guidelines related to "Overlap of Data Among Different Messages". These two topics had some complementary material. The group judged that David's initial action item to create the guidelines had been satisfied, however, the document was viewed as a living document and an action item to update it for the next meetings was assigned. Joe's document was the result of a London action item for which he had volunteered. In addition to the 3 cases discussed by Joe (Independent Definition, Common Definition, and Reference), Dan suggested a fourth case that involved merger of related standards documents/data structures; this case has arisen in his work with the ISO TC20/SC14. In general, the group decided that we could not answer the overlap question definitively; the old standby "it depends" seems to apply because there are situations where one could make a plausible argument for any of the cases. A cursory check of CCSDS Editor Boot Camp material yielded no definitive statement that was applicable. Consensus at the conclusion of these discussions was that we should be as consistent as possible with prior works, and have a solid rationale for departing from consistency. These discussions took us up to the lunch break.

### **1330 1530 Tracking Data Message (TDM) Version 2**

David led discussion through the few changes between the TDM P1.0.2 and TDM P1.0.3. There are few changes because review comments from only one reviewer had been received, and they were relatively few in number and focused on only a few pages of the document. Because of the low number of differences between the two TDM versions, the discussion of TDM only required a couple of hours. David expressed hope that other comments on the TDM P1.0.2 would be received. During discussion of the TDM, Kyohei Akiyama stated that addition of keywords for "EXPECTED\_SIGMA" and "EXPECTED\_BIAS" would be desirable based on his discussions with Hiroshi Takeuchi of the Delta DOR Working Group. There was some discussion of the fact that these numbers were generally not assignable in an automated fashion, and were generally not provided by the tracking networks but rather by navigation analysts or tracking analysts based on a variety of factors.

### **1530 1730 Navigation Hardware Message (NHM) WB 11**

For the final work of the afternoon we initiated discussion of the NHM White Book 11; Joe initiated a White Book version 12 to capture the changes made in real time. The discussion focused on items in Joe's consolidated Comment Resolution Matrix (CRM) that contained review comments from several reviewers (for details, see the CRM on the CWE). Most of these changes had been made in the WB11, however, there were a number that required discussion with the group. The group worked through most of these issues in the last two hours of the day, but did not quite complete. There was lots of discussion on the topics of redundancy, syntax topics, etc. Notable decisions: David had suggested using the keyword "MNEMONIC" in the NHM metadata as had been done in the early issues of the NHM prior to changing to "DEFINE"; Joe offered a good rationale for sticking with "DEFINE" as the metadata keyword used to define the mnemonic keywords used in the Data Section of the NHM. At day's end, discussion on Tuesday was slated to begin with a continuation of the NHM discussions.

### **DAY 2, TUESDAY 24-MAR-2015**

0845 1030 Navigation Hardware Messages (NHM)  
1030 1230 Pointing Requests Message (PRM)  
1230 1330 Lunch  
1330 1645 Pointing Requests Message (PRM)  
1645 1730 "Events" Discussion ("pre-EVM")

In attendance this day were Kyohei Akiyama, David Berry, Jürgen Fertig, Joseph Hashmall, Reinhard

Kiehling, Alain Lamy, Fran Martinez, Dan Oltrogge, Patrick Zimmerman.

Prior to the scheduled meeting start, David conducted a test of the WebEx capability with Juan Raymond, who was unable to travel to Pasadena. The test was successful; consequently we scheduled a discussion of the Green Book for Wednesday afternoon when Juan reports to work back at GSFC.

#### **0845 1030 Navigation Hardware Messages (NHM)**

Discussion of the NHM that had started the previous afternoon was completed. There were a few minor changes; e.g., for the XML implementation, <defineSet> was changed to <defineBlock>. Joe took an Action Item to produce NHM White Book 12; David has an action item to update the XML sections of the document and provide the input to Joe prior to his creating NHM WB12. David suggested that we seem to be converging and that we may be able to promote the NHM to Agency Review around the time of the Fall 2015 meetings.

#### **1030 1230 Pointing Requests Message (PRM)**

#### **1330 1645 Pointing Requests Message (PRM)**

Fran Martinez led discussion of the PRM draft 2.5. He led the group through the suggestions from reviewers of the PRM 2.3 and 2.4, with a focus on those that required additional clarification or discussion (for details, see the CRM on the CWE). In several instances there were returns to the topic of the previous day regarding consistency between Nav WG standards. At the conclusion of the discussion, Jürgen and Fran noted that there were still a few items of a more difficult nature that require resolution. Fran has an action item to produce PRM 2.6, which is planned to be the last White Book version before the Agency Review. Accordingly it was proposed that the 2.6 White Book be the "transition to Red" version, i.e., that a CESG poll be requested to initiate an Agency Review sometime between the end of these Spring Meetings and the upcoming Fall Meetings. Depending on the timing of the completion of the PRM 2.6, the Agency Review could conceivably be complete prior to the Darmstadt meetings, which would be desirable from the standpoint of RID resolution during the face-to-face meetings. New Area Director Mario Merri and new Deputy Area Director Brigitte Behal joined us briefly during the discussion of the PRM to monitor the group.

#### **1645 1730 "Events" Discussion ("pre-EVM")**

At the conclusion of the PRM discussion, there were about 45 minutes remaining in the day. Alain Lamy led us briefly through the list of candidate "events" that could be under consideration for the Events Message (EVM). This discussion was quite spirited (unusual for an end of day discussion, especially given that the room was quite hot, around 29 °C). Dan mentioned that the concept could have application in the RF interference determination that is part of the Space Data Center charter. Joe inquired whether or not "combination events" were considered, and also whether commanded events were included (as opposed to events that could be computed from the ephemeris/attitude). Other questions dealt with relative events (events relative to some other event). Some events require additional information beyond that which can be computed from an OEM and/or AEM ephemeris (e.g., things like acquisition of signal, which require station location and antenna mask information; or RFI events, which require information regarding antenna transmit/receive patterns, etc.). It was noted that in the original concept, orbital events were intended to be those that could be computed from an OEM and/or AEM; Alain indicated that the message was meant to be extensible and that other information could definitely be applicable to events (e.g., additional information associated with a given event, phenomena that are not directly related to the orbit and/or attitude, etc.). David noted that this extensibility to things like acquisition of signal, loss of

signal, etc., that require information beyond OEM/AEM were the reason that the CCSDS System Engineering Area felt that the "events framework" was within their purview. A resolution was added to the WG's final report to the Area requesting that the task of completing the events framework be assigned to some applicable group in the CCSDS so the work can progress.

Finally, in the category of administration regarding the [moims-nav-exec@mailman.ccsds.org](mailto:moims-nav-exec@mailman.ccsds.org), Joe Hashmall indicated that he is still having problems posting to the mail list. He had emailed a Green Book CRM to Juan Raymond with copy to the moims-nav-exec list, and Juan received the email but the members of the list did not. David briefly described a test that he would like to conduct after the meetings in order to collect a full set of data for the CCSDS Tech Support without bombarding people with messages.

### **DAY 3, WEDNESDAY 25-MAR-2015**

0845 1230 Attitude Data Messages Version 2 (ADM)  
1230 1330 Lunch  
1330 1700 Nav Green Book V.4 Topics

In attendance this day were Kyohei Akiyama, David Berry, Jürgen Fertig, Joseph Hashmall, Reinhard Kiehling, Alain Lamy, Byoung-Sun Lee, Fran Martinez, Dan Oltrogge, Juan Carlos Raymond (telecon), Patrick Zimmerman.

#### **0845 1230 Attitude Data Messages Version 2 (ADM)**

Alain led us through discussion of the Attitude Data Messages (ADM) revisions. He indicated that many changes were anticipated based on his analysis of the ADM 1.0. The ADM is very flexible per Alain, but which led to it being ambiguous... one can do the same thing many ways. During this discussion Alain asserted that "the minimum choice the better in a standard"; this is a topic which has arisen with us before in the context of optional elements in the standard, "user defined keywords", etc. As usual, the challenge is to find the right balance.

Fran noted that a current project with EUMETSAT is using CCSDS standards heavily ("as much as possible"), including the AEM. Introducing "major changes" as proposed by Alain could be very disruptive in this particular case. Alain countered that the number of users of the ADM (in his estimation) is very low compared to other navigation standards (e.g., ODM, TDM); however, we do not really know how others may be using the existing standard. Per Fran, improving is good, re-implementing completely is not good.

Another area we focused on in this ADM discussion was the action item from London related to the NUTATION\* keywords and a possible corrigendum to the ADM 1.0. There was a great deal of discussion on the topic, primarily dealing with the exact definitions of the terms "precession" and "nutation". After a bit of discussion, Jürgen suggested that we should write the equations, and then the determination as to the definition in the ADM will become apparent. A few diagrams (but no equations) were utilized to assist in resolution of the issue. After much discussion, it became apparent that there is no agreement as to the exact definition of the term "nutation". Dan Oltrogge found a reference that indicated ambiguity with respect to the use of the terms "nutation" and "precession". After considering two approaches (1) rename all "NUTATION\*" keywords to "PRECESSION\*" and (2) a note of corrigendum, the WG agreed to add a note of Corrigendum in the "Conventions and Definitions" section of the ADM 1.0 document (section 1.3). Joe drafted the Corrigendum, and the WG wordsmithed it a bit, with the result: "As in some attitude dynamics references, in this document the term 'Nutation' is used to

mean the motion of the spin axis of a body about an inertial axis. In many other references this motion is called 'Precession'." David took the Action Item to submit the corrigendum to the Secretariat.

There was one area where Alain indicated that he felt clarification was necessary, in particular, at minimum he would like to improve the descriptions associated with the SPIN\* related keywords. It was agreed that improving the descriptions would not be disruptive to any user code making use of the keywords (exception: if the user misinterpreted the existing descriptions and made coding errors as a result). The possibility of adding optional keywords to cover missing derivatives was not viewed as impactful to user logic either.

In resolving another London action item, the group reviewed a set of changes to the AEM that Juan Carlos Raymond had introduced for MMS operations (NASA mission "Magnetospheric Multiscale"). There was agreement that these modifications were not generally applicable, rather, they were very specific to MMS operations. Alain indicated it was possible that addition of one of the extensions (the angular momentum vector) might be possible in the ADM 2.0. There was also discussion of adding the inertia tensor to the AEM metadata, from which a variety of other matrices could be derived if a user so desired.

We also considered one of the action items from the London meetings that had been suggested by Dmitry Marareskul, specifically, consideration of the Russian conventions for the X-axis. We attempted to work through this issue, but had no clarification from Dmitry; he was not able to attend the meetings and has not responded to email requests for clarification. A seemingly applicable International Space Station document on reference frames was found via a web search. We assumed that the conventions discussed were relative to the "XPOP" with the X-axis defined as the negative of the angular momentum vector ( $-\mathbf{h}$ ). Alain's action item was closed.

Alain indicated that his analysis so far has focused mostly on the APM... he also analyzed the AEM and presented the analysis to the group; this went relatively quickly as many of the discussion topics had already been covered while presenting the new proposed APM changes. Next steps for the ADM: Alain will try to clarify the meanings in the description text. He accepted an action item to produce a first draft Pink Book with a target date during mid-summer.

### **1330 1700 Nav Green Book V.4 Topics**

The Navigation Green Book discussion was conducted via a WebEx/telecon with Juan Carlos Raymond, who was not able to travel due to MMS commitments. The goal of the telecon was to work through the joint Comments Resolution Matrix (CRM) that had been prepared by Juan and to address issues of a non-trivial nature that could not be immediately accepted. We went through the changes in the Green Book volume 1 version 3.8 that arose from previous CRMs (for details see the CRM on the CWE). The CRM mostly contained comments received from reviewers of the Green Book volume 1 version 3.7. Although some comments had been received from WG reviewers on the version 3.8, there were not large in number and had not yet been applied to the document.

We did however focus during the WebEx session on some of the relatively larger changes that seemed desirable, in particular, removal of some of the process diagrams that had been in earlier versions. The issue that had been raised at London with these drawings is that they all had a different look and feel; though they did have a few technical inaccuracies, correction of these would not correct the look/feel issue. The group was more in favor of the simplified, uniform look/feel diagrams prepared by Joe Hashmall and refined by Luis Martin. So the old process diagrams and the old "mega use-case" diagram were all removed. In order to be able to show the changes on the screen as they were made, Juan initiated development of Green Book volume 1 version 3.9 in real time. The changes will be in version 3.9 when



it is published.

The WebEx/telecon with Juan allowed us to make progress on the Green Book volume 1, and it worked better than anticipated. It was perhaps not as good as a face-to-face meeting, but it was generally very satisfactory. The biggest issue was that those present at Caltech could not communicate well with Juan. We could hear him quite well on the room speakers, and could see both the CRM and the document changes being made on Juan's desktop, but the only satisfactory output from us to Juan could come from those seated near David's computer. If we were to try this again, we could have more people log into the WebEx session and use their microphones, but we might get some feedback problems from that. Under the circumstances, however, we were fortunate to be able to conduct a WebEx/telecon and the facilities were generally accommodating.

#### **DAY 4, THURSDAY 26-MAR-2015**

0845 1130 Orbit Data Messages (ODM) Pink Book/Sheets  
1130 1300 Prep Closing Report, 5 Year Plan, Action Items, Set Next Telecon  
1300 1400 Lunch  
1400 1500 Navigation Data Messages XML Specification (NDM/XML)  
1500 1500 End of Navigation WG Meeting

In attendance this day were Kyohei Akiyama, David Berry, Jürgen Fertig, Joseph Hashmall, Reinhard Kiehling, Alain Lamy, Byoung-Sun Lee, Fran Martinez, Dan Oltrogge, Patrick Zimmerman.

The day started with a few technical difficulties (recalcitrant computers) so we filled the time with some of the administrative closing items, specifically, we set the next telecon date (see the bottom of these minutes) and started to assign due dates for some of the new action items accumulated during the week.

#### **0845 1130 Orbit Data Messages (ODM) Pink Book/Sheets**

When the technical difficulties resolved, Dan Oltrogge led us through the updates that had been made to the ODM document as part of the 5 Year Review Revisions. The principal changes are the addition of a new "Orbit Hybrid Message" (OHM) that responds to several ephemeris use cases that are not well covered by the ODM 2.0. The OHM is meant to be a combination and extension of the three existing ODMs (OPM, OMM, OEM). David noted that there were prototyping issues, issues with the placement of some of the keywords, issues with consistency of keywords with other of the ODMs. However with time and effort these challenges are all surmountable.

Jürgen inquired about the strategy of adding a new message as opposed to producing an entirely new standard. The advantages and disadvantages of the two approaches were briefly discussed... there are arguments in favor of and against both. Some advantages of a new standard are that separation between existing documents and the new document can be better enforced; when the existing standard is no longer used it can be retired; we have greater freedom to define structures as needed without being consistent with the existing document. Some disadvantages of a new standard include the greater difficulty of obtaining approval for an entirely new document; we can't be guaranteed that the existing standards will really fall out of use, or it may take a long time; and maintaining a desired level of consistency with existing orbit standards is more difficult with similar material in two different books.

There was discussion of making review assignments for the first draft of the ODM Pink Book that had been distributed (i.e., ODM P2.29), but based on the several ideas and suggestions that arose during the discussions, Dan elected to create an ODM P2.30 and have that be the first version to have review

assignments within the group. Dan took an action item to produce the updated ODM by end of April.

### **1130 1300 Prep Closing Report, 5 Year Plan, Action Items, Set Next Telecon**

We reviewed and completed the group's report to the Area Director for the MOIMS Closing Plenary (shown below in the minutes), insofar as that was possible to accomplish given that Friday's events had not yet occurred. We completed the list of action items, target dates, and assignees (shown above in the minutes). We reviewed the Charter, with two minor changes suggested: (a) removal of "/WG3" from the listing of relationship with ISO TC20/SC14, and (b) changing the email address of the Area Director from Nestor's to Mario's. We did not make these changes because any alteration of the Charter causes it to move into "Pending" status and a decision by the CESG and/or CMC is required to approve it; in this case the changes were inconsequential and under the circumstances do not warrant immediate revision.

Document project schedules on the CWE Framework were not reviewed given that none of them showed as being "Behind Schedule" in the Framework. Any adjustments can be made during our monthly telecons. For the same reason, the Navigation WG 5 Year Plan was not reviewed, since it was derived from the individual document schedules, which had not changed. As with the document schedules, any changes can be reviewed during telecons.

Dan sent David a "Launch Support Package" that could be a future standard. David told the story about how we got to where we are today with NHM, PRM, SMM, EVM... these works all began in 2008/2009 based on group member thoughts as to areas of flight dynamics that had not yet been standardized. At the time of the Berlin meeting in Fall 2008, the TDM was complete, the ADM was complete, and the ODM version 2 and NDM/XML documents were nearing completion; consequently the Navigation WG was relatively close to going out of business. Between Fall 2008 and Fall 2009 we had specific agenda items for discussion of topics for future standardization. In some cases it has taken a while for the new documents to get started, but they all start with someone's idea to standardize an area that has not yet been standardized.

The "main" portion of Thursday's meeting ended at this point, as there were some group members who needed to get to the airport for return flights. The group was congratulated on a productive meeting week, adieus were bid, and we started making plans for the next meetings in Darmstadt, Germany in November 2015. David offered those who were interested a discussion after lunch of the NDM/XML document and various attendant issues. Several group members indicated an interest.

### **1400 1500 Navigation Data Messages XML Specification (NDM/XML)**

After lunch David reviewed progress towards the NDM/XML document: strategy, namespace issues, elementFormDefault issues, oemType issues, etc. The document strategy is to remove the discussions of ODM, ADM, and TDM from the NDM/XML document and migrate them into the revised documents that are currently being prepared; this keeps us from having to issue two Blue Books each time one of these documents is revised. A revised NDM/XML 2.0 will eventually be published given that the document is up for 5 Year Review this year. The namespace issue relates to the fact that the NDM/XML namespace was built using the original recommendation of the XSG SIG, but they have changed direction in the past couple of years; there is also a need for better versioning control. The elementFormDefault issue arises from the fact that the NDM/XML schemas are currently "unqualified"; however, to make them useful for import into other CCSDS group schemas they should be "qualified". This issue is a bit XML esoteric, but in essence it requires a largely duplicate set of schemas. The oemType issue arose from the Service Management WG, which wants to use the NDM/XML schemas directly (as they should). Fran suggested addressing John Pietras' issue as requested by John, i.e., by versioning the oemType.

## **1500            End of Navigation WG Meeting**

The review of the NDM/XML material was the final act of business for the Navigation WG meeting. All materials from the meetings (agenda, introductory presentation, action items, report, and minutes) are available on the CWE at the following link:

<http://cwe.ccsds.org/moims/docs/Forms/AllItems.aspx?RootFolder=%2Fmoims%2Fdocs%2FMOIMS-NAV%2FMeeting%20Materials%2F2015%2FSpring&View={8E605C3A-1DB4-4034-B479-91C6E2A03139}&>

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

<http://cwe.ccsds.org/moims/docs/Forms/AllItems.aspx?RootFolder=%2fmoims%2fdocs%2fMOIMS-NAV%2fdraft%20Documents&FolderCTID=&View={8E605C3A-1DB4-4034-B479-91C6E2A03139}>

## **DAY 5, FRIDAY 27-MAR-2015**

There was no meeting of the Navigation WG this day, as we had completed our Navigation WG program work the prior evening.

## **0845    1300    XML SIG Meeting**

The XML Standards and Guidelines (XSG) Special Interest Group (SIG) was held in the morning. David attended given the large number of XML schemas produced by the group and the CMC directive to produce XML implementations our standards. In attendance were Peter Shames (NASA), David Berry (NASA), Marc Blanchet (SANA Operator), Stefan Veit (DLR), Ramon Krosley (NASA/GSFC), Anthony Crowson (ESA), John Garrett (NASA), Daniele Boucon (CNES), Nestor Peccia (ESA), and Audric Schiltknecht (SANA team).

The first part of the meeting was allocated to a discussion of a new standard being developed in the MOIMS-DAI working group (number 647). The XSG SIG was consulted given that the material in this new standard is in XML. There was no particular information here pertinent to the Navigation WG.

After the discussion of document 647 was complete, there were general discussions regarding the direction of the XSG SIG. Peter Shames shared his vision for the group, specifically, that the work now being performed in the SIG would be migrated to the System Architecture Working Group (SAWG), the XSG SIG would be disbanded, and an "XML Expert Group" would be created. At this time there is no precedent for an "Expert Group" in the CCSDS, i.e., the "Organization and Processes" document contains no such entity; David suggested that the XML Expert Group just be called a Special Interest Group (SIG)

We looked over the IETF (Internet Engineering Task Force) RFC (Request for Comments) document that has at long last been submitted to the IETF for review and approval. This document requests the CCSDS URN namespace (urn:ccsds). It is currently under review by the IETF, and there is no estimate for when it might be approved. We also reviewed (quickly) the namespace policy document (a Yellow Book draft). If the namespace is not awarded, the URN policy document will need to be modified accordingly because it assumes that the "urn:ccsds" URN will be allocated to the CCSDS; while this seems a good assumption, it is not official until reviewed and awarded by IETF/IESG/IANA. The CCSDS SANA will be responsible for updating the RFC if not acted upon by the IETF/IESG/IANA within six months. Once approved, it becomes permanent and doesn't need to be renewed anymore. The assignment of the URN

and the CCSDS URN Policy Yellow Book impact the Navigation WG because the URN appears in our standards documents, all the schemas, etc. The policy directs the way in which we construct our namespace string and maintain it.

The remainder of the meeting consisted of a presentation containing proposed XML guidelines drafted by Peter. He reiterated much of the material that he had presented at London, specifically, a presentation he had prepared that surveyed of all the XML based data formats in CCSDS (DEDSL DTD, ndmxml, SM Service Package, SM&C schemas (including XTCE), and SOIS XTEDS), with the observation that there is quite a range of things done in different styles (issues exist with consistency in the XML realm as well). He suggested that what we need to do for CCSDS XML guidelines is to see if there is a set of common guidelines that will make things hang together better, but admitted that there is not a lot of guidance here. He showed the guidance that he did find in Google XML Document Format Style Guide (2008), ESA Design & Style Guide for XML Data and Schema (2005), XML Schema Best Practices, from XML-DEV, compiled by University of Cambridge (2001). These guidelines vary in content, but are helpful in terms of providing assistance. Peter extracted some common elements and showed them in his presentation. Peter also wants to work on the CCSDS Glossary and revise it. We didn't spend much time on this topic.

At the conclusion of the XSG SIG meeting, before the SANA Steering Group Meeting, David had an opportunity to speak with Marc Blanchet, the SANA Operator, regarding the new SANA Registry that is being proposed by the Navigation WG for the NHM. Per Marc, the process of getting the new registry is quite informal; David indicated that he would file a request with Marc via email to establish the candidate registry.

### **1300 1500 MOIMS Closing Plenary (optional)**

David attended Area Director Mario Merri's MOIMS Closing Plenary at 1300. Attendance at the Plenary included: Nestor Peccia (ex-MOIMS Area Director (AD)), Mario Merri (new MOIMS AD), Brigitte Behal (new MOIMS Deputy AD), Daniele Boucon (DAI WG Chair), David Berry (Navigation WG Chair), Dan Smith (SM&C WG Chair), Mehran Sarkarati, Tiago Nogueira, John Garrett, Byoung-Sun Lee, Michela Muñoz, and several other members of the SM&C WG.

Dan Smith presented the SM&C report. They have over 20 members at these meetings each day (!). There were a couple of interesting points in the SM&C report, for example, Dan Smith mentioned that there had been discussion in the SM&C meeting regarding who would be responsible for creating the Navigation Services Blue Book. David indicated that the Navigation WG has not necessarily recognized a need for definition of services; rather, we have focused on formats to be used for data exchange. It was also stated that the Navigation WG is interested in seeing an example of a defined SM&C services Blue Book or Magenta Book, because to date there are no exemplars to which we can refer; Mario responded that the SM&C document number 522.1-R-3 "Mission Operations Monitor & Control Services" is an example document which is in Red Book review.

The reports of the DAI WG and Mission Planning BOF were also presented.

For the Navigation WG, the report shown immediately below was presented. As in the Navigation WG meeting, there was substantial discussion of the "Events Message" concept (see "Resolution 1" below). Mario and Brigitte were reminded of the need to file resolutions for the CESG/CMC Poll for the ADM and ODM Revision projects. Otherwise, there were no particular issues. After the various MOIMS WG chairs presented their reports, the meeting week was concluded.

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

- **Documentation Status**

- Tracking Data Message (TDM)
  - Reviewed TDM P.1.0.3 with a few 5 Year Revisions based upon minimal review comments received to date
- Navigation Hardware Message (NHM)
  - Completed comprehensive discussion of comments/issues arising from internal review of NHM White Books 10 and 11
  - Initiated NHM White Book version 12 with meeting discussions
- Pointing Requests Message (PRM)
  - Completed comprehensive discussion of comments/issues arising from internal review of PRM White Books 2.3 through 2.5
  - Initiated PRM White Book version 2.6 with meeting discussions
  - Initiation of CESG Red Book Poll anticipated before Fall
- Attitude Data Messages (ADM)
  - Continued review of potential major 5 Year Revisions to the ADM (no new draft yet, still discussing)
  - Sent a corrigendum to Secretariat related to ambiguity in the document's usage of terms "nutation" instead of "precession"
- Orbit Data Messages (ODM)
  - Completed review of initial 5 Year Revisions to the ODM; a new hybrid message is the principal modification discussed
  - Initiated ODM Pink Book 2.30 based on meeting discussions
- Navigation Green Book
  - Continued discussion of edits to Navigation Green Book (vol. 1, version 3.8); we are approaching readiness for CESG poll
  - Initiated version 3.9 with meeting discussions
- Navigation Data Messages / XML Specification
  - Initiated 5 Year Review discussions; "REVISE" 100% probable
- Events Message (EVM)
  - Resumed discussion of orbital events that might be pertinent to a Navigation Events Message; reviewed a conceptual list of potential events. There was much enthusiasm.
- Spacecraft Maneuver Messages (SMM)
  - Dropped from agenda for various administrative reasons (editor inability to travel and family health matters)

- **Issues**

- We have many books in progress; consequently it is difficult to get detailed commentary on the new drafts. We are still recovering from the 2.5 year long "laser focus" on the CDM that caused significant delays to occur in other work.
- The group addressed and resolved 1 "thorny issue" that has arisen several times in the past but had not previously been definitively answered (specifically, should "state" data structures from one NDM be duplicated in another NDM?)
- Wednesday WebEx/telecon worked reasonably well in absence of lead editor ability to travel; less productive than face-to-face

- **Overall Assessment**

- Made satisfactory progress catching up on items delayed by intensive work on CDM (ADM, EVM, Green Book, NHM, ODM, PRM)
- Modest (not substantive) progress on TDM, no progress on SMM

- **Requested Feedback Items**

- None

- **Unsolicited Feedback Items**

- Facilities:

- Location was excellent... Caltech campus was a very serene and pleasant environment
- Meeting room on Monday/Tuesday was very warm... required maintenance service
- Meeting rooms were spacious, well equipped... room keys would have been nice for security reasons, but we worked around it by leaving sentries during lunch and breaks
- Meeting room materials (projection capability, audio, whiteboards) were excellent... exception: access to power
- Provision of refreshments (coffee, tea, water, cookies, etc.) was very good
- Wireless connectivity was very good... no reported problems

- **RESOLUTIONS Issued**

- **Resolution 1:**

- The Navigation WG suggests that the “events” framework be elaborated by an applicable WG as determined by the CESG as soon as possible.

- **Resolution 2:**

- The Navigation WG expresses appreciation to the staff of NASA/JPL and Caltech for their excellent support of these meetings.

## **NAVIGATION STANDARDS 5 YEAR PLAN**

Given that the individual document schedules were not revised, and the 5 Year Plan is based on those, the 5 Year Plan was not updated during these meetings. We will address this plan in monthly telecons as the need arises.

## **NEXT TELECON:**

The WG established Wednesday 06-May-2015 @ 1300 UTC as a next telecon date. A meeting invitation will be sent. The tentative agenda is TBD, but will likely include status updates on the documents in work, action item status (we have 15 action items with scheduled completion before 06-May-2015), and possibly some 5 Year Plan revisions.