

MINUTES OF NAVIGATION WORKING GROUP SPRING 2016 WORKSHOP 15-Apr-2016
David S. Berry / Chair

The CCSDS Spring 2016 Meetings were conducted at the Westin Hotel in Cleveland, Ohio, USA, during the week of 04-Apr-2016 through 08-Apr-2016. The United States National Aeronautics & 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), Dale Force (NASA/GRC), David Frew (ESA/ESAC), Cheryl Gramling (NASA/GSFC), Alain Lamy (CNES), Byoung-Sun Lee (ETRI), Dalin Li (NSSC), Francisco Martinez (ESA/ESOC/GMV), Dan Oltrogge (NASA (AGI, SDC, and ISO TC20/SC14)), Patrick Zimmerman (NASA/JSC).

TELECON PARTICIPANTS

Not applicable.

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/2016/Spring/navwg-agenda-201604.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/2016/Spring/navwg-action-items-201604.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

##	Action Item	Actionee	Due Date (Original)	Due Date (Current)
1	Request candidate registry for PRM templates	David Berry	15-Apr-2016	15-Apr-2016
2	Check with Frank re PRM prototyping	Fran Martinez	15-Apr-2016	15-Apr-2016
3	Prioritize RDM/FDM	Tim Flohrer	15-Apr-2016	15-Apr-2016
4	Add guideline regarding SI units to WG Guidelines	David Berry	15-Apr-2016	15-Apr-2016
5	Update PRM drafts on CWE	David Berry	22-Apr-2016	15-Apr-2016

##	Action Item	Actionee	Due Date (Original)	Due Date (Current)
6	Produce updated PRM R1.1	Fran Martinez	30-Apr-2016	30-Apr-2016
7	Produce PRM Test Plan	Fran Martinez	30-Apr-2016	30-Apr-2016
8	Find ROSETTA sample to convert to PRM	Fran Martinez	30-Apr-2016	30-Apr-2016
9	Produce Green Book 3.2	Dale Force	30-Apr-2016	30-Apr-2016
10	Produce CDM corrigendum for "N_BODY_PERTURBATIONS" keyword	David Berry	13-Jan-2016	30-Apr-2016
11	Review NHM WB 15	All (assigned below)	17-Feb-2016	30-Apr-2016
12	Send Alain suggestions for "SPIN" block in the APM	All	15-Jan-2016	30-Apr-2016
13	Determine agencies for "Prototype 2" for all Nav WG books lacking them; convey to Mario	David Berry	30-Apr-2016	30-Apr-2016
14	NDM/XML add project to Framework	David Berry	15-May-2016	15-May-2016
15	Produce ADM P1.2	Alain Lamy	31-Jan-2016	15-May-2016
16	Register PRM templates in the SANA Registry	Fran Martinez	31-May-2016	31-May-2016
17	Produce ODM P2.33	Dan Oltrogge	31-May-2016	31-May-2016
18	Write relay topics for Nav GB	Cheryl Gramling	31-May-2016	31-May-2016
19	Produce SMM White Book 5	Cheryl Gramling	04-Apr-2016	31-May-2016
20	Produce TDM P1.0.4	David Berry	15-Jun-2016	15-Jun-2016
21	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-Jan-2016	31-Jul-2016
22	Produce NDM/XML P1.1	David Berry	31-Jan-2016	31-Jul-2016
23	Next available number	N/A	31-Dec-2030	31-Dec-2030

Navigation Hardware Message White Book Version 15 Review Assignments (AI-11 Above)

Pages	Reviewer #1	Reviewer #2	Reviewer #3
Pages 1-1 thru 3-3	Frank Dreger	Tim Flohrer	Cheryl Gramling
Pages 4-1 thru 4-13	Dale Force	Patrick Zimmerman	Kyohei Akiyama
Pages 5-1 thru 6-2	David Berry	Fran Martinez	Reinhard Kiehling
Annex A-1 thru C-3	Dan Oltrogge	Juan Raymond	Dmitry Marareskul
Annex D-1 thru G-4	David Vallado	Alain Lamy	Cheryl Gramling
Annex H-1 thru J-1	David Berry		

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 04-APR-2016

0800 0845 Registration
0845 1015 CCSDS Opening Plenary
1015 1145 MOIMS Opening Plenary
1145 1230 Admin: Agenda, Intro to Nav WG
1230 1330 Lunch
1330 1730 Pointing Requests Message (PRM) RIDs Dispositioning

0845 1015 CCSDS Opening Plenary

The CCSDS Spring 2016 Meeting series started with a CCSDS Opening Plenary attended by all participating CCSDS members. Nestor Peccia chaired the meeting. We had a few opening remarks from Dr. Rickey Shine of NASA's Glenn Research Center (workshop hosts). Shine's talk highlighted the many space technology research projects conducted at NASA/GRC. Afterwards Nestor announced that the contract for the Secretariat of the CCSDS had been transferred to a new organization. David Ross of the (new) CCSDS Secretariat also spoke on the traditional set of various logistical matters and items of general interest (e.g., details of start/stop times, break times, lunch logistics, wireless access, 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 2016 hosted by ASI at Rome, Italy (dates TBD, feedback on two possible options requested by Nestor Peccia)
 - b) Spring 2017 hosted by NASA at San Antonio, Texas, USA
 - c) Fall 2017 hosted by ESA at TBD, Europe
 - d) Spring 2018 hosted by NASA at TBD, USA
 - e) Fall 2018 hosted by DLR at TBD, Germany
 - f) Spring 2019 hosted by NASA at TBD, USA
2. The "Boot Camp" sessions that had originally been scheduled will be cancelled this week. David Ross indicated that a telecon Boot Camp would be established in the near future.
3. The CCSDS now has 150 active publications, of which 92 are normative.
4. The number of missions that have used CCSDS standards in some respect is now up to 782.
5. The CCSDS now has 23 WGs, 1 Birds of Feather (BOF), and 1 Special Interest Group (SIG); this is approximately the number of entities reported at Darmstadt, Fall 2015. One WG (Telerobotics) is in danger of being disbanded due to lack of progress.

6. There are 83 approved projects in the CWE Framework (54 of which are behind schedule), and 64 "draft projects".

7. The number of people registered for the meetings is 170.

During his presentation, Nestor highlighted a few things of importance to the Navigation WG, notably, the fact that the CMC Poll required for project approval will now be rejected if the Prototype 2 commitment is not included as part of the request; the Navigation WG currently has 4 active projects with the characteristic that the Prototype 2 responsibility has not been assigned.

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. One item of special note was the System Engineering Area's interest in developing stronger conventions for the SANA Registry (SANA Re-Engineering); this was also mentioned at Darmstadt in Fall 2015, but the effort continues to move forward and it will be a far reaching change.

Finally, Nestor requested feedback from the Working Groups during closing plenaries on the topic of the dates for the Fall Meetings at Rome. Due to various conflicts (mostly having to do with holidays in various countries), the original dates selected cannot be supported by ASI, who is hosting the meetings. The two options are:

17-Oct-2016 through 21-Oct-2016 (5 day meeting)

24-Oct-2016 through 27-Oct-2016 (4 day meeting)

1015 1145 MOIMS Opening Plenary

The overall CCSDS Plenary was followed immediately by the MOIMS Opening Plenary meeting, which was chaired by Area Director Mario Merri. During the MOIMS Plenary, Mario presented material on the status of the various WGs in MOIMS (Navigation (Nav), Spacecraft Monitoring & Control (SM&C), Mission Planning & Scheduling (MPS) all with high momentum; Data Archive Ingest (DAI) and Telerobotics with low momentum). He highlighted the "London Agreement" on the topic of services, which does not directly the current work program of the Navigation WG, but strongly affects the work program of the SM&C WG. The notion of two models of MOIMS standards was discussed: one in which the primary effort is to define data formats, with data exchange defined by participants often via files (a la Nav WG), and another in which the primary effort is to define concrete, practical services (a la SM&C WG). Schedule-wise, Mario confirmed the time of the MOIMS Closing Plenary (Thursday 07-Apr-2016 at 1600) and indicated that the MOIMS Area Dinner would be held on Thursday 07-Apr-2016 at 1930 at the Hofbrauhaus in Cleveland. Following Mario's presentation, there was some discussion on the topic of the status of "events" and standards related to their description/exchange. David explained that the Navigation WG has not done anything substantive with respect to "events" given that the System Engineering Area had effectively claimed definition of the event format as part of their purview. We did meet with the CSS/SM WG at Darmstadt, and have a meeting planned for Cleveland as well, but these meetings dealt with the CSS/SM event definitions and their potential compatibility with the concepts that had been discussed in the Navigation WG.

The bulk of the MOIMS Plenary was devoted to a presentation by François Allard (IOAG) which focused on the work program of the SM&C. The findings included 8 concerns (listed below); for each concern there were associated risks and recommendations. Mario indicated that he found this study interesting, and suggested an outline of how to respond should be prepared by SM&C.

#1 Scope Too Broad: The size and scope of the MO Services standards framework is too large to expect that the effort will be completed in a “reasonable” time period, commensurate with other industry standards development efforts.

#2 Standards Development Roadmap: A complete roadmap showing the full suite of existing and planned mission operations services, their key development milestones, and the organization (standards working group) assigned to the standards development is essential to gaining confidence across the agencies and their missions.

#3 Range of Interoperability Needs: It was clear to the MOSSG team, which studied a range of missions, that the extent to which interoperability capabilities were required varied greatly. It is important that the MO services team address explicitly the spectrum of interoperability degrees.

#4 Must Encourage Long Term Innovation: The rate of functional innovation for software-based systems and services is much higher than the rate of change for many other standards, including RF link protocols, packet formats, etc. It is important that the MO services recognize and support the need for agencies, missions, or COTS product providers to add additional services or to add capabilities to existing services without requiring modifications to the documented standards.

#5 Must Have a Cohesive Approach Across All of CCSDS: CCSDS has multiple efforts working on services, service management, and service frameworks. It was not clear to the MOSSG team that these efforts are coordinated with each other. There may be significant overlap or inconsistency among the efforts.

#6 Promoting Infusion and Re-use: There is an inherent difficulty in adopting any new suite of standards or approaches. Approval to incorporate a service-oriented approach may be particularly difficult since the paradigm is better known in software development circles than in management circles. This raises the importance of agencies working together to collectively to promote the infusion of the MO services approach.

#7 Code Sharing: Code sharing through CCSDS has been proposed as a means of MO services standards infusion across space agencies and is listed as a key benefit of the services approach.

#8 Need for Guiding Principles: No set of guiding (or architecture) principles appears to exist for the depth and scope for the definition of MO services.

1145 1230 Admin: Agenda, Intro to Nav WG

The Navigation WG meeting was started immediately after the close of the MOIMS Opening Plenary. In attendance this day were Kyohei Akiyama, David Berry, Dale Force, David Frew, Cheryl Gramling, Alain Lamy, Byoung-Sun Lee, Dalin Li, Fran Martinez, Dan Oltrogge, Patrick Zimmerman.

Given that the plenary meetings had taken so long, there was little time before lunch for the customary Navigation WG administrative matters. There was only time for introductions around the room, a very brief spin through the agenda for the week, and a quick presentation of the "Introduction to the Navigation WG" material. David sent the presentation slides to the group since there was not time to go over the document details. This presentation highlighted the progress since the Fall 2015 meetings and set the priorities for the week.

Review of the action items from London showed that as of the start of the meetings, 16 of 26 were completed (62%), 10 remain outstanding (38%), and 0 were cancelled (9%). David noted that the

duration since the end of the Darmstadt meetings was only 143 days, a somewhat shorter period of time than between the end of Spring 2015 Meetings and the beginning of the Fall 2015 Meetings. Given the shorter period of time, the percentage of action item completion was quite good.

1330 1730 Pointing Requests Message (PRM) RIDs Dispositioning

After lunch the WG initiated the process of dispositioning RIDs from the Agency Review of the PRM. This was a very detailed, tedious process, but very necessary in preparing the book for publication. A very large number of the RIDs discussed in this first afternoon were relatively easy to accept, given their mostly editorial nature. Only a very small number of RIDs was rejected. There were a few left in a "TBD" status that Fran will research as soon as possible. The details of the RID resolutions will not be presented in these minutes, rather, a report of the dispositions must be provided to the reviewers and to the CESC. That report will contain the details for each RID (e.g., accepted, accepted with modifications, rejected (along with rationale)). We did not complete resolving all the RIDs that had been filed, so the process was scheduled for continuation the following day given that PRM RID dispositioning is THE priority item for this meeting series (experience has shown that RID resolution is much more effective in the face-to-face setting compared to trying to do it via telecon).

DAY 2, TUESDAY 05-APR-2016

0845 0915 Admin: Agenda, Guidelines, Previous Action Items
0915 1030 Orbit Data Messages (ODM) Version 3 (Pink Book)
1030 1100 ODM/OCM potential overlaps with SMM / Vallado ephemeris proposal
1100 1245 Pointing Requests Message (PRM) RIDs Dispositioning
1245 1345 Lunch
1345 1630 Pointing Requests Message (PRM) RIDs Dispositioning
1630 1730 Meeting with Wolfgang Hell regarding CSTS-Validated Radiometric
1730 ??? CCSDS Spring Meeting Reception / Vanda Room

In attendance this day were Kyohei Akiyama, David Berry, Dale Force, Cheryl Gramling, Alain Lamy, Byoung-Sun Lee, Dalin Li, Francisco Martinez, Dan Oltrogge, Patrick Zimmerman.

0845 0915 Admin: Agenda, Guidelines, Prev Action Items

We started the day with completion of a few administrative items that had been skipped for time reasons on Monday. There was the customary agenda check, followed by discussion of the "good citizen guidelines" for the group. These guidelines were completed at Darmstadt in Fall 2015, but it is worth reviewing as part of the introductory matters. Finally, we did a final assessment of the action items assigned at Darmstadt. One was determined to be complete, one was cancelled, and eight were extended into the next set of action items.

0915 1030 Orbit Data Messages (ODM) Version 3 (Pink Book)

1030 1100 ODM/OCM potential overlaps with SMM / Vallado ephemeris proposal

Dan led the group in discussion of the very few comments he had received in review of the ODM P2.32. The discussion of the actual comments was in general fairly short, but there was discussion on a variety of matters germane to the overall OCM concept. Dan expressed his opinion that the OCM is nearing readiness for Agency Review. One particular topic was an analysis of potential message overlaps between the ODM/OCM and the SMM. Dan showed his analysis of the data content between the two messages. It appeared that there was enough distinction between the data elements in the two messages that we could

make a decision to continue with the SMM development.

There was very brief discussion of an ephemeris proposal that had been raised by Dave Vallado; this was done in a fairly incomplete manner based on the fact that it is based on a format that has apparently fallen into disuse per Cheryl Gramling. We probably owe the idea a bit more consideration in a telecon.

1100 1245 Pointing Requests Message (PRM) RIDs Dispositioning

When discussion of the ODM/OCM completed, we continued the dispositioning RIDs from the PRM Agency Review. There were several "aha!" moments during this discussion. It was in some ways rather alarming to find required data items that the WG had completely overlooked in the development of the PRM but were caught by the fresh eyes turned upon it during the Agency Review. During this discussion we had a bit of discussion about how the PRM templates would be registered with the SANA. David took an action item to request of Marc Blanchet (SANA Operator) that a candidate registry allocated (the URL suggested was <http://sanaregistry.org/r/ndmxml/prm.html>). Fran has the action item to populate the registry once it has been obtained. Fran indicated that there would be some preliminary activities prior to population of the registry given that the templates will need to be extracted from the PRM document and tested. Currently they do not exist outside the document.

1245 1345 Lunch

Normally over lunch there is not much actual business conducted, however, on this occasion we debated the merits of the various options that had been offered for the Fall 2016 meetings at Rome (feedback on this topic had been specifically requested during the Opening Plenary). David expressed a preference for the 5-day meeting series from 17-Oct-2016/21-Oct-2016 because it allows support of the SANA Steering Group and the XML SIG, which have growing importance. The 4-day meeting series from 24-Oct-2016/27-Oct-2016 does not allow this. Most WG members did not express a preference, and reported no known schedule conflicts at this time. However, Cheryl indicated that she would not be able to participate during the week 17-Oct-2016/21-Oct-2016. Accordingly, David indicated that he would assert the group's preference for the 4-day meeting series from 24-Oct-2016/27-Oct-2016. NOTE: Subsequent to this, and based on inputs from all (or at least multiple) WGs, it was reported that the CMC had unanimously selected the 5-day meeting series starting 17-Oct-2016. Upon hearing this, Cheryl indicated that she would research how her previously established plans might possibly be modified to enable her to participate in the CCSDS meetings.

1345 1630 Pointing Requests Message (PRM) RIDs Dispositioning

After lunch the WG continued dispositioning RIDs from the Agency Review of the PRM. We did not complete the effort in the afternoon, but very good progress has been made. The agenda for Wednesday was adjusted in order that we could complete the dispositioning effort.

1630 1730 Meeting with Wolfgang Hell regarding CSTS-Validated Radiometric

For the last hour of the day we were joined by two members of the Cross Support Transfer Services WG, Margherita di Giulio (chair) and Wolfgang Hell. They had prepared a presentation on the topic of the CSTS Validated Radiometric Service, an offline service utilizing a standard service they are working on. In many ways this discussion was a re-hash of discussions conducted during the TDM development. It was difficult for several of the Nav WG members to understand the merit of the offline transfer service, e.g., for a file transfer, in particular one advertised as "generic", it seems that the service would just pick up a file at a designated source and deliver it to a designated destination. There is apparently more to the service, in particular, there were several provisions that involved active use of the SANA Registry to

maintain information that is now either in the TDM itself or in bilateral agreements (aka "ICD") between exchange partners. The discussion more or less ended with an agreement to disagree. Given the various SANA re-engineering efforts currently in progress, and the recent CESG emphasis on reducing the need for ICD's, it seems likely we will need to re-address the issues associated with the CSTS Validated Radiometric Service.

DAY 3, WEDNESDAY 06-APR-2016

0845 1215 Pointing Requests Message (PRM) RIDs Dispositioning / Prototyping
1215 1330 Lunch
1330 1600 Attitude Data Messages (ADM) Version 2 Pink Book
1600 1730 Navigation Data - Definitions & Conventions Green Book Version 4 Topics

In attendance this day were Kyohei Akiyama, David Berry, Dale Force, Cheryl Gramling, Alain Lamy, Byoung-Sun Lee, Francisco Martinez, Dan Oltrogge, Patrick Zimmerman.

0845 1215 Pointing Requests Message (PRM) RIDs Dispositioning / Prototyping

The group completed dispositioning all PRM RIDs. David showed the group what needed to be done from here (i.e., substantiate to the Area Director that the Agency Review had occurred, provide evidence that the RIDs had been dispositioned and reviewers notified, Test Report, document with dispositions applied). We spent some time discussing whether the changes in the PRM post-review were of sufficient magnitude to trigger another review. All present agreed that no, the changes were primarily editorial and clarifying, and these would not trigger another Agency Review. However, there was one RID from Frank Dreger that had been rejected that could trigger a review if we had to implement it due to the far reaching changes in the templates. Fran has the action item to follow up with Frank to see if he is satisfied in the alternative solution that Fran had suggested. Afterwards we initiated discussion of what it means to prototype the PRM; it is not completely straightforward because building an instantiation is primarily a matter of downloading the applicable template, substituting the variables required for the particular request, and sending it to the intended recipient. Processing the PRM requires an application that is not part of the PRM itself; this application would have to evaluate the request against the applicable spacecraft configuration and constraints to see if the request could be accommodated or not. The WG felt that exercising the templates, exercising the definitions, and building a PRM from scratch might suffice. The recipient would read and interpret the PRM (but this is not actually processing the PRM). Determination of the suitability of the request with the spacecraft constraints is outside standard. Did the receiver get the request properly? Convert PRM to natural language. Fran took the action to propose an initial guideline for what the prototyping approach could be.

We concluded the PRM discussions with discussion of SI unit guidelines given that there were some non-SI units in the draft PRM annex discussing units. David took an action item to update the "good citizen" guidelines to include one expressing the desirability of using SI units wherever possible.

1215 1330 Lunch

Over lunch, we discussed Prototype 2 requirements. This was prompted by the fact that the CMC has determined they will reject new project proposals where Prototype 2 is not specified. Although there has been no announcement of action against existing projects that have been approved without a Prototype 2, there has been some emphasis placed on assigning Prototype 2 commitments as soon as possible; there

will have to be a CMC Poll for each project that currently has no Prototype 2 commitment once that commitment has been proposed. The Nav WG has four projects with no commitment for Prototype 2; the most immediate need is for a Prototype 2 volunteer for the PRM, given that it is quite possibly the next work to be published by the Nav WG.

1330 1600 Attitude Data Messages (ADM) Version 2 Pink Book

Alain led the group through changes he was proposing to the Attitude Data Messages (ADM). He had not distributed the document prior to the meetings, but had done some work between the time of the most recent telecon 23-Mar-2016 and the time of the meetings. He started off by stating that his plan had changed, in that he now planned to focus on modifications that seemed necessary as opposed to changing things with which he didn't necessarily agree. David noted that this was a very responsible strategy for a published international standard. If it's wrong, we need to fix it; if it's unclear, we need to clarify it; and if it's just a matter of style or opinion, we need to leave it alone. Alain still wants to do some additional editing of the document, so does not plan to send it out immediately. In comparison to Fall 2015, the changes now include some changes to the AEM (in Fall 2015 the only proposed changes were in the APM). In response to a question, he responded that he had still not yet had any suggestions from the WG regarding the SPIN parameters in the APM. So the date for a distributed ADM P1.2 will be a bit in the future.

1600 1730 Navigation Data - Definitions & Conventions Green Book Version 4 Topics

Dale showed the group the changes that had been made in the Navigation Definitions and Conventions Green Book. The changes were exclusively updates in references and removal of material that Juan Carlos Raymond had migrated from the "Navigation Data - Definitions & Conventions" Green Book (first publication of the Navigation WG years ago) into the new "Navigation Data Messages Overview" Green Book. There was some discussion of adding information on time systems and reference frames that are recommended in the various Navigation WG standards but are not yet described in the Green Book; adding brief definitions of these would be good additions. The concentration on ground tracking stations and absence of space-based tracking in the current edition was discussed, and Cheryl took an action item to draft some material to discuss space relay tracking stations.

DAY 4, THURSDAY 07-APR-2016

0845 1000 Meeting with MOIMS Area Director
1000 1130 Future Topics (FDM, RDM, LDM Concept Papers; Acceleration Message; Time Systems normative; etc.)
1130 1230 Meeting with CSSM WG regarding Events
1230 1330 Lunch
1330 1400 "Free Time"
1400 1530 Tracking Data Message (TDM) Version 2 (Pink Book)
1530 1730 Prep Closing Report, 5 Year Plan, Action Items, Set Next Telecon
1730 1730 End of Navigation WG Meeting
1930 ???? Mario's MOIMS Area Dinner

In attendance this day were Kyohei Akiyama, David Berry, Dale Force, Cheryl Gramling, Alain Lamy, Dan Oltrogge, Patrick Zimmerman. For joint meetings, we were joined by Mario Merri (MOIMS), Brigitte Behal (MOIMS), Erik Barkley (CSS-SM), Colin Haddow (CSS-SM).

0845 1000 Meeting with MOIMS Area Director

At the beginning of the day, both Mario Merri (MOIMS Area Director) and Brigitte Behal (MOIMS Deputy Area Director) arrived to both observe and participate in the discussions. To some extent this seems to have been prompted by a query from David regarding one of the WG's resolutions from the Fall 2015 meetings that had not been acted upon. Specifically, one of the Fall 2015 resolutions sought approval to enter a project in the Framework for the revision of the CCSDS 505.0-B-1 Navigation Data Messages XML Specification. The 5 Year Review performed at Darmstadt had concluded with a decision to review, primarily based upon the direction of removing the XML material on the ODM, ADM, and TDM from the NDM/XML document and migrating it into the revised documents that are currently being prepared. The rationale that it keeps us from having to issue two Blue Books each time one of these documents is revised was explained. The NDM/XML Specification document will still have viability for describing the "combined instantiation" scenario, so it will still exist, but it will be a much slimmer document. Mario and Brigitte inquired about the existence of the Prototype 2 commitment for this project; David indicated that Fran would be consulting with Frank Dreger regarding this; it is presumed that the two agencies involved will be NASA and ESA since they executed the testing on the initial Blue Book. Mario suggested that perhaps a case could be made to the CESG that prototyping would not be necessary since the updates involve removing material from the Blue Book rather than adding material.

1000 1130 Future Topics

With Mario and Brigitte still in attendance, we switched to a discussion of future topics. The current WG members have come up with many worthwhile ideas for further flight dynamics standardization, which presents a bit of a problem given that it has proven difficult to have WG members review drafts of the works already in progress. From Fall 2015, we have had three new Concept Papers: the Fragmentation Data Message (FDM) from Flohrer/Mancas, the Re-Entry Data Message (RDM) from Flohrer/Mancas, and the Launch Data Message (LDM) from Oltrogge. We started by briefly looking at the Concept Papers for the FDM and RDM (given that neither Tim nor Alexandru was able to travel to the meetings, we could not entertain detailed discussion of the topics). Being mindful of the length of time usually required for the standards development process, and knowing how much work is already in the Nav WG queue, it was suggested that Tim Flohrer prioritize which of these projects he would like to undertake at this time; an action item to this effect was assigned. Dan speculated that the FDM would be the better choice given the greater need, but the decision will be Tim's. We discussed the new requirement to have a Prototype 2 commitment at the time a project is approved, and no one could commit to the Prototype 2 responsibility. While Dan seemed like a logical choice, he indicated that he would need to think about it (the ODM/OCM is already a big commitment). David cited Jurgen's suggestion that if a Prototype 2 can be assigned to a proposal, then the WG should move forward, but if no Prototype 2 could be assigned then the WG should not start the project. We will now get the "help" of the CMC on this topic.

After the discussion of the FDM and RDM, we looked at the Concept Paper for the Launch Data Message (LDM) proposed by Dan. David stated that after reviewing the Concept Paper, he had the impression that the LDM was really outside the purview of the Nav WG. There seems to be a fairly large amount of material that is not flight dynamics related included, and would thus be outside our Charter. The concept seemed to David to be more appropriate to the Charter of the ISO TC20/SC14 WG3 (Space Operations). Dan indicated that the WG3 at the most recent ISO TC20/SC14 Plenary had only three attendees, and thus may not be able to take on the work. The discussion of the LDM ended without a firm direction/decision given that the parties for our joint meeting with CSTS had arrived.

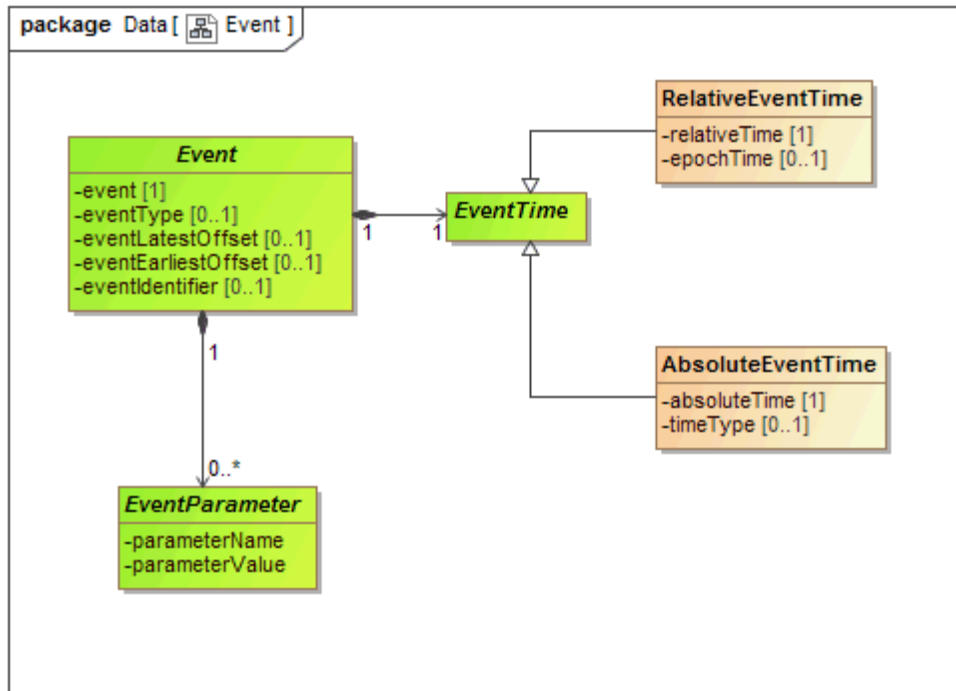
During this future topics discussion, there was a question as to the existence of a Concept Paper template. David responded that there is no template, though he has inquired about this prospect on more than one occasion. The group expressed the opinion that the lack of a template puts the onus for including all the

proper material in a Concept Paper on the proposer, and concluded that a Concept Paper template should be added to the set of templates on the CWE.

There was a question about the "Accelerations Message" topic. David indicated that Frank Budnik of ESA/ESOC had suggested an Accelerations Message based on some material in the JPL/ESA Flight Dynamics ICD. Dan indicated that this may be covered by the OCM's Acceleration History section. This would be good in that it would satisfy the ESA/ESOC need in probably a more timely fashion than would be possible if an entirely new book is created.

1130 1230 Joint Meeting with CSSM WG Regarding Events

We were joined by Colin Haddow and Erik Barkley of the Cross Support Services/Service Management WG to continue the discussion initiated at Darmstadt on "events". David noted that the event description was embedded in a document entitled "Planning Data Formats", so it was not completely obvious where one would find the event description if any other WG wished to define events. There was a fair amount of discussion of the fact that "events" pervade the space domain, and that many CCSDS WGs might desire to define events that were relevant to their particular interests. A couple of interesting ideas came out of this discussion. One idea involved the extraction of the event structure definition from the Planning Data Formats book and creating a "slim" standard containing that structure that could be utilized by any other WG to define specific events related to their Charter. Another idea related to the use of the SANA Registry to define specific events that would fit into the structure; such an idea would perhaps more easily accommodate the likelihood of a requirement to add new event definitions over time. Two specific comments on the proposed event structure presented by Colin and Erik were the addition of a way to accommodate "relative time" and time scales other than UTC in the event definition. David suggested that the existing event structure might be able to handle the time scale via the existing parameter structure. Later in the day we received an email from Colin Haddow showing how he had modified the event structure to include the relative time construct (see below).



1330 1400 "Free Time"

We had a bit of free time after lunch due to David's need to prepare some items for the "closing" section later in the afternoon. People were free to check email, etc.

1400 1530 Tracking Data Message (TDM) Version 2 (Pink Book)

Unfortunately, the discussion of the TDM had been pushed late in the week based on the need to conduct dispositioning of PRM RIDs. We were able to squeeze in a bit of discussion on the PRM. David displayed the full set of changes that were being proposed for the TDM Version 2 and the group commented. We also reviewed some comments from Dan Oltrogge and Cheryl Gramling on the P1.0.3 draft. In most cases, the comments were from members who were not involved in the original TDM development, and raised questions on the standard content that were discussed and agreed upon several years ago; it is envisioned that re-opening these discussions will require extending the TDM Version 2 schedule longer, and it is already well overdue. In counterpoint to this, Dan suggested that if we can simply accommodate additional use cases it would expand the infusion level of the TDM, possibly significantly.

Particular comments: in addition to absolute and apparent magnitudes, Dan suggested that "intrinsic" was a visual magnitude metric should be added and that "MAG" needs a phase angle added to the description ("at 0 degrees phase angle"); David took a note to refer to Frank Budnik's paper requesting transmit/receive phases to expand the description in the TDM document; we agreed that we would use ITRFyyyy/ITRFyy in the reference frame table instead of restricting to specific years or using ITRFnnnn/ITRF-nn as appears in the current draft; there was a suggestion to explore use of JSON instead of XML formats for the TDM.

In general, there was only sufficient time to discuss the TDM in very cursory fashion. David took an action item to produce a TDM P1.0.4 draft.

1530 1730 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). We completed the list of action items, target dates, and assignees (shown above in the minutes). We reviewed the Charter, and concluded that there were no necessary changes.

Document project schedules on the CWE Framework were not reviewed during the meeting; however, David indicated that he had been updating them through the week to remove the "Behind Schedule" assessments in the Framework. At the beginning of the week, there was only one of our active projects that showed "On Schedule". By the end of the week David indicated that all of the schedules would be updated. These schedules form the basis for the consolidated Five Year Plan, which we will review in telecons.

1730 1730 End of Navigation WG Meeting

After determination of the next telecon date/time, the Navigation WG meeting was concluded. The group was congratulated on a productive meeting week, adieux were bid, and we started making plans for the next meetings in Rome, Italy in October 2016.

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%2F2016%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}>

1930 ???? Mario's MOIMS Area Dinner

After the Navigation meetings formally concluded, most attendees participated in Mario's MOIMS Area Dinner at the Hofbrauhaus in Cleveland. It was a good time!

DAY 5, FRIDAY 08-APR-2016

There was no meeting of the Navigation WG this day in order to enable support of the XML Standards & Guidelines (XSG) Special Interest Group (SIG), Lead Editors' Boot Camp, and SANA Steering Group. As it turned out, the Boot Camp had been cancelled, but there was a "pop-up" meeting of the SEA System Architecture WG focusing on the MOIMS and SOIS application layer. As these various meetings each dealt with unique subject matter, the attendance is listed in the detailed notes below.

0845 1000 XML Standards & Guidelines SIG (attendance optional)
1000 1230 SEA System Architecture WG (SAWG) (attendance optional)
1230 1330 Lunch
1330 1600 SANA Steering Group (attendance optional)
1600 1730 MOIMS Closing Plenary (attendance optional)

0845 1000 XML Standards & Guidelines SIG (attendance optional)

In attendance at this meeting were Peter Shames (CESG), Nestor Peccia (CESG), David Berry (Nav), Sylvain Gully (CSTS), Ramon Krosley (SOIS).

Peter Shames led the XML Standards & Guidelines (XSG) SIG. He started by noting that the group had been struggling "for years", and that the principal issue was resources. Peter noted that he was not an expert in XML, so was dependent on those in attendance for their expertise. On the other hand, Peter has done a fair amount of research into various conventions associated for XML development, as he has demonstrated with his presentations in prior XSG SIG meetings. He stated that he "would love to have a CCSDS document" on XML guidelines, given that many WGs have or are creating XML message formats (e.g., Navigation, SM&C, SOIS, CSTS, SM); however, we don't have such a document. Peter is interested in having such a document, and polled attendees on their interest and energy in producing an XML guidelines document. He stated a desire to have a draft in 3 to 6 months. We went around the room and everyone stated their interest and energy level for such an effort. There was a familiar refrain of lack of resources for the effort, so there was no real plan. Peter based part of the argument for the need for guidelines on the fact that the CSS-SM WG wants to be able to import Nav WG schemas, which branched into a review of the problems cited by John Pietras (CSTS) when he tried to import the Nav WG schemas (OEM and OPM in particular). David showed Pietras' presentation that outlined the problems as well as suggested remediation and prioritization. Briefly the two problems were (a) use of "elementFormDefault='unqualified'" and (b) use of different types with the same name in the same namespace. David presented the NDM/XML schema structure, showed how the elementFormDefault

problem had been corrected, and stated that he had not yet been able to solve the second problem relating to duplicate types. Although the meeting had been scheduled for nearly 4 hours duration, it ended rather abruptly with no real conclusion when people started arriving for the SAWG meeting that had been added to the agenda during the week.

1000 1230 SEA System Architecture WG (SAWG)

In attendance at this meeting were Peter Shames (CESG), Nestor Peccia (CESG), David Berry (Nav), Ramon Krosley (SOIS), Roger Thompson (SM&C), Mario Merri (MOIMS), and many others (a detailed list was not available, but it was very well attended in general).

Peter Shames led this meeting, indicating that it was the result of a request from the CMC to create a CCSDS Reference Architecture; there was a first instance of this meeting series at Darmstadt in Fall 2015. While other layers of the protocol stack have been well documented, it was stated that the Application Layer was not well specified (in particular, standards from MOIMS and SOIS). Peter stated that an effort is in progress that will specify the Application Layer in two phases: (a) "Quick & Dirty Cartoons" and (b) formal documents. The "Quick & Dirty Cartoons" will essentially be a Powerpoint approach that will provide material that will be more formally elaborated in CCSDS documents. It was stated that the SAWG is presently in the middle of the "Quick & Dirty Cartoons" effort. The architecture specification will define several views: Service View, Functional View, Protocol View, and Information View. One of the diagrams presented was based on the Nav WG functional diagram that had been planned for inclusion in the Navigation Data Messages Overview Green Book (see below), but was ultimately excluded because there was a feeling it was not "correct". No action items were assigned to Navigation, at least not yet, though David did make a note to send the most recent Navigation WG Technical Program chart to Roger Thompson, the MOIMS representative to the process, because it appeared that he may have started with an older generation of the drawing.

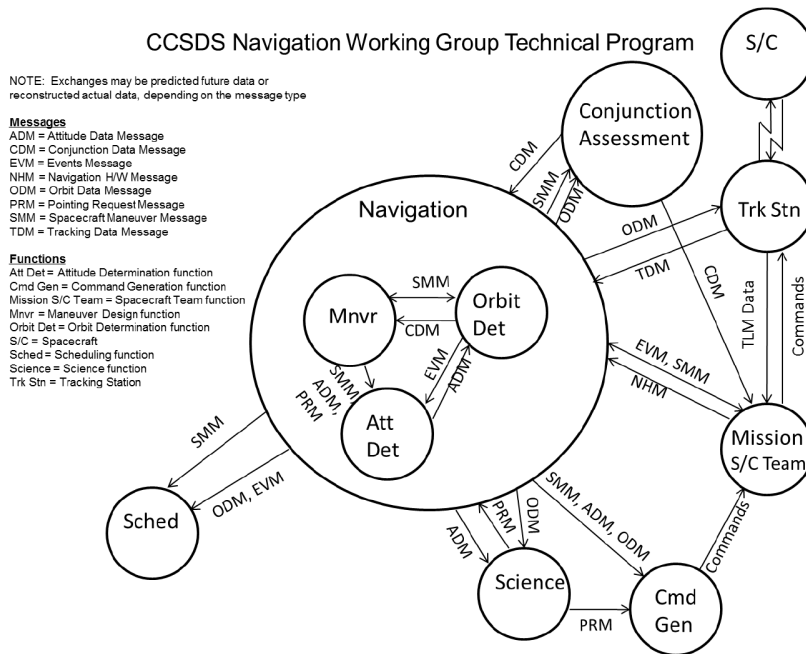


Figure 4-1: Example of NDM Exchange and Direction of the Information Flow in a Mission Operations Environment

1330 1600 SANA Steering Group (attendance optional)

In attendance at this meeting were Peter Shames (CESG), Nestor Peccia (CESG), Marc Blanchet (SANA), Audric Schildknecht (SANA), Howie Weiss (Security), Tom Gannett (Secretariat), Osvaldo Peinado (SIS), David Berry (Nav).

The meeting was chaired by Peter Shames, who had a number of agenda items. First up was Marc Blanchet with the SANA Operator's Report. Marc's report noted that a number of registries had been updated; discussed work from the SANA Registry Management Policy (RMP, CCSDS 313.1-Y-1) currently pending approval by the CMC; mentioned a SpaceOps paper on the SANA that will be presented in May. It was also reported that the CCSDS URN had finally been approved (though in some senses this was a bit of old news). Peter provided a status of progress on the RMP (currently satisfying conditions from the CESG review), and highlighted some feedback that had been received from various WGs. The RMP will introduce a rather far-reaching re-engineering effort by the SANA Operator. David's request to modify the format of the names in the "Contacts" registry so it could be sorted more meaningfully was seen as not particularly compelling. A major effort within the SANA Registry is the reclamation of spacecraft ID's (SCIDs), a topic that does not affect the Navigation WG in general. The final topic of this meeting dealt with a proposal from David to remove the UTC Offsets registry. The specific problem of this registry is that it contains the offsets between UTC and atomic time (Temps Atomique International, or TAI). For systems that use UTC as the time scale (such as the Deep Space Network), it is essential to have an accurate record of the addition/subtraction of leap seconds, and the related offset between UTC and TAI. It was surprising that this information was in the SANA, and was found to be incorrect. Since it was not being updated, and there is a normative source, it was proposed to remove the registry. The registry of UTC Offsets had been requested by Adrian Hooke, so Marc was reluctant to remove it. The SANA Steering Group (i.e., those present) were polled and there was no opposition to removing the registry.

1600 1730 MOIMS Closing Plenary

In attendance at this meeting were Nestor Peccia (CESG), David Berry (Nav), Dan Smith (SM&C), Mehran Sarkarati (MPS), Steve Chien (MPS), Brigitte Behal (MOIMS), Mario Merri (MOIMS), and 3 others (probably from SM&C or MPS).

The reports of the Mission Planning & Scheduling (MPS), Spacecraft Monitor & Control (SM&C), and Navigation WGs were presented; the DAI and Telerobotics WGs did not meet during this meeting series. First David presented for Navigation; the report is shown immediately below. A couple of action items were received: (1) David will need to complete the determination of which agencies will perform Prototype #2 for four Nav WG standards, and convey them to Mario; and (2) David will need to enter a draft project into the Framework for the XML 5 Year Revision. These were added to the Nav WG Action Items list (shown at the beginning of these minutes). On the topic of the Resolution relating to Security boilerplate being added to the Blue/Magenta Book templates, David felt that perhaps it should not appear given that not all books are using this same approach, so there may not be as much boilerplate as David assumed. Mario felt that it was still valuable to put the resolution forth.

During the Plenary there was some interest expressed by Mehran Sarkarati (MPS) in the SMM. David explained the strategy we had been discussing for the SMM, i.e., starting with the MPM and publishing that, while working on the more detailed specifications in the MDM and MAM. David stated his opinion that MPS would probably be most interested in the MDM since it has been envisioned as having information such as activity by individual thruster and other more detailed maneuver parameters that would be necessary for the generation of spacecraft commands.

MOIMS CLOSING PLENARY / NAVIGATION WORKING GROUP REPORT

Navigation (NAV) Working Group: Document Status

- Pointing Requests Message (PRM)
 - Completed dispositioning of 90 RIDs from Agency Review (mostly editorial, a few outstanding TBDs, but not many)
 - Initiated discussion of prototyping responsibilities and methodology
- Orbit Data Messages (ODM)
 - Completed review of WG member comments on ODM P2.32
 - Initiated ODM Pink Book P2.33 based on meeting discussions
- Attitude Data Messages (ADM)
 - Initiated review of ADM P1.2 containing 5 Year Revisions to the ADM
- Navigation Data – Definitions & Conventions Green Book
 - Minimal discussion, few changes to date in current update process
- Navigation Data Messages / XML Specification
 - Completed discussion of document revision strategy with MOIMS Area Director; discussed addition of revision project
- Events Message (EVM)
 - Continued discussion with Service Mgmt WG of an event structure potentially pertinent to a Navigation Events Message
 - Initiated discussion of potential use of SANA for event catalog
- Tracking Data Message (TDM)
 - Completed review and brief discussion of changes to date
 - Initiated discussion of further changes based on internal review
- Spacecraft Maneuver Messages (SMM)
 - Initiated discussion of potential overlaps between SMM and ODM/OCM; way forward is yet TBD
 - Minimal discussion given new Lead Editor and insufficient time to prepare new draft (SMM had been removed from the agenda)
- Navigation Hardware Message (NHM)
 - No discussion this meeting series in absence of Lead Editor

Cross-Area Meetings & Technical Issues

- ISO TC20/SC14 representative was present all week
- Completed joint meeting with SM WG on Events Message topics
- Completed joint meeting with CSTS WG on the “Validated Radiometric Service” topic
- Supported XSG SIG, SAWG, and SANA SG meetings (thanks to 5 day meeting)

Administration

- Continued discussion of Navigation Data Message Consistency
- WG Charter: Reviewed charter, no changes made
- Document Schedules: Updated “behind schedule” document schedules
- Project Resources in Framework: No changes... no edit ability
- Navigation Working Group 5 Year Plan: Will address via telecon
- Attendance: Representatives from CNES, ESA/GMV, ETRI, JAXA, NASA, NSSC/CAS, ISO TC20/SC14 participated in the meetings; from 9 to 11 participants each day

Issues

- We have many books in progress; consequently it is difficult to get detailed commentary on new drafts. We are still recovering from the 2.5 year “laser focus” on the CDM that caused significant delays to occur in other work.
- Group is still generating ideas for future standardization at a lively pace; which is frustrating given slow progress on existing items.
- New Lead Editor was unable to attend Boot Camp due to its cancellation

Overall Assessment

- Made satisfactory progress catching up on items delayed by intensive work on CDM (PRM, ODM, ADM)
- Little progress on TDM, Green Book, EVM
- No progress on NHM, SMM
- OVERALL STATUS of the WG is "OK"

Requested Feedback Items

- Feedback on Fall 2016 meetings
 - Option 24-Oct-2016 through 27-Oct-2016 (4 days): #1 choice
 - Option 17-Oct-2016 through 21-Oct-2016 (5 days): #2 choice

Unsolicited Feedback Items

- Facilities
 - Opening Plenary activities (CCSDS and MOIMS) took until nearly noon... we should strive to keep this short and as meaningful as possible
 - We got lucky with the meeting room! It was spacious, had a great view, AND a private restroom. For security, it was nice to have a room key.
 - Meeting room materials (access to power, projection capability, light control) were excellent
 - Wireless connectivity was very good... no reported problems

RESOLUTIONS Issued

- Resolution 1: The Navigation WG requests approval to add to the Framework a project to update the Navigation Data Messages XML Specification (5 Year Revisions)
- Resolution 2: The Navigation WG proposes that the “boilerplate text” Security section of Blue/Magenta books be added to the Blue/Magenta Book templates
- Resolution 3: The Navigation WG proposes that a “Concept Paper Template” be added to the document templates on the CESG CWE site
- Resolution 4: The Navigation WG expresses appreciation to NASA and the staff of the Westin Cleveland for their excellent support of these meetings.

NAVIGATION STANDARDS 5 YEAR PLAN

Given the amount of time necessarily allocated to resolution of PRM RIDs, there was insufficient time to update the 5 Year Plan. We will address this plan in monthly telecons starting in May 2016.

NEXT TELECON:

The WG established Wednesday 11-May-2016 @ 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, and possibly the initiation of a review of the Nav WG 5 Year Plan.