

MINUTES OF NAVIGATION WORKING GROUP SPRING 2025 WORKSHOP 06-Jul-2025

David S. Berry / Chair

The CCSDS Spring 2025 Navigation Working Group (NavWG) Meetings were conducted at the Johns Hopkins University Applied Physics Laboratory (JHU/APL), Laurel, Maryland, USA, from 09-Jun-2025 through 13-Jun-2025. Both in-person and virtual attendance were supported for these meetings. NASA hosted the event, which was conducted in several meeting rooms around the JHU/APL campus. This is a summary of the activities of the NavWG during the Meetings. The Navigation WG is an element of the Mission Operations and Information Management Services (MOIMS) Area in the CCSDS organization.

Base Link for NavWG Spring 2025 Materials:

<https://spacecomm.sharepoint.com/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/> . Specific file names are listed below in the minutes.

ON-SITE NAV WG PARTICIPANTS

David Berry (NASA/JPL), Julien Bernard (SANA), Juan Crenshaw (NASA/GSFC), Cheryl Gramling (NASA/GSFC), Julie Halverson (NASA/GSFC), Jose Miguel Lozano (GMV/ESA/ESOC), Dan Oltrogge (NASA (COMSPOC, ISO TC20/SC14)), Dianne Poster (NASA (NIST/NOAA)), Rob Wolff (NOAA), Patrick Zimmerman (NASA/JSC).

VIRTUAL/TELECON NAV WG PARTICIPANTS

Vitali Braun (ESA/ESOC), Frank Dreger (ESA/ESOC), Ralph Kahle (DLR) Kiyoshi Hamada (JAXA), Alain Lamy (CNES), Brian Swinburne (Airbus, UKSA).

OTHER PARTICIPANTS

Daniel Fischer (ESA), Clemens Heese (ESA), Eric Pitts (NASA), Mehran Sarkarati (ESA).

AGENDA

The final agenda for the WG meetings is available on the NavWG Spring 2025 CWE in file navwg-agenda-spring-202506.pdf. In the meeting proceedings below, the detailed agenda for each meeting day (approximately as realized) is included in the minutes to provide context.

CURRENT ACTION ITEMS

The following action items were either produced during the meetings or carried forward from previous meetings if they had not yet been completed. The action items and due dates below reflect the status as of the date of preparation of these minutes; the list on the NavWG Spring 2025 CWE will be updated periodically between the end of this meeting series and the beginning of the next meeting series. The list on the NavWG Spring 2025 CWE will thus reflect relative completion progress and any new action items added after the meeting series, available on the NavWG Spring 2025 CWE at <https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/navwg-action-items-202506.pdf?csf=1&web=1> .

New Action/Outstanding Action Items

If "Status" = "Open", then "Date" = "Target Date"

If "Status" = "Complete", then "Date" = "Completion Date"

If "Status" = "Cancelled", then "Date" = "Cancellation Date"
Sort is by "Status" (Descending), "Date" (Ascending), "##" (Ascending)

##	Action Item	Category	Actionee	Status	Due Date (Original)	Date
27	Send CDM Test Plan and CDM Word version to Alinda Mashiku, NASA/CARA	CDM	Brian	Open	20-Jun-2025	20-Jun-2025
29	Design test of dual relative metadata concept and add to test plan	CDM	Brian	Open	20-Jun-2025	20-Jun-2025
30	Send updated test plan to all WG members	CDM	Brian	Open	20-Jun-2025	20-Jun-2025
38	Propose editorial correction to fix contradiction discovered in OCM related to default values in optional keywords	ODM	David	Open	20-Jun-2025	20-June-2025
57	Vote regarding the meeting schedule between Spring 2025 and Fall 2025 Meetings (see Spring 2025 minutes at the end).	Nav WG	ALL	Open	23-Jun-2025	23-Jun-2025
00	Research "master" XML schema conversions to JSON	NEM	David	Open	30-Jun-2024	27-Jun-2025
11	Update CDM schemas for CDM 2.0 (P-1.2) (#50, #12 are dependent)	CDM	David	Open	20-Nov-2022	27-Jun-2025
35	Query the history of USLP document as potential exemplar for resolution of NCM concept issues	NCM	David	Open	27-Jun-2025	27-Jun-2025
50	Create XML schema 4.0.A Test Set (depends on #11)	CDM	David	Open	14-May-2023	27-Jun-2025
12	Update CDM style sheet for CDM 2.0 (depends on #11)	CDM	David	Open	04-Dec-2022	30-Jun-2025
20	Review UDL and identify any "useful" data types missing from the TDM 2.0.3.	TDM	Jose Miguel	Open	30-Jun-2025	30-Jun-2025
53	Decision from OSC/TraCSS regarding CDM direction (2nd Metadata section for "With respect to" Object1 or Object 2	CDM	Wolff, Baumann, Starzyk	Open	30-Jun-2025	30-Jun-2025
86	Discuss Blue Book PDF names with CCSDS Tech Support (e.g., ...e2c2.pdf)	Web	David	Open	03-May-2024	30-Jun-2025
91	Review NavWG registry "Provisional" assignments and request change to "Assigned", as applicable.	SANA	David	Open	31-May-2024	30-Jun-2025
05	Prepare NEM White Book 1	NEM	Alain / Frank	Open	12-Jun-2024	01-Jul-2025
06	Provide multiple references for NDMXML schemas on SANA (505+50x as applicable... do with	NDM/XML	David	Open	31-Aug-2024	01-Jul-2025

##	Action Item	Category	Actionee	Status	Due Date (Original)	Date
	NDM/XML 4)					
52	Prepare Navigation Events Message White Book 1.0	NEM	Alain / Frank	Open	01-Jul-2025	01-Jul-2025
60	Prepare new project for update of Navigation Data Definitions & Conventions	NDDC	David	Open	31-Dec-2023	09-Jul-2025
19	Write up Objectives and a Use Case Justification for CCSDS Navigation Working Group to develop a new GNSS Standard.	General	Dianne	Open	15-Dec-2024	15-Jul-2025
74	Prepare Navigation references for SANA Registry (#96 is dependent)	SANA	David	Open	31-Oct-2018	15-Jul-2025
09	Produce TDM P-2.0.3 draft	TDM	Juan	Open	15-Jan-2025	18-Jul-2025
21	Distribute TDM P-2.0.3	TDM	Juan	Open	21-Jul-2025	21-Jul-2025
22	Prepare Proofreading Review Assignments	TDM	David	Open	24-Jul-2025	24-Jul-2025
34	Confirm TDM's Delta-DOR implementation	TDM	Kiyoshi	Open	31-Jul-2025	31-Jul-2025
39	Discuss NavSol for GNSS data in TraCSS	ODM	Dan/Dianne	Open	31-Jul-2025	31-Jul-2025
96	SANA implementation of Nav References (depends on #74)	SANA	SANA	Open	31-Jan-2019	31-Jul-2025
23	Perform TDM P-2.0.3 Proofreading Review	TDM	All, as assigned	Open	31-Aug-2025	31-Aug-2025
26	Update to UNOOSA Compendium of Space Debris Standards https://www.unoosa.org/oosa/de/ourwork/topics/space-debris/compendium.html	General	Dan/David	Open	31-Aug-2025	31-Aug-2025
36	Check all SANA Links to References (depends on #96)	SANA	David	Open	15-Jun-2023	31-Aug-2025
48	Create CDM P-1.4	CDM	Brian	Open	31-Aug-2025	31-Aug-2025
43	Determine TraCSS Contact info for SANA Organizations Page	SANA	Dianne	Open	01-Sep-2025	01-Sep-2025
28	Rob/Dan work on LDM	LDM	Dan/Rob	Open	12-Sep-2025	12-Sep-2025
31	Add telephone contact # and email for TraCSS on "Organizations" registry.	SANA	SANA	Open	15-Sep-2025	15-Sep-2025
32	Confirm relative reference frames language (what contribution? Coriolis? WxR)	David	David	Open	15-Sep-2025	15-Sep-2025
33	Review NavWG SANA registries with respect to Policy = "WG Chair" and Authority = "CCSDS.MOIMS.NAV"	SANA	David	Open	15-Sep-2025	15-Sep-2025
41	Develop UNOOSA brochures for Nav WG	SANA	Dan/David	Open	15-Sep-2025	15-Sep-2025

##	Action Item	Category	Actionee	Status	Due Date (Original)	Date
42	Select GNSS orbital elements for SANA	SANA	Dan/Jose Miguel	Open	15-Sep-2025	15-Sep-2025
44	Remove specific CDM version # from NTW_Rotating & RSW_INERTIAL frames	SANA	David	Open	15-Sep-2025	15-Sep-2025
45	Send "canned" query to Julie	SANA	David	Open	15-Sep-2025	15-Sep-2025
46	Info regarding Felix Hoots new element set	SANA	Cheryl	Open	15-Sep-2025	15-Sep-2025
47	Check whether still in possession of ADM V.2 XML tests	NDM/XML	Jose Miguel	Open	15-Sep-2025	15-Sep-2025
49	Solve problem of linkage of JSON schema to instantiation	NDM/XML NDM/JSON	David	Open	15-Sep-2025	15-Sep-2025
54	Change all SANA "Terms" entries attributed to "[ccsds-500.0-G-n]" to "[ccsds-NavWG]"	SANA	SANA	Open	15-Sep-2025	15-Sep-2025
56	Identify some "longer" message examples to post on the SANA	SANA	Juan	Open	15-Sep-2025	15-Sep-2025
24	Prepare TDM P-2.0.4 Draft (post-proofread)	TDM	Juan	Open	26-Sep-2025	26-Sep-2025
25	Submit TDM P-2.0.4 to MOIMS AD	TDM	David	Open	29-Sep-2025	29-Sep-2025
02	Prepare LDM White Book 1	LDM	Dan	Open	12-Jun-2024	31-Dec-2025
16	Request deletion of "Conjunction Data Message Catalog Name" registry (post-CDM 2.0 publication)	SANA	David	Open	18-Jan-2023	31-Dec-2025
37	Experiment with develop in XML, translate to JSON and vice versa	NCM	David	Open	31-Dec-2025	31-Dec-2025
40	UNOOSA brochures on SANA	SANA	Dan/Julian	Open	31-Dec-2025	31-Dec-2025
51	Arrange for floating point number and other data type changes in other documents after CDM V.2 is Blue.	"All"	David	Open	31-Jan-2024	31-Dec-2025
55	Transform "Navigation Data - Definitions & Conventions" to a SANA application	SANA	Julie	Open	30-Apr-2026	30-Apr-2026
81	Prepare Corrigendum for Green Book	NDDC	David	Cancelled / Obsolete	10-Apr-2024	13-Jun-2025
94	Library of referenced papers on CWE	CWE	David	Cancelled / Obsolete	10-May-2021	13-Jun-2025
58	Next available action item number	N/A	N/A	AAAAA	15-Sep-2035	15-Sep-2035

WORKSHOP PROCEEDINGS

MONDAY 09-Jun-2025

0800 0845 Registration

0845 1215 CCSDS Opening Plenary, Room Migration

1215 1300 NavWG Meeting: Intro to Nav WG, Agenda, Action Items, Doc Status, etc.

1300 1400 Lunch
1400 1715 Conjunction Data Message (CDM) Version 2 Issues

0845-1215: CCSDS Opening Plenary / Area Director Presentations / Logistics

Sami Asmar, Ed Birrane (APL), Steve Krein (APL), and Janice Starzyk (NOAA Office of Space Commerce) opened the meeting series with brief remarks.

Mr. Krein offered us a bit of the history and heritage of APL (main clients are Defense and NASA (#2 contractor to NASA)). APL is a UARC (University Affiliated Research Center) that is known for its technical expertise. Many space missions have been flown (or will be flown) by APL, including New Horizons, Parker Solar Probe, Clipper, IMAP (launching 2025), Dragonfly (launching 2028), and others...

Following Mr. Krein, Janice Starzyk, the Acting Director of the Department of Commerce, Office of Space Commerce (OSC) discussed growth in space and the partnerships of government and industry. She described Space Situational Awareness (SSA) as essential. She noted a reliance on CCSDS for standards related to SSA, specifically, for use by the TraCSS system (Traffic Coordination System for Space) which will provide data and alerts to keep space safe. In May 2025 Program Element 1.2 was released to beta users. TraCSS uses an agile development process. She noted that TraCSS is interfacing with the CCSDS Navigation Working Group. She stated that this collaboration is appreciated and will grow. Future activities include exploring SSA data sharing. The data policy is available on the TraCSS website and in other formats. Finally, she indicated that TraCSS is also working closely with EUSST, the European Union Space Surveillance and Tracking organization.

Sami Asmar, General Secretary of the CCSDS, followed Ms. Starzyk. He explained the scheduling quandaries that had faced CCSDS which resulted in conducting Spring Meetings in June and Fall Meetings in September. From a Working Group perspective, it is not clear how much actual progress will be made between the 2025 Spring and Fall Meeting series.

The next two speakers focused on NASA "Moon to Mars" topics. Cheryl Gramling (a member of the Nav WG) spoke regarding the need for Lunar standards, and not just CCSDS standards. She mentioned standards formulated by the ISECG (International Space Exploration Coordination Group) and various PNT systems from ESA, NASA, China, Japan, ISRO, and the ICG/IOAG Cislunar Workshop. She described LunaNet as a framework for standards based interoperable communications, PNT, and alert services that is not limited to CCSDS standards.

Jim Schier followed Cheryl and indicated his focus on Mars and standards for Mars exploration, while acknowledging budget issues. With aging assets at Mars (e.g., MRO, Odyssey, MAVEN), the budget situation is not promising. He described an ambitious vision for a Mars Net and expressed desire to maximize the commonality of Lunar and Mars solutions.

Daniel Fischer, Director of CESG, followed. He described a need for Cislunar PNT standards. Of more interest to the general CCSDS Working Group member, he noted that the Fall Meetings would be conducted at the Technical University of Hamburg (TUHH). On personnel matters, he noted that Ignacio would be retiring. The six Area Directors then previewed the works in progress in their respective WGs and also their plans for the week: Jim Lux, Mehran Sarkarati, Erik Barkley, Simon Singh, Ignacio Sanchez, and Vinny Ristovski (representing Tomaso de Cola).

Information on other future meetings that was formerly provided was yet again not provided, with the

exception of the next meeting series (Fall 2025). Other information below is based on the canonical meeting hosting schedule (NASA, ESA, NASA, a smaller CCSDS agency):

- a) Fall 2025 hosted by ESA at Technical University of Hamburg, Germany, 15-Sep-2025 - 19-Sep-2025
- b) Spring 2026 hosted by NASA at TBD, dates TBD
- c) Fall 2026 hosted by TBD at TBD, dates TBD
- d) Spring 2027 hosted by NASA at TBD, dates TBD
- e) Fall 2027 hosted by ESA at TBD, dates TBD
- f) Spring 2028 hosted by NASA at TBD, dates TBD

1200-1210: MOIMS Opening Plenary

There was no appreciable MOIMS Plenary given the length of the Full Plenary. Instead, Mehran briefly gathered the MOIMS Area WG Chairs and Deputy Chairs together discuss plans for the MOIMS Dinner (to be scheduled Thursday 12-Jun-2025).

1210-1315: Navigation WG Meeting Introductory Matters

Attendance this day included: David Berry, Juan Crenshaw, Frank Dreger, Cheryl Gramling, Julie Halverson, Kiyoshi Hamada, Jose Miguel Lozano, Dan Oltrogge, Dianne Poster, Brian Swinburne, Rob Wolff, Patrick Zimmerman. We also had Daniel Fischer, Clemens Heese, and Mehran Sarkarati visiting for some of the discussion.

After getting settled in the conference room, David presented the "Introduction to the Navigation WG" material. As part of the Intro we conducted an around the room "face-to-face" introduction since we had new participants, and not everyone had been able to attend at London. We had another new member from the TraCSS team (Rob Wolff, Lead Flight Dynamics Engineer of the US Department of Commerce, Office of Space Commerce (DOC/OSC)). The presentation was distributed to the WG mailing list, and also uploaded to the NavWG Spring 2025 CWE at <https://spacecomm.sharepoint.com/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/navwg-intro-202506.pdfnavwg-intro-202506.pdf>. We did not review Action Items at this time, given the late start; we broke for a late lunch...

1415-1730: Conjunction Data Message

Note that Daniel Fischer, Clemens Heese, and Mehran Sarkarati, the CESG management and our Area Director, joined us for this important discussion. Brian briefly recapped the material he wanted to discuss: the current status up to version P-1.2 and the CDM Test Plan. That was, as he put it, "pretty much it". David noted that in the 4 tests in the Test Plan, tests #1 and #4 have been previously assigned. We discussed the TraCSS issues with keyword re-ordering, new keywords, etc. Brian provided an overview of the proposed solution to include the two relative metadata sections, one for each spacecraft with respect to the other. Dan stated that he has discussed this proposed solution with the TraCSS Team; he also suggested that CCSDS might consider an "encoding/decoding task force" that would address such topics strategically. David indicated that this might be a good longer term proposal, but we need to decide "immediately" what we do now with the CDM issues raised by the TraCSS implementation. One option is annexes for format variants such as the SAT1/SAT2 keyword prefixes that TraCSS wants to use. Rob queried if the SAT1/SAT2 prefixes could be optional? David indicated that these prefixes are not part of the standard implementation. They complicate the Agency required testing. Subsequently Brian showed the P-1.3 solution with the two Relative Metadata/Data Sections. David indicated that because it does not introduce any new keywords or items to calculate, it doesn't represent "technical changes" that would trigger an additional agency review. David also explained that he still needs to solve the problem of linking a JSON schema to a JSON

instantiation before we can support a JSON version of the standard. Brian will send P-1.3 to Rob Wolff, Ethan Baumann, and Janice Starzyk. An action item has been created for their decision with respect to the dual metadata section concept. There was an inquiry from the WG as to whether or not the CDM is part of NCM(?). David suggested that we need to decide the current question regarding the CDM V.2 first, and complete the CDM V.2. We can then determine how the CDM fits into the NCM concept. We could also propose a CDM V.3 while still working on the CDM V.2; this approach was proposed and accepted for the TDM V.2 and TDM V.3... we were still completing the TDM V.2 when we proposed, and were approved for, the TDM V.3. Cheryl collected TDM V.3 ideas for a few years until we could get started on the production of TDM V.3. There was also an idea to produce a Magenta Book that would cover the XML=>JSON conversion idea.

During a discussion of resolving RIDs, Brian inquired about what we had to send to RID submitters. David briefly described the artifacts that are necessary for us to provide to the Secretariat to earn approval to publish (Item 2 below covers Brian's question):

1. Evidence that an Agency Review was performed;
2. RID dispositions from the Agency Review and evidence that the dispositions were communicated to the reviewer;
3. The report of prototype testing;
4. The report of changes since the prior version of the Blue Book was published;
5. The prospective "Transition to Blue" version of the document (either Red or Pink Book).

Brian's CDM P-1.3 draft proposal is on the CWE at https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/508x0p13_CDM-PROPOSAL-DRAFT-20250610.pdf?csf=1&web=1

TUESDAY 10-Jun-2025

0845 1235 CDM TraCSS Issues, CDM Test Plan/Report, Any Open Items

1235 1335 Lunch

1330 1730 Tracking Data Message Issues & Discussion

Attendance this day included: David Berry, Vitali Braun, Juan Crenshaw, Frank Dreger, Cheryl Gramling, Julie Halverson, Kiyoshi Hamada, Ralph Kahle, Alain Lamy, Jose Miguel Lozano, Dan Oltrogge, Dianne Poster, Brian Swinburne, Rob Wolff, Patrick Zimmerman.

0845 1235: Conjunction Data Message - CDM TraCSS Issues, CDM Test Plan/Report, Open Items

We continued discussion of CDM V.2 test cases. The ultimate assignment of cases is:

Test 1: CNES/JSC

Test 2: DLR/ESA/ESOC

Test 3: TraCSS/CARA

Test 4: NASA/JPL (David to convert messages=>XML, test against schema)

Test 5: We need to add some kind of test for the second relative metadata section, if TraCSS decides to use this solution. (Note: If TraCSS decides to NOT use this version, then there is no need to perturb CDM V.2 and we can add this to a CDM V.3 list). Rob also indicated 5 different versions of TraCSS messages... CCSDS-compliant KVN and XML, Space-Track JSON, TraCSS JSON, and CSV.

Vitali pointed out that some critiques of the CDM had been provided by ESA. The WG members reviewed

the set of critiques and adopted those considered applicable. Some discrepancies noted: inconsistent use of "N/A" (which will be deprecated in the future) and inconsistencies in certain values.

By the end of the morning, all CDM matters were wrapped up (though we still need a decision regarding the TraCSS direction with respect to the second Relative Metadata/Data Section... Action Item to Rob Wolff and Ethan Baumann). All tests in the Test Plan were assigned, with the exception of the proposed Test 5 (for a second Relative Metadata/Data Section).

1235 1345: Tracking Data Message - Issues & Discussion

After lunch, we turned our attention to the TDM. Juan started by showing the objectives for Post-Fall 2024, and reporting on the degree of satisfaction/completion, which was quite high. He also outlined the changes to the document from version 2.0.2 to 2.0.3 and showed the closure of comments on P-2.0.2. There was one item that needed confirmation of completion, specifically, Kiyoshi was to check with Hiroshi Takeuchi regarding some of the requested changes to TDM for processing of Delta-DOR data.

A potential new source of TDM data types arose in discussion of the "UDL" (the Unified Data Library, which supports the Space Force's space domain awareness mission and other areas, including command and control). Jose Miguel received an action to review the data library and identify any "useful" data types that are missing from the TDM. At the conclusion of the discussion, there seemed to be some confidence that Juan may be in sight of completing the TDM updates. David suggested doing a proofreading review of the P-2.0.3 Pink Book, producing a 2.0.4 with the editorial updates, and requesting an Agency Review as soon as it is feasible. Action items were scheduled with this plan in mind.

Juan's presentation material is available on the NavWG Spring 2025 CWE at https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/TDM-v2.03-Overview-CCSDS-Spring-2025_Share.pdf?csf=1&web=1.

WEDNESDAY 11-Jun-2025

0845 0945 Navigation Data Definitions & Conventions
0945 1100 NCM Concept Paper "Read Through"
1100 1140 TDM "STEC" Data Type Discussion
1100 1230 FDM/LDM wrt NCM Concept
1230 1330 Lunch
1330 1500 LDM/FDM wrt NCM Concept
1500 1700 Orbit Data Messages/OCM Issue
1700 1730 Free

Attendance this day included: David Berry, Vitali Braun, Juan Crenshaw, Frank Dreger, Cheryl Gramling, Julie Halverson, Kiyoshi Hamada, Alain Lamy, Jose Miguel Lozano, Dan Oltrogge, Eric Pitts, Dianne Poster, Brian Swinburne, Patrick Zimmerman.

0845-0930: Navigation Data Definitions & Conventions Green Book Reformatting

Julie provided a quick overview of progress on her effort to "re-imagine" the Green Book as a SANA representation. Even though this was a short session, it inspired several questions for the meeting with Julien Bernard (SANA) the next day (e.g., is there a way to link to SANA terms and invoke a filter at the

same time? Can the references in the Glossary be sorted in numerical order? Can we generate a document (e.g., a "pseudo-Green Book") directly from material in a SANA registry?)

0945-1140 NCM Concept Paper "Read Through"

Next, David read aloud the NCM Concept Paper in order to provide everyone a common baseline for discussions of the Navigation Composite Message (NCM) that were scheduled next. This inspired a few questions, and obviously a few things have changed since the Concept Paper was submitted (along with the proposal for a project to realize it). David commented as necessary.

David noted that it may be difficult to create the NCM standard but noted a possible parallel in the USLP (Unified Space Link Protocol) that was first published in 2018 and is still in use. There was some resistance in CCSDS to accept the new protocol because it represented a change in standard protocol use (David has action item to find out more about this). For reference, the NCM Concept Paper (from Spring 2024) is on the CWE at <https://spacecomm.sharepoint.com/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Draft%20Documents/Concept%20Papers/NCM/navigation-composite-message-concept-paper-changesaccepted-20240522.pdf>.

1100 1140 TDM "STEC" Data Type Discussion

Immediately following the NCM "read through", Kiyoshi inquired if he could ask a question about the TDM, specifically, regarding the STEC data type (Slant Total Electron Count, i.e., the total number of free electrons along a slant path through the ionosphere). Specifically, there was a question as to whether or not the PATH statement is necessary in a TDM section that has STEC data. Since "path" is part of the definition "slant path through the ionosphere", there is an implied need for the PATH statement. However, there are cases when it is not necessary (e.g., when there is no specific spacecraft signal involved, as in a GPS ground receiver at a tracking station).

1100 1230 FDM/LDM wrt NCM Concept

1330 1440 LDM/FDM wrt NCM Concept

After Kiyoshi's question, we returned to discussion of realizing the NCM concept. Per Dan, the FDM and LDM have been "treading water" waiting for more direction regarding the NCM. So Dan (LDM) and Vitali (FDM) commenced working together to start fleshing out the concept. Dan and Vitali presented a detailed description of an NCM first draft White Book that covered the basics of a Nav WG standard, provided a structural skeleton, addressed a number of issues and also raised a number of questions as to how the work would evolve, e.g., is the NCM:

- Existing standards plus addenda?
- Backwards compatible? If so, how to accomplish?
- Do the "old" documents die? or carry on?
- Does the NCM replace prior docs? or is it "mix & match"?
- Do we draw blocks from existing documents? or have an annex for each type?
- XML? JSON? Develop in XML and convert to JSON? or vice versa?

Clearly some of these ideas are content-focused, others format-focused, and some are compatibility-focused. It is clear that configuration management becomes key in these scenarios.

David stated that he appreciated the efforts of Dan and Vitali to give the working group a solid foundation towards realizing the NCM concept; it was an exciting discussion. The draft material presented by Dan and

Vitali is on the CWE at [https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Draft%20Documents/Navigation%20Composite%20Message%20\(NCM\)/navigation-composite-message-concept-paper-final-20240522.pdf?csf=1&web=1](https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Draft%20Documents/Navigation%20Composite%20Message%20(NCM)/navigation-composite-message-concept-paper-final-20240522.pdf?csf=1&web=1) .

1500 1700 Orbit Data Messages/OCM Issue

After a short break, we resumed discussions with another TraCSS based question. Dan queried Rob Wolff about the TraCSS desire for GNSS data in the OCM. Dan inquired whether NavSol would be sufficient to provide this (recall that NavSol was discussed at the Fall 2024 London meetings). Rob suggested that this was an issue for the TraCSS Standards Working Group. Dan and Dianne have an action item to discuss this issue with respect to the NavWG; there is not much desire at this time to create a new GNSS Standard, so it is hoped that NavSol will meet the TraCSS requirements.

Dan also brought up a contradiction that was discovered in the OCM related to default values and optional keywords. There were statements in the OCM that stated contradictory options, so obviously one is not correct. David suggested that we should try to fast track the correction as an editorial error rather than a Corrigendum, which requires CESC and CMC Polls (i.e., at least a month, and probably much longer) to get a decision. David will address with the Secretariat. (See Dan's email 15-May-2025 11:09).

THURSDAY 12-Jun-2025

0845 0945 Preparations for Joint Meeting with SANA Operator
0945 1115 Joint Meeting with SANA Operator
1115 1230 Navigation Events Message
1230 1330 Lunch
1330 1445 Navigation Data Messages XML Format
1445 1530 Work on Final Report

Attendance this day included: Julien Bernard, David Berry, Juan Crenshaw, Frank Dreger, Julie Halverson, Ralph Kahle, Alain Lamy, Jose Miguel Lozano, Dan Oltrogge, Dianne Poster, Brian Swinburne, Patrick Zimmerman.

(a) 0845-0945: Preparations for Joint Meeting with SANA Operator

(b) 0945-1115: Joint Meeting with SANA Operator

The purpose of the first of these two sessions was to identify discussion topics for the Joint Meeting between the NavWG and the SANA Registry team regarding the NavWG use of the SANA Registries, e.g., "What's New at SANA?", review the Green Book material that Julie has been working on for the SANA, etc. For the second session, Julien Bernard of the SANA Registry team joined us for discussion of the identified topics/issues. The text in black in the following numbered list represents the questions, the text in green represents Julien's response:

1. References... is there a way to link to terms in the SANA Glossary and invoke a filter at the same time? (links to various Green Book versions and definitions) We can "save" a query in a fairly straightforward way, which was demonstrated. Julien also indicated that he can make all of the references to versions of the Green Book (500.0-G-n) appear as "ccsds-NAV WG".
2. Is it possible to put the "References" in the Glossary in "CCSDS numerical order"? Julien showed that we can just type in a document number (e.g., 500) and see the list of terms from those books.

(David was trying to type in exactly how the reference was represented (e.g., [ccsds-500.0-G-2]), but that isn't necessary. So the request for numerical order is irrelevant.

3. Can we get multiple references for the same document (but different versions, e.g., 500.0-G-1, 500.0-G-2, 500.0-G-3, 500.0-G-4, etc.)? See response to question #1.
4. Is it possible to generate a document directly from SANA listings? Julien indicated that we may be able to do such a thing using the SANA registry "Navigation Standards Registries".
5. Add telephone contact # and email information for TraCSS-related contacts on "Organizations" registry. There will probably be more than one. Julien indicated that we need NASA approval to add such entries in the "Organizations" registry. Dianne has an action item to identify the parties that should appear in the "Organizations" registry for TraCSS.
6. Would SANA be willing to post content from ISO TC20 SC13/SC14 such that we can provide links to that content to UNOOSA (United Nations Office of Outer Space Affairs) and others? Julien said "Yes" to this. Dan and David have action items to prepare the relevant content.
7. What "Policy" and "Authority" will allow the NavWG Chair to edit appropriate entries in the SANA Registry? Seems like "Authority" would be CCSDS.MOIMS.NAV. Julien indicated that Policy is "WG Chair" and authority would be CCSDS.MOIMS.NAV.
8. We'd like to add a few new GNSS "orbital element" sets to the registry:
https://sanaregistry.org/r/orbital_elements/ . We can send a list when we have this determined. Julien said "OK".
9. Can we post message examples on the SANA web pages (longer)? Julien said "Yes".
10. "Relative reference frames" language in registry. Julien said to send it to him if we finally figure out what was intended by this list item... no one could remember! (Note: in his comments on the draft minutes, Patrick wrote: " I recall now a discussion of removing, in the "Others have referred to this" column in the Registry, the two instances of callouts to the CDM Blue Book. These are in NTW_Rotating (e.g., CCSDS CDM Blue Book 508.0-B-1) and RSW_Rotating (per CCSDS CDM Blue Book 508.0-B-1)." David has referred the request to remove the CDM callouts to the SANA Team.

After the session with prepared questions ended, there were a few ad hoc discussion items that arose:

- Dan mentioned that the ongoing updates of Terms by ISO TC20/SC14 was going very slow.
- There was a brief discussion to determine who would prepare the various brochures mentioned in item 6 above (answer: Dan & David).
- Cheryl noted that Felix Hoots was interested in adding a new element set to those already present in the SANA Registry (Cheryl has action item to track down the specifics).

1115-1230: Navigation Events Message

Alain started off this topic with a short presentation highlighting the progress since the Fall 2024 Meetings. He indicated slow progress due to other priorities and stated that Frank had developed some tools related to NEM schemas. He described the three main requirements he and Frank are trying to address:

1. Applicable to events described in other applications, but one can design bespoke events (since they cannot possibly identify all events)
2. Be compatible with events defined by CSS (Cross Support Services) such as the abstract event structure and the "PIF" (Planning Information Format)
3. Support both KVN and XML environments (as with other Nav WG standards)

Frank described the concept of the "NEMD" (Navigation Events Message Dictionary) that is only available in the XML environment. Certain tools will be available in SANA (schema for NEMD, a schema generator to check messages to be exchanged, and a list of typical events). The structure of the document will consist of a description of the "event" concept, and XML events.

Frank described the NEMD schema:

(a) NEMD.xml describes the content of an NEM, but not the format (either XML or KVN)

(b) NEMD.xsd provides validation and NEM.html is generated by XSLT using NEM.xsd.

The NEM concept requires a definition of an event for Frank to generate a schema for it. Given that Frank will be departing from the NavWG in the near future, the future of this apparatus is at this time indeterminate.

See NEM materials at

https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/NEM_spring2025.pdf?csf=1&web=1

and

<https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/507x0m1-NEMD.pdf?csf=1&web=1>

1330-1445: Navigation Data Messages XML Format

1445-1530: Work on Final Report

David described the current situation with the NDM/XML P-3.2 draft. The version P-3.1 was reviewed some time ago (review closed in July 2024) but progress has been slow for various reasons (e.g., need to develop version 4.0. A schema for CDM, several non-CCSDS assignments, changes in the plans for hosting archived schemas on the CWE, budget problems in fiscal year 2024 at both the overall JPL Standards project level and David's work for the Nav WG). We also spent time discussing the fact that the ADM schemas needed to be updated to support the publication of that document, but it was not possible to complete the NDM/XML document update in the same time frame (which had been the original plan). Because of this, the NDM/XML focus for the ADM was getting the schemas up-to-date, tested, and then getting them on the SANA Registry. Consequently, the ADM V.2 schemas were tested as part of the ADM V.2 test plan, but the document that described them in detail was not yet ready for Agency Review and publication. The text is effectively ready for publication, but it will be necessary to make the case that the testing was already completed as part of the ADM V.2 testing. David also noted that it is quite possible that this may be the last version of this particular document, given that most of the Nav WG material has been migrated into the constituent Blue Books, and some efforts were taken to "future proof" the NDM/XML 4 standard. The recent need to support JSON versions of the schemas and messages may modify this plan, however.

1445-1530: Work on Final Report

In anticipation of the following day's Closing Plenary, and because the NDM/XML discussion completed early, we spent a few minutes discussing the Final Report of the proceedings. The bulk of the effort occurred on Friday morning, per the planned schedule.

FRIDAY 13-Jun-2025

0845 1145 Closing Matters (Final Report, Action Items, Doc Schedules, 5 Year Plan), End of Meeting

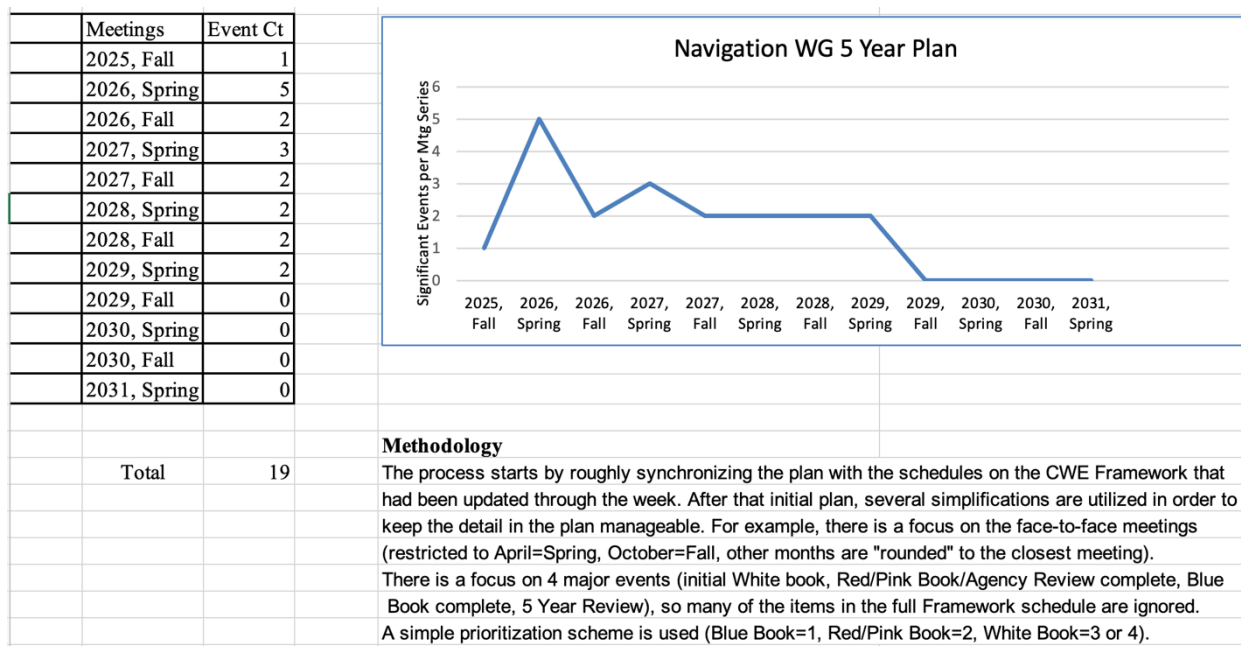
1145 1300 Lunch
 1300 1400 Minutes development
 1400 1600 MOIMS Closing Plenary

Attendance this day included: David Berry, Vitali Braun, Juan Crenshaw, Frank Dreger, Cheryl Gramling, Julie Halverson, Alain Lamy, Jose Miguel Lozano, Dan Oltrogge, Dianne Poster, Brian Swinburne, Patrick Zimmerman.

0845-1145: Closing Matters, End of Meeting

During this session we worked on the Navigation WG Final Report to the Area Director (which is presented by the WG Chair at the Area Closing Plenary and used by the AD to prepare the MOIMS report to the CESG). We went page-by-page through the draft report developed throughout the week, and members of the Working Group offered comments, suggestions for additional material, improvements, things that had been missed, etc. The report as presented at the plenary is shown in the "MOIMS Closing Plenary" section immediately below. We also reviewed new Action Items and updated the official Document Schedules. We had also intended to work on the 5 Year Plan, but it was close to lunchtime and the process takes a while, so we decided to adjourn the meeting. David indicated that he had sufficient information given the document schedules to flesh out the 5 Year Plan and distribute it with the minutes. The result is shown immediately below; all the materials are available on the CWE at

<https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/navwg-5-year-plan-202506.pdf?csf=1&web=1>



All materials from these Spring meetings (action items, agenda, introductory presentation, report, document presentations, these minutes, etc.) are (or will be) available on the NavWG Spring 2025 CWE at <https://spacecomm.sharepoint.com/:f:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring?csf=1&web=1>. Draft documents reviewed during the meetings will be in their respective directories on the NavWG Spring 2025 CWE.

1400-1600: MOIMS Closing Plenary

The MOIMS Closing Plenary was conducted immediately following a late lunch. Attendance at the Plenary included: Mehran Sarkarati (MOIMS Area Director), Stefan Gaertner (MOIMS Deputy Area Director), David Berry (Nav Chair), Frank Dreger (Nav Deputy Chair), John Garrett (DAI Deputy Chair), an SM&C Representative (name unknown), and Peter van der Plas (MP&S Chair). There were also a small number of members of the various MOIMS Working Groups.

The Working Group Chairs and/or representatives delivered their reports; David Berry presented for Navigation (NavWG). Because David had to leave early to catch a flight, he is not certain of the order of other presentations. Frank Dreger had not yet joined at the time David completed his report, probably because a Teams link had not been sent with the meeting invitation; that was eventually realized and an invite sent. Logically, John Garrett presented for Digital Archive Ingest (DAI), the Spacecraft Monitor & Control (SM&C) representative presented for SM&C, and Peter van der Plas for Mission Planning and Scheduling (MP&S). The Navigation report immediately below was presented during the Plenary. The report is also available on the CWE at:

<https://spacecomm.sharepoint.com/:b:/r/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2025/Spring/navwg-report-202506.pdf?csf=1&web=1> .

NAVIGATION WORKING GROUP CLOSING REPORT for LAUREL, MARYLAND, USA

NAV WG EXECUTIVE SUMMARY

MOIMS/Nav Meeting Demographics

Agency	NAV WG	
CNES	1	Alain Lamy (virtual)
DLR	1	Ralph Kahle (virtual)
ESA	6	Frank Dreger (virtual), Vitali Braun (virtual), Clemens Heese, Jose Miguel Lozano, Daniel Fischer, Mehran Sarkarati
JAXA	1	Kiyoshi Hamada (virtual)
NASA	9	David Berry, Juan Crenshaw, Cheryl Gramling, Julie Halverson, Dan Oltrogge, Dianne Poster, Rob Wolff, Patrick Zimmerman, Eric Pitts
UKSA	1	Brian Swinburne (virtual)
Total	19	
Meeting Duration	5 days	
Agency Diversity	6	
Others (Non-Nav WG personnel)	1	SANA: Julien Bernard (SANA)

NAV WG Executive Summary

Achievements for this meeting cycle:

- Completed discussion of Conjunction Data Message V.2 (advanced from P-1.2 to Pink Book P-1.3) with members of the TraCSS system being developed by NOAA for civil space conjunction assessment; completed Test Plan assignments of tasks to agencies

- Completed disposition of comments on Tracking Data Message V.3 draft P-2.0.2 and discussion of plans for P-2.0.3 content. Initiated plans for possible Agency Review in early 2026.
- Completed discussion of progress on 4 White Books 1.0: Navigation Events Message and the Navigation Composite Message (includes Launch Data Message and Fragmentation Data Message)
- Completed discussion of migration of material from Navigation Green Book into SANA

Working Group Status: Good progress, "High Momentum", with very good attendance

Interaction with other WGs:

- Met with representative of SANA Operator Team to discuss various topics related to NavWG use of SANA

Problems & Issues:

- Opening Plenary and keynote content, while appreciated and interesting, should be deconflicted with normal WG meetings and announced further in advance so CCSDS WG chairs can better accommodate.
- Better integration of materials provided when attendees check in at Registration on their first day would be great!
- Changes made to agendas aren't being automatically reflected on the CWE, as they were in the past. This has been reported to CCSDS Tech Support.

Resolutions agreed upon this meeting:

- NAV-01: The Navigation WG thanks the JHU/APL for arranging the outstanding meeting facilities, excellent A/V support, and convenient lunch options.

Further Resolutions anticipated in the next 6 months:

- NAV-02: Navigation WG will request "Approval for Agency Review" polling for Tracking Data Message V.3
- NAV-03: Navigation WG will request "Approval to Publish" polling for Conjunction Data Message V.2
- NAV-04: Navigation WG will request "Approval to Publish" polling for Navigation Data Messages XML Specification V.4

- **Planning (Only Approved Projects):**

Area & WG name	CCSDS Ref Nr	Document Title	Status / Comments	Start and / or Target Publication Date	
MOIMS NAV	503.0	Tracking Data Message Version 3 Revision	Very good progress. Completed discussion of TDM changes in Pink Book 2.0.2 draft and plans for Pink Book 2.0.3, which could be the penultimate version prior to publication. Initiated planning for Agency Review.	Start date	06-May-2019
				End date	30-Aug-2026
MOIMS NAV	505.0	Navigation Data Messages XML Specification Version 4 Revision	Acceptable progress, close to wrapping up, but it needs more attention	Start date	06-Jan-2023
				End date	15-Sep-2026
MOIMS NAV	507.0	Navigation Events Message (NEM)	Good progress. We reviewed a presentation discussing the status of White Book Version 1.0 and associated schemas and overall plans for the project. Target date will change.	Start date	07-Nov-2017
				End date	31-May-2026
MOIMS NAV	507.1	Launch Data Message	Good progress. We reviewed a draft of White Book material in the framework of the NCM.	Start date	02-Jun-2023
				End date	30-Sep-2026
MOIMS NAV	508.0	Conjunction Data Message 5 Year Revision	Good progress. We addressed issues related to the Office of Space Commerce implementation of the CDM and completed assignments for the prototype testing.	Start date	14-Jan-2019
				End date	30-Apr-2025
MOIMS NAV	508.2	Fragmentation Data Message	Good progress. We reviewed a draft of White Book material in the framework of the NCM.	Start date	02-Jan-2024
				End date	30-Sep-2026
MOIMS NAV	TBD	Navigation Composite Message	Very good progress on structural design and plan for this standard, as motivated by discussion of LDM and FDM content.	Start Date	04-Nov-2024
				End Date	31-Aug-2027

NAV WG Upcoming New Work Items

- None.

NAV WG Issues for CESG/CMC

Conflicts in Working Group schedules and Special Activities diminish the full CCSDS Experience

Examples from this Meeting Series

- The "Distinguished Plenary" on Tuesday was scheduled at a time that created conflicts with Working Group meeting schedules. The first time we heard of this was in the "Spring 2025 Technical Plenary" packet received at onsite Registration. CCSDS Technical Support had been requesting agendas from WG Chairs for at least 2 weeks prior to the Plenary, and we could have scheduled around this, had we known about it.
- The Boot Camp is often scheduled at times when there are active WG Meetings. Perhaps it could be scheduled as a working lunch, or evening activity, or combined with a Happy Hour, etc.

NEXT TELECONS:

We will continue the 1-hour telecons approximately monthly between Spring 2025 and Fall 2025 Meetings. The Fall Meetings will be sponsored by ESA in Hamburg, Germany, from 15-Sep-2025 thru 19-Sep-2025. (NOTE: US Daylight Savings Time ends 02-Nov-2025 and Europe Daylight Savings Time ends 26-Oct-2025; both end well after the Fall Meeting schedule, so our standard meeting time is not perturbed by the switch to Standard Time). There will be two Working Group telecons prior to the Fall Meetings, as follows:

- 16-Jul-2025 1300-1400 UTC
- 27-Aug-2025 1300-1400 UTC
- 15-Sep-2025 thru 19-Sep-2025 Fall Meetings sponsored by ESA in Hamburg, Germany