

MINUTES OF NAVIGATION WORKING GROUP FALL 2024 WORKSHOP 08-Dec-2024
David S. Berry / Chair

The CCSDS Fall 2024 Navigation Working Group (NavWG) Meetings were conducted in person in London, England, United Kingdom, from 04-Nov-2024 through 08-Nov-2024. Although the meetings were held in person, the ability to attend virtually was also offered to those who were not able to travel. UKSA hosted the meetings, which were conducted in two locations: (1) Hotel Clayton Chiswick and (2) The British Standards Institute. 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 Fall 2024 Materials](#) . A sort by "name" is recommended... note that CCSDS Tech Support has changed to a Sharepoint backend implementation for the NavWG Fall 2024 CWE, and I'm still figuring out how best to get an exact link in the document, hence the change. Specific file names are listed below in the minutes.

ON-SITE NAV WG PARTICIPANTS

David Berry (NASA/JPL), Vitali Braun (ESA/ESOC), Juan Crenshaw (NASA/GSFC), Frank Dreger (ESA/ESOC), Cheryl Gramling (NASA/GSFC), Julie Halverson (NASA/GSFC), Kiyoshi Hamada (JAXA), Alain Lamy (CNES), Jose Miguel Lozano (GMV/ESA/ESOC), Dan Oltrogge (NASA (COMSPOC, ISO TC20/SC14)), Dianne Poster (NASA (NIST/NOAA)), Brian Swinburne (Airbus, UKSA), Patrick Zimmerman (NASA/JSC).

VIRTUAL/TELECON NAV WG PARTICIPANTS

Ralph Kahle (DLR)

OTHER PARTICIPANTS (SANA, Delta DOR WG, Time Management WG)

Julien Bernard (SANA), Jon Hamkins (NASA), Sinda Mejri (ESA), Eric Pitts (NASA), Christian Stangl (DLR), Javier Vicente (ESA), Miriam Sawczuck (JAXA), Hiroshi Takeuchi (JAXA), Chris Volk (NASA), Yukio Yamamoto (JAXA).

AGENDA

The final agenda for the WG meetings is available on the NavWG Fall 2024 CWE in file navwg-agenda-fall-202411-final. 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. They are also available on the NavWG Fall 2024 CWE at navwg-action-items-202411.pdf. The action items and due dates below reflect the status as of the date of preparation of these minutes; the list on the NavWG Fall 2024 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 Fall 2024 CWE will thus reflect relative completion progress and any new action items added after the meeting

series.

New Action/Outstanding Action Items

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

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

If "Status" = "Cancelled", then "Date" = "Cancellation Date"

Sort by "Status" (Descending), "Date" (Ascending), "##" (Ascending)

##	Action Item	Category	Actionee	Status	Due Date (Original)	Date
00	Research "master" XML schema conversions to JSON	NEM	David	Open	30-Jun-2024	20-Dec-2024
86	Discuss Blue Book PDF names with CCSDS Tech Support (e.g., ...e2c2.pdf)	Web	David	Open	03-May-2024	20-Dec-2024
14	Inquire about navsol solution for OSC/TraCSS	GNSS	Dan	Open	15-Nov-2024	09-Jan-2025
15	Write up Objectives and Use Case Justification for CCSDS/Nav to Develop New GNSS Standard	GNSS	Dianne	Open	15-Dec-2024	09-Jan-2025
05	Prepare NEM White Book 2	NEM	Alain / Frank	Open	12-Jun-2024	15-Jan-2025
06	Provide multiple references for NDMXML schemas on SANA (505+50x as applicable... do with NDM/XML 4)	NDM/XML	David	Open	31-Aug-2024	15-Jan-2025
08	Suggest moving Area Director plans to Area Plenary meetings	General	David	Open	31-Dec-2024	15-Jan-2025
09	Produce TDM P-2.0.3 draft	TDM	Juan	Open	15-Jan-2025	15-Jan-2025
11	Update CDM schemas for CDM 2.0 (P-1.2) (#50, #12 are dependent)	CDM	David	Open	20-Nov-2022	15-Jan-2025
18	Inquire CCSDS position on "message" formatting (e.g., XML vs. JSON vs. ???)	General	David	Open	15-Jan-2025	15-Jan-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-Jan-2025	15-Jan-2025
50	Create XML schema 4.0.A Test Set (depends on #11)	CDM	David	Open	14-May-2023	15-Jan-2025
60	Prepare new project for update of Navigation Data Definitions & Conventions	NDDC	David	Open	31-Dec-2023	15-Jan-2025
74	Prepare Navigation references for SANA Registry (#96 is dependent)	SANA	David	Open	31-Oct-2018	15-Jan-2025
91	Review NavWG registry "Provisional" assignments and request change to "Assigned", as applicable.	SANA	David	Open	31-May-2024	15-Jan-2025
02	Prepare LDM White Book 1	LDM	Dan	Open	12-Jun-2024	31-Jan-2025
17	Update Navigation Terms in CCSDS Glossary (original + RDM terms)	Glossary	Secretariat	Open	31-Aug-2019	31-Jan-2025
36	Check all SANA Links to References (depends on #96)	SANA	David	Open	15-Jun-2023	31-Jan-2025
81	Prepare Corrigendum for Green Book	NDDC	David	Open	10-Apr-2024	31-Jan-2025
12	Update CDM style sheet for CDM 2.0	CDM	David	Open	04-Dec-2022	15-Feb-2025

##	Action Item	Category	Actionee	Status	Due Date (Original)	Date
	(depends on #11)					
16	Request deletion of "Conjunction Data Message Catalog Name" registry (post-CDM 2.0 publication)	SANA	David	Open	18-Jan-2023	15-Feb-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	15-Feb-2025
94	Library of referenced papers on CWE	CWE	David	Open	10-May-2021	26-Feb-2025
96	SANA implementation of Nav References (depends on #74)	SANA	SANA	Open	31-Jan-2019	26-Feb-2025
90	Suggest addition of "SANA Boot Camp" to CCSDS Plenary meetings	SANA	David	Complete	31-May-2024	04-Nov-2024
07	NavWG Standards ISO status	General	Jose Miguel	Complete	04-Nov-2024	05-Nov-2024
70	Create mockup of segmented Green Book for placement on SANA.	NDDC	Julie	Complete	31-Dec-2023	05-Nov-2024
10	Write up alternate SEFI implementation	CDM	Dan	Complete	15-Nov-2024	19-Nov-2024
13	Distribute CDM Test Plan Draft in quest for volunteers	CDM	Brian	Complete	04-Dec-2024	04-Dec-2024
78	Produce initial draft CDM V.2 Test Plan/Report	CDM	Brian/Dan	Complete	07-Feb-2024	04-Dec-2024

WORKSHOP PROCEEDINGS

MONDAY 04-Nov-2024

0800 0845 Registration
0845 1030 CCSDS Opening Plenary
1030 1030 MOIMS Opening Plenary
1030 1130 NavWG Meeting: Intro, Agenda, Action Items, Doc Status, etc.
1130 1230 Conjunction Data Message (CDM)
1230 1330 Lunch
1330 1700 CDM RID Resolution, Test Plan, Security Section

0845-1030: CCSDS Opening Plenary / Area Director Presentations / Logistics / Schedule

Matt Cosby (UKSA) opened the meetings with a brief talk that included many cricket analogies, appropriate given the Wednesday evening scheduled social event. He advised about potential rail issues getting to the event due to impending strikes (which were thankfully called off).

Sami Asmar followed Matt and offered thanks to UKSA. He noted that the meetings for Spring 2025 in the USA are converging on the Applied Physics Laboratory (APL), but discussions are still ongoing so it is not yet confirmed. Sami also announced that Klaus-Juergen Schulz (current CESG Chair) is retiring, Daniel Fischer is ascending to leadership of the CESG, and several Area Directors are retiring (among them Peter Shames, retiring in January after 24 years of CCSDS leadership, to be replaced by Jim Lux). Jonathan Wilmot (SOIS) is also retiring. In the near future, 4 of the 7 members of the CESG will be new in their positions.

The CESG Chair and some of the Area Directors who are retiring provided some thoughts for those continuing in CCSDS. Klaus Juergen stated that innovation and standardization fuel growth, and these are key aspects of CCSDS. Jonathan Wilmot spoke about his experiences with standards development, innovation, cross support, etc., and encouraged his predecessor to carry on in similar fashion. Peter Shames asserted that interoperability is essential and the key component of CCSDS. He encouraged all to "lean into the notion of interoperability".

After the opening speakers, Klaus-Jurgen Schulz, current CESG Chair, introduced his replacement (Daniel Fischer). He also provided the customary presentation itemizing new publications since the last meetings in Spring 2024. He cited the number of CESG/CMC polls, Approvals to Publish, Agency Reviews, and New Project approvals in the last six months (this included the Navigation Composite Message). Klaus-Jurgen reiterated that there are lots of leadership positions available in CCSDS, and showed a full slide of the various openings. He indicated that the spacecraft ID number space has been exhausted, so the CCSDS is moving towards 10-bit spacecraft numbers.

The six Area Directors then previewed the works in progress in their respective WGs and also their plans for the week: Peter Shames, Daniel Fischer, Erik Barkley, Jonathan Wilmot, Ignacio Sanchez, and Vinny Ristovski (representing Tomaso de Cola).

Peter followed the Area Director presentations with a refresher on the SANA Registry. The SANA was created in 2004 as part of the CCSDS reorganization; it was re-engineered in 2015 due to there being multiple registries covering same types of data. The SANA exists as a set of online searchable registries with programmatic access. Peter discussed the broad strokes of the SANA organization. There are 3 categories of registries (Enterprise, Global, Local/WG Registries). Julien Bernard followed Peter and gave a presentation on more details about the registries (during this presentation one of the NavWG reference frame pictures was shown!).

After Julien's presentation, the full Plenary ended. Unfortunately, information on other future meetings that was formerly provided was yet again not provided. Not even Spring 2025 information could be provided, as noted above. The information below is from past meeting notes, so it may not be reliable:

- a) Spring 2025 hosted by NASA at TBD, dates TBD (Sami indicated they are leaning towards APL)
- b) Fall 2025 hosted by ESA at TBD, dates TBD
- c) Spring 2026 hosted by NASA at TBD, dates TBD
- d) Fall 2026 hosted by TBD at TBD, dates TBD
- e) Spring 2027 hosted by NASA at TBD, dates TBD

1030-1030: MOIMS Opening Plenary

Daniel Fischer suggested skipping the MOIMS Plenary (which was scheduled for 1030) since most of the time allocated had been consumed by the CCSDS Opening Plenary. This proposal was accepted by the MOIMS Chairs. (NOTE: Given Daniel's forthcoming ascendance to the CESG Chair, there is an opportunity to revive the idea of allocating the Area Director presentations to the Area Plenaries instead of including them as part of the full Plenary.)

1030-1130: Navigation WG Meeting Introductory Matters

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, Patrick Zimmerman.

After getting settled in the conference room, we conducted an around the room "face-to-face" introduction. Not everyone had been able to attend at Washington DC and thus did not have an opportunity to meet Dr. Dianne Poster of NIST who has joined the Working Group as part of the US Department of Commerce, Office of Space Commerce (DOC/OSC). The DOC/OSC is in the process of implementing "TraCSS" (The Traffic Coordination System for Space), which will assume many of the responsibilities for civil space traffic management currently performed by the US Department of Defense. David then presented the "Introduction to the Navigation WG" material. The presentation was distributed to the WG mailing list, and also uploaded to the NavWG Fall 2024 CWE at [navwg-intro-202411.pdf](#).

During review of the Spring 2024 Action Items, David indicated that not much progress had been made on open items, many of which are his, which were delayed by his being required to stand down for budget reasons for most of the last quarter of the fiscal 2024 (July through September). Progress was thus less than normal.

Julie pointed out that on Thursday we will discuss the quaternion clarification that she worked on. This topic arose because there was a reference to differences in the process documented in the NavWG Green Book and that developed by Malcolm Shuster.

1130-1230: Conjunction Data Message, 1330-1700

Brian had prepared a presentation that itemized all the open matters from the Agency Review. We spent the remainder of the day working through these issues. We resolved the remaining issues with the Security Section in the Annex C based on Howie Weiss' input. David explained to the group that we were allowed to proceed to Agency Review over Peter Shames' concerns about the Security Section upon promising to address it post-Agency Review. Brian showed the various changes in the Security Section. There was one question that arose during this discussion regarding a "Doyle Hall Reference". Dan queried Lauri Newman directly about this and received an answer by the afternoon.

One point that induced a fair amount of discussion was the topic of hard body radius (HBR), and various other qualifications (e.g., "Effective HBR" and "Effective Combined HBR"), and how these figure into the calculation of the probability of collision. CARA has made a request to have the Effective Combined HBR included in CDM V.2; current CDMs produced by CARA contain this quantity in a COMMENT statement that is used operationally.

During the 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:

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).

Another item for which significant discussion was entertained was a set of keywords having to do with "SEFI" (Space Environment Fragmentation Impact). At the end of the discussion, the group agreed to remove the SEFI related information items from the CDM. [Note: after the meeting series, a revised "SPACE_ENVIRONMENT_BURDEN" construct was proposed and drafted, so the "impact" (i.e. "burden") concept was restored, but the data structure is simpler.] Towards the end of the CDM discussion

we discussed the "1 to n" nature of 3 keywords: COLLISION_PERCENTILE, COLLISION_PROBABILITY, and SEFI_COLLISION_PROBABILITY. David indicated that such a data structure is not achievable in XML. We decided to set these up in XML as "unchecked strings" (with the exception of SEFI_COLLISION_PROBABILITY which has been recharacterized).

It was noted that in CDM P-1.1, the paragraph numbers in Annex F, Section F3 are incorrect.

By the end of the day, we had completed discussion and resolution of all of the "RID" related CDM items accumulated by Brian. We had not had opportunity to address the CDM Test Plan. David indicated that we need to discuss the Test Plan because completing the CDM V.2 is the most important WG item at this point. Consequently, we will revise the Wednesday schedule so that we can make progress on the TDM V.3 per the announced schedule.

Dan gave us a "gee whiz" number at the end of the day... The US Space Force produces over 600,000 CDMs per day

Brian's presentation material is available on the NavWG Fall 2024 CWE at presentation-2024-11-06-CDM-P1.1-Requested-Modifications.pdf .

TUESDAY 05-Nov-2024

0845 1230 Tracking Data Message Issues & Discussion

1230 1330 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, Patrick Zimmerman.

0845-0910: Meeting Room Logistics

We were in a different meeting room on Tuesday than we were on Monday, and the room setup was not conducive to Working Group progress. Everyone chipped in to rearrange the tables, reroute the electric cables, and get the screen working.

0910-1235, 1335-1745: Tracking Data Message (TDM)

Juan Crenshaw led us through dispositioning of comments received on the TDM Pink Book 2.0.2, and factored them into a forthcoming TDM P-2.0.3. There were quite a few comments for which there was significant discussion, and discussion of the TDM consumed the entire meeting day. There were two CRMs with lots of comments, one from Jose Miguel and one from David. CRMs from other WG members had already been processed. Very good progress was made on the development of the TDM P-2.0.3. Details and conclusions related to the discussions will be reflected in the CRM for TDM P-2.0.2 that will soon be posted to the NavWG Fall 2024 CWE. Some topics discussed were:

- The maximum number of participants in a TDM segment; we ended up settling on the current maximum of 9.
- The format of the covariance matrix; while there was preference stated for the lower triangular form, there was some reluctance to eliminate the options for upper triangular and full matrix forms. Dan pointed out that the OCM has all these options. David suggested thinking forward to the Navigation

Composite Message (NCM) where we may want to restrict some options. Allowing all the options increases flexibility but introduces complexity in the TDM reader application and the potential need for an ICD. Juan ultimately decided that all forms would be an option, but the lower triangular form would be the default.

- Considerable time was spent discussing the apparent overloading of the "TRACK_ID" keyword, which was originally introduced as a way to help organize optical observations of unknown objects, but Juan has utilized in a clever way to reduce the amount of repeated metadata required in TDMs with multiple segments where identical metadata is used. After consulting with Ralph, who had originally proposed the TRACK_ID keyword, ultimately the group agreed that both proposed uses of TRACK_ID were legitimate.
- We discussed the set of values for the TDM_BASIS keyword, which was added for congruence with the OCM and ACM. The TDM_BASIS has a small set of values (OPERATIONAL, SIMULATED, TEST, PLAYBACK). There was agreement that OPERATIONAL and PLAYBACK constituted clearly defined TDM basis categories, but there was discussion as to whether the differentiation between TEST and SIMULATED was as clear.
- There was some discussion regarding the use of the new "System Configuration Parameters" and "System Status" sections, e.g., case conventions, how to represent in XML, etc.

Ultimately most of the outstanding comments on P-2.0.2 were resolved, or Juan had sufficient direction to finalize the resolutions. Juan will continue updating the TDM P-2.0.3 and it will soon be out for internal Working Group review.

Juan's presentation material is available on the NavWG Fall 2024 CWE at https://spacecomm.sharepoint.com/sites/MOIMS/Shared%20Documents/MOIMS-NAV/Meeting%20Materials/2024/Fall/presentation_TDM-v2.02-Overview-CCSDS-Fall-2024-share.pdf.

WEDNESDAY 06-Nov-2024

0845 0945 Navigation Data Definitions & Conventions
0945 1110 CDM Test Plan
1110 1140 Break + Team Photo
1140 1215 Navigation Composite Message (Brief Introduction)
1215 1330 Lunch
1330 1730 GNSS Systems Questions for TraCSS
Evening: Social Event at the Cricket Club

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, Patrick Zimmerman.

0845-0910: Meeting Room Logistics

The Working Group was in a different room this day (at BSI instead of at the hotel), so again had to do some work to arrange the room. The initial issue related to a possible requirement to use the same "ClickShare" application that caused issues in Washington, DC in the Spring Meetings. Luckily the BSI IT Technician was able to bypass ClickShare by routing direct to the screen via an HDMI cable.

0910-945: NDDC Green Book Reformatting

Julie provided more detail on her idea of migrating/reformatting the Navigation Data - Definitions & Conventions (NDDC) Green Book into SANA Registry pages. She started with a couple of questions:

1. Is it possible to provide some notes at the top of a SANA Registry page? Answer: Yes, it is. David showed a couple of existing pages that have such notes at the top.

2. How to deal with definitions of navigation terms? David suggested that "Terms" could go directly into the SANA "CCSDS Glossary" Registry, in particular, the "Terms" page (<https://sanaregistry.org/r/terms/>); we can include the applicable units with the terms. One potential issue with this is that currently only the CCSDS Editor is authorized to make changes the Glossary, which slows things down considerably.

After illustrating several pages from her mockup of the eventual "SANA Based Green Book", Julie also brought up the topic of the conventions for quaternion multiplication that she and Juan had researched a while back. That can also go on the existing SANA "Attitude and Spacecraft Conventions" page https://sanaregistry.org/r/attitude_and_spacecraft_conventions/ . Julie asked who will be the future "Guardian of SANA" since Peter Shames is retiring; this is not known, but perhaps it will be the new Area Director of the CCSDS Systems Engineering Area (nominee is Jim Lux... the CMC Poll is open until 13-Nov-2024, but based on the votes to date this nomination will be approved).

Julie's presentation material is available on the NavWG Fall 2024 CWE at [presentation_SANACConversionDraft_LondonMtg.pdf](#).

0945-1110: CDM Prototype Test Plan

This discussion started off with an appeal for JSON from Dan, who argued that the KVN and XML formats are considered "older". He argued that 80% of the NavWG messages are not specific to format, i.e., only a small percentage is mapped to a specific format. It was suggested that other people could help with the JSON formatting. David indicated that he has been (intermittently) working on a method that may simplify this formatting, but it's not ready for discussion yet. David reiterated that the Navigation WG had been "asked" (ordered?) to produce an XML format of its messages, although that happened years ago and could perhaps be revisited.

We also spent time with some late breaking requests for changes in the CDM. David raised the option of creating a CDM V.3 project in parallel with the CDM V.2 (as was done with the TDM V.2/V.3), or should the new CDM items be targeted for the Navigation Composite Message (NCM)? Brian felt that producing a CDM V.3 would take too much time and would break backwards compatibility (one of the key objectives for CDM V.2). There was discussion of possibly adding the new CDM data items to the new NCM, but that work will potentially take longer to produce for the requestor. In the end there was no decision, however, the new requests will not be part of the CDM V.2.

Another discussion involved an idea to move the "SEFI" items (Space Environment Fragmentation Impact) to the in-progress Fragmentation Data Message (FDM) instead of removing them from the CDM. However, Dan doesn't think this is good. He raised a proposal to revise the SEFI material to be "less technical", but still allow a user to develop a risk analysis (SEFI adds "consequence" to go with "likelihood" (i.e., collision probability) given that likelihood and consequence are the two components of a risk analysis). Dan took an action item to prepare a statement of his alternate SEFI proposal that Brian can include in the CDM.

Brian discussed his analysis of why the SCREEN_VOLUME keyword moved in the CDM V.2, breaking backward compatibility... it was based on the need for prior information to use the SCREEN_VOLUME. Dan stated that he tried to do a similar precedence ordering arrangement in the OCM but found it impossible

sometimes. So Brian will put the SCREEN_VOLUME back in the original order, which preserves the backwards compatibility.

Brian then showed his draft test plan, and indicated he was looking for volunteers for the various tests.

1110-1140: Break

David requested a break... and during the break we took a group photo, later supplemented with a screen shot of Ralph, who was not able to attend in London. See immediately below...



The CCSDS Navigation WG 06-Nov-2024 (w/Floating Ralph, attending via MS Teams)

1140-1215: Navigation Comprehensive Message (NCM)

David showed the compilation of the tables that he created, showing all the keywords in the various messages, and explained how it had been assembled. The file performance is very slow, but it allows us to see where each keyword has been used, and it is easy to see where there are discrepancies between the standards. Eliminating such discrepancies is in principle a desirable goal in the NCM. Such an arrangement would be the finest level of granularity possible in an NCM, but it might be excessive. We discussed briefly a few requirements for the NCM, but it's still very early in the elaboration of this concept. We were ultimately able to inform the discussion of several of the new works based on the impending NCM.

1330-1515: GNSS Systems Questions for TraCSS

After lunch, we discussed a White Paper from the US Department of Commerce, Office of Space Commerce (DOC/OSC) that related to the in-progress TraCSS (Traffic Coordination System for Space). In particular,

the TraCSS Working Group has been internally discussing GNSS formats. TraCSS may be interested in having the NavWG develop a new standard for GNSS data that could be used by someone to determine an orbit. Given that there are already a few GNSS standards, it is unclear whether such a new standard would be within the purview of the CCSDS. Until now the group has specifically declined to develop a new GNSS standard. Dianne took an action item to write up Objectives and a Use Case Justification for CCSDS Navigation Working Group to develop a new GNSS Standard. Dan noted that there are several operators with GNSS data that can share that data. Cheryl opined that TraCSS should "Take the Raw", i.e., access or collect the unprocessed, "raw" data directly from a GNSS receiver, which provides detailed information about the signals received from each satellite, including measurements like pseudoranges and Doppler shifts, allowing for a greater variety of positioning calculations.

1515: Early Adjournment

We adjourned early so people could have a break before the social event scheduled to begin at 6:00 PM after a trek on the Tube. On the way to the social event, members of the NavWG re-enacted the Beatles' Abbey Road album "crosswalk" cover (... it was cold, so no one was barefoot!). For more pictures of this event, see the end of these minutes, or look at the pictures on the NavWG Fall 2024 CWE (all pictures start with "pix"). Clearly folks had fun with this!



Blast from the Past... Re-Imagined (see additional pix at end of document)

THURSDAY 07-Nov-2024

- 0845 0930 Preparations for Joint Meeting with SANA Operator
- 0930 1030 Joint Meeting with SANA Operator
- 1030 1130 Joint Meeting with DeltaDOR WG
- 1130 1230 Joint Meeting with Time Mgmt WG

1230 1330 Lunch
1330 1530 Launch Data Message Issues & Discussion
1530 1730 Navigation Events Message Issues & Discussion

Attendance this day included: Julien Bernard, David Berry, Vitali Braun, Juan Crenshaw, Frank Dreger, Cheryl Gramling, Julie Halverson, Jon Hamkins, Ralph Kahle, Alain Lamy, Jose Miguel Lozano, Sinda Mejri, Dan Oltrogge, Eric Pitts, Dianne Poster, Miriam Sawczuck, Christian Stangl, Hiroshi Takeuchi, Javier Vicente, Chris Volk, Yukio Yamamoto, Patrick Zimmerman.

(a) 0845-0930: Preparations for Joint Meeting with SANA Operator

(b) 0930-1030: 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 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.

Julien let us know about some new things that were coming up with the SANA Registry, including:

- That short notes can appear above the tables that are the bulk of SANA information (e.g., for some of Julie's Green Book transformation work).
- Improved support for plots of various types; this was in response to an item that Dan raised at the Spring Meetings.
- David noted that some items previously requested were still in the "nav.sanaregistry.org" beta site. Shortly after the meetings, Julien migrated the beta material into the production site.

Towards the end of this session, Julien confirmed that the NavWG remains in the vanguard with respect to providing information for use by SANA users.

1030-1130: Joint Meeting with Delta-DOR Working Group

We were joined by Javier Vicente, Chris Volk, and Hiroshi Takeuchi of the Delta-DOR Working Group for a discussion of Delta-DOR topics with relevance to the TDM. The Delta-DOR group members presented several ideas raised by Hiroshi for improving the Delta-DOR data in the TDM; this involved the addition of several new keywords. Juan had some suggestions based on the Delta-DOR proposals, e.g., moving the `OBS_COVARIANCE_*` to the metadata section, and remove trailing commas, squared units and small values in covariance since there is no loss of precision, and differenced frequency since it should not affect Delta-DOR. Juan suggested a preference for having the `DOR_AMBIGUITY` as a "System Parameter" instead of a keyword.

1130-1230: Joint Meeting with Time Management Working Group

We were joined by Sinda Mejri, Eric Pitts, Miriam Sawczuck, Christian Stangl, and Yukio Yamamoto of the Time Management group. After around the room introductions, the two groups discussed areas of common interest. There were no action items from this meeting, but several areas for future interaction were raised.

1330 1530 Launch Data Message Issues & Discussion

Dan indicated that while he had not made much progress on the Launch Data Message, that was driven in large part due to our objective that the LDM and FDM would be the first instantiations of the nascent Navigation Composite Message (NCM), but the NCM has not yet been sufficiently defined. Dan presented

at a top level the elements of information (and higher-level categories) that the LDM needed to contain, and then used that top-level set of information to pivot over to the NCM and how it would implement the LDM, FDM, etc. The group explored how the NCM might work, whether it would be able to incorporate large data blocks from existing NAV WG messages, or whether entirely new tailored message blocks from existing messages could be extracted and modified for use in the NCM. While the group did not come up with answers to those questions, Dan and Vitali took an action to examine how the NCM might work and prototype what it might look like in the context of the LDM and FDM. Among the discussion items were:

- how best to organize the data blocks (e.g., by satellite, by topic, or no structure)
- best approaches to share contact information
- during the discussion, Jose Miguel showed how a big JSON file can be loaded in a browser, displayed in a user-friendly manner, and easily filtered.

1530 1730 Navigation Events Message Issues & Discussion

Alain and Frank went through their presentation slides. They plan to share a WB draft in the coming weeks. The presentation materials are available on the NavWG Fall 2024 CWE at [presentation_NEM_fall2024.pdf](#) and [presentation_NEM%20Diagrams-fall2024.pdf](#)

FRIDAY 08-Nov-2024

0845 1045 Fragmentation Data Message
1045 1115 NDM/XML Status/Issues
1115 1230 Closing Report, Action Items, Doc Schedules, 5 Year Plan
1230 1330 Lunch
1330 1500 Free Time
1500 1630 MOIMS Closing Plenary (Optional for all but David/Frank)

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, Dianne Poster, Brian Swinburne, Patrick Zimmerman.

0845-1230: FDM, NDM/XML, RDM 5 Yr Review, NavWG 5 Year Plan, Closing Report, End of Mtg

Based on a Friday morning email from the MOIMS Area Director, it appeared that the MOIMS Closing Plenary would be conducted immediately following lunch instead of late in the day. Accordingly, the Friday morning schedule was rearranged so the group could work on the Closing Report. We did have a brief discussion of the Fragmentation Data Message (FDM) updates that were made since the Spring Meetings; as with other documents just starting out (e.g., LDM) we focused discussion with the NCM in mind. After the FDM discussion, David gave a brief overview of the status and direction of the NDM/XML document, principally that he plans for the Version 4 NDM/XML to be the last version of this document. He indicated that he was trying to "future proof" this version of the document such that the periodic updates that have been necessary for the past few years will not be necessary in the future.

Following the FDM and NDM/XML discussions, there was insufficient time for a discussion of the RDM 5 Year Review; we will execute this process during a monthly telecon. We also did not have an opportunity to review the 5 Year Plan last updated in Spring 2024... so that will be a topic during a telecon prior to the Spring 2025 Meetings.

Finally, the WG members went over the Navigation WG Report that was scheduled to be presented after lunch at the MOIMS Closing Plenary. David went page-by-page through the report that had been developed

through the week, and members of the Working Group offered comments, suggestions, improvements, things that had been missed, etc. The report as presented at the plenary is shown in the "MOIMS Closing Plenary" section immediately below.

The dates and times for monthly telecons are listed at the end of these minutes. Meeting announcements will be sent in advance of each meeting. The single 1-hour meeting approximately once per month will be maintained. All materials from these Fall meetings (action items, agenda, introductory presentation, report, document presentations, these minutes, and various pictures) are available on the NavWG Fall 2024 CWE. Draft documents and concept papers reviewed during the meetings are in their respective directories on the NavWG Fall 2024 CWE.

1500-1630: MOIMS Closing Plenary

Attendance at the Plenary included: Daniel Fischer (MOIMS Area Director (outgoing)), David Berry (Nav Chair), Frank Dreger (Nav Deputy Chair), John Garrett (DAI Deputy Chair), Mehran Sarkarati (SM&C Chair), Stefan Gaertner (SM&C Deputy Chair), and Peter van der Plas (MP&S Chair). There were also several other members of the various MOIMS Working Groups.

As it turned out, the MOIMS Closing Plenary was not conducted immediately following lunch, although all of the MOIMS WG Chairs had indicated that it was OK with them to hold the meeting immediately following lunch. The Working Group Chairs and/or representatives delivered their reports: John Garrett for Digital Archive Ingest (DAI), Mehran Sarkarati for Spacecraft Monitor & Control (SM&C), David Berry for Navigation (NavWG), 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 NavWG Fall 2024 CWE at navwg-report-202411.pdf .

NAVIGATION WORKING GROUP CLOSING REPORT for LONDON, UK

NAV WG EXECUTIVE SUMMARY

MOIMS/Nav Meeting Demographics

Agency	NAV WG	
CNES	1	Alain Lamy
DLR	1	Ralph Kahle (virtual)
ESA	3	Frank Dreger, Vitali Braun, Jose Miguel Lozano
JAXA	1	Kiyoshi Hamada
NASA	7	David Berry, Juan Crenshaw, Cheryl Gramling, Julie Halverson, Dan Oltrogge, Patrick Zimmerman, Dianne Poster
UKSA	1	Brian Swinburne
Total	14	
Meeting Duration	5 days	
Agency Diversity	6	
Others (Non-Nav WG personnel)	10	Delta DOR WG: Javier Vicente, Chris Volk, Hiroshi Takeuchi; Time Mgmt WG: Sinda Mejri, Jon Hamkins, Eric Pitts, Christian Stangl, Yukio Yamamoto, Miriam Sawczuck SANA: Julien Bernard (SANA)

NAV WG Executive Summary

Achievements for this meeting cycle:

- Completed discussion of Conjunction Data Message V.2 (Review draft Pink Book 1.1) with members of the TraCSS system being developed by NOAA/NIST for civil space conjunction assessment
- Continued processing of comments on Tracking Data Message V.3 draft P-2.0.2 and discussion of plans for P-2.0.3 content updates
- Completed discussion of progress on 4 White Books 1.0: Launch Data Message, Fragmentation Data Message, Navigation Events Message, and Navigation Composite Message (abbreviated)

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

Interaction with other WGs:

- Met with the Delta-DOR WG to discuss requested additions to the Tracking Data Message
- Met with the Time Management WG to discuss common interests in time management
- Met with representative of SANA Operator Team to discuss various topics related to NavWG use of SANA

Problems & Issues:

- At BSI there was an apparent requirement to use "ClickShare" on computers to manage the display screen (circumvented by using direct HDMI connection). In the future such software requirements should be conveyed to WG Chairs in advance because most members are not allowed to install "unknown" software on our work computers.
- One room we were assigned was not optimally configured for a collaborative discussion of the whole group ("lunch room" style or "small group breakout style" rather than "meeting style").

Resolutions agreed upon this meeting:

- NAV-01: The Navigation WG thanks the UKSA, BSI, and the Clayton Chiswick Hotel for arranging the meeting facilities, the great daily lunches, break time refreshments, and Marylebone Cricket Club social event!
- NAV-02: MOIMS Closing Plenary should be planned in advance for immediately after lunch Friday. Current practice is disruptive.

Further Resolutions anticipated in the next 6 months:

- NAV-03: Navigation WG will request "Approval for Agency Review" polling for Tracking Data Message V.3
- NAV-04: Navigation WG will request "Approval to Publish" polling for Conjunction Data Message V.2
- NAV-05: 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. Spent considerable time discussing TDM changes in the recently distributed Pink Book 2.0.2 draft. Had joint meeting with Delta-DOR working group regarding some requested changes. Will not change target date yet, but it may be improved due to the rate of progress.	Start date 06-May-2019 End date 30-Aug-2026
MOIMS NAV	505.0	Navigation Data Messages XML Specification Version 4 Revision	Very good progress.	Start date 06-Jan-2023 End date 15-Jan-2025
MOIMS NAV	507.0	Navigation Events Message (NEM)	Good progress. We reviewed a presentation discussing the status of White Book Version 1.0 and overall plans for the project. Target date will likely change.	Start date 07-Nov-2017 End date 28-Feb-2026
MOIMS NAV	507.1	Launch Data Message	Good progress. We reviewed a draft of White Book Version 1.0. Target date will likely change.	Start date 02-Jun-2023 End date 01-Dec-2025
MOIMS NAV	508.0	Conjunction Data Message 5 Year Revision	Good progress. We addressed RIDs and other issues related to the Agency Review and made progress on the Test Plan.	Start date 14-Jan-2019 End date 30-Apr-2025
MOIMS NAV	508.2	Fragmentation Data Message	Very good progress. We reviewed a draft of White Book Version 2.	Start date 02-Jan-2024 End date 15-Sep-2026
MOIMS NAV	TBD	Navigation Composite Message	Minimal progress.... just barely got started with this new project, but its existence informed discussion of LDM & FDM	Start Date 04-Nov-2024 End Date 31-Aug-2027

NAV WG Upcoming New Work Items

- None definite... there is a possibility that we elect to revise the RDM, which we will decide in a forthcoming telecon.

NAV WG Issues for CESG/CMC

Increasingly Major Issue Related to CCSDS Standards Co-Published with ISO

- The ISO "Revisable Figure Rule" can require extensive (and expensive) effort to provide revisable figures for older documents. Suggestion to editors of all CCSDS standards that will be co-published with ISO is to restrict the use of figures only to those absolutely necessary to convey essential content.

Issue Related to CCSDS Draft Projects and Concept Papers

- Note that the CCSDS A02.1-Y-4 "Organization and Processes for the Consultative Committee for Space Data Systems" states in 6.1.1 "Every CCSDS document (or family of related documents) starts out as a CCSDS concept paper".
- A02.1-Y-4 contains extensive discussion about the purpose, content, etc. of concept papers, but there is no current way to associate a concept paper with a Draft Project on the CWE when a CMC Poll is requested.
- It seems logical that a Concept Paper could be attached to the Draft Project form.

NEXT TELECONS:

We will continue the 1-hour telecons approximately monthly between Fall 2024 and Spring 2025 Meetings (NOTE: US Daylight Savings Time begins 09-Mar-2025, Europe Daylight Savings Time begins 30-Mar-2025). The schedule for the monthly telecons is below:

- 15-Jan-2025 1400-1500 UTC
- 19-Feb-2025 1400-1500 UTC
- 02-Apr-2025 1300-1400 UTC
- 07-May-2025 1300-1400 UTC
- Spring Meetings: will be sponsored by NASA in the USA, possibly as late as June. Dates, location, and other details are still under review by the CMC/CESG. Telecon schedule may be adjusted accordingly.



Stop Action Fun Sequence At Abbey Road



Frankly, He's Enjoying Himself!