| **Page** | **Section** | **Line** | **Type** | **Comment/ Rationale** | **Source of Comment (Name/Agency)** | **Suggested Disposition** | **Disposition**  **(Completed by Principal Editor)** |
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|  |  |  |  | **NOTE: ALL PAGE REFERENCES ARE WITH RESPECT TO THE "CHANGES TRACKED" VERSION OF THE DRAFT.** |  |  |  |
| iii-iv | Foreword | All | ed | Note: The CCSDS Editor maintains the current list of all observer agencies, etc., so we don't have to worry about that. | David S. Berry / NASA | You can ignore changes to this page in the future. | Accepted. Leaving current changes in place, and ignore in future |
| vi | Table of Contents & Table of Figures |  | ed | The Table of Contents and Table of Figures should be re-done in each draft. The current Table of Figures references the NHM and SMM, | David S. Berry / NASA | Re-do the Table of Contents and Table of Figures for each draft. | Accepted. Section TOC and Figure TOC now updated. |
| 1-1 | 1.1 | 6-7 | te/ed | The phrase "the definitions and conventions associated with inter-Agency cross-support situations involving the transfer of navigation data" might apply more to the OTHER Green Book. Much of the front matter in this document was copied from that document. | David S. Berry / NASA | Consider whether or not this part of the sentence applies to this document. If not, delete it. If it applies, OK to retain. | Interagency is mentioned multiple times in later sections and appears to be applicable here. (3.2 Agency Center, 3.3.2, etc.) |
| 1-2 | 1.3 | 2 | ed | Suggested word addition. | David S. Berry / NASA | From: "definition of terms"  To: "definition of key terms" or "definition of fundamental terms" | Accepted. Added ‘key’ |
| 1-3 | 1.4 | [19] & [20] | ed | Note that the web pages for these two references resolve to "https://" links. The "http://" works, but is converted to "https://" by my browser. This comment also applies to p.4-17, sec 4.5.1. | David S. Berry / NASA | From: http://  To: https:// | Accepted all three.  Caused by http to https migration? Affecting urls in all books? |
| 2-1 | 2.2.2 | "Orbit", line 1 | ed | Word choice. | David S. Berry / NASA | From: "... around a large central body..."  To: '... around a larger central body..."  NOTE: the body is not necessarily "large", but with respect to the spacecraft it is. | Accepted |
| 2-1 | 2.2.2 | "Orbit", line 4 | ed/te | Word choices | David S. Berry / NASA | From: "... orbiting the large central body through space."  To: "... around the central body through space." | Accepted |
| 2-1 | 2.2.2 | "Attitude", line 3 | ed/te | Unnecessary repetition | David S. Berry / NASA | From: "... depends on the attitude stabilization mode ..."  To: "... depends on the stabilization mode ..."  Since we are already talking about attitude, and the word "attitude" has already been used in the sentence, "attitude stabilization mode" feels redundant. | Removed second ‘attitude’.  Also removed ‘the attitude of’ in the following sentence for similar redundancy reasons. |
| 2-3 | 2.2.3 | 2-3 | ed | Sentence flow. | David S. Berry / NASA | From: "... observations from navigation hardware and orbit and attitude parameters or ephemeris...  To: "... observations from orbit parameters, attitude parameters, and ephemeris ...  NOTE: The beginning of this phrase refers to "navigation hardware" which may be a holdover from the NHM days. | Nav Hardware here may be referring to the tracking equipment producing the measurements and obs. Still awkward sentence though. Modified. |
| 2-3 | 2.2.3 | third from bottom | ed | Unnecessary, diminishing word | David S. Berry / NASA | From: "... process is just the result ..."  To: "... process is the result ..." | Accepted |
| 3-2 | 3.2 | first full para, last line | ed | Missing indefinite article. | David S. Berry / NASA | From: "... referred to as complex."  To: "... referred to as **a** complex." | Accepted |
| 3-4 | 3.3.2(b) | 4 | ed | Word choice. Uses "protocol", when "format" would be better... in CCSDS, the word "protocol" is generally used for command/telemetry standards. | David S. Berry / NASA | From: "... each with its own protocol"  To: "... each with its own format" | Accepted |
| 4-1 | 4.1 | para 4 | ed/te | This paragraph states what will be described by the NEM, but not the RDM. | David S. Berry / NASA | Consider either adding a very brief (commensurate length) statement about what will be provided by the RDM, or removing the statement about what will be provided by the NEM. | Accepted |
| 4-2 | 4.1 | CDM (mid page) | ed/te | Better description of relationship | David S. Berry / NASA | From: "... different space objects at different times"  To: "... two space objects at their time of closest approach". | Accepted |
| 4-2 | 4.1 | PRM (mid page) | ed/te | Bettter description of content | David S. Berry / NASA | From: "... at one or more times"  To: "... at one or more future times" | Accepted |
| 4-2 | 4.1 | RDM (mid page) | ed/te | Word choice | David S. Berry / NASA | From: "The RDM contains information that defines..."  To: "The RDM contains information that describes..." | Accepted |
| 4-4 | 4.2.1 | end para 2 | te | More TDM users | David S. Berry / NASA | Add at end "ESA has also supported China's Chang-E-2 mission and Russia's Phobos-Grunt mission with TDMs. | Accepted. And added a JSC case |
| 4-5 | 4.2.2 | last para | te | This paragraph mentions the ODM revisions. | David S. Berry / NASA | Consider adding a similar paragraph to the TDM section 4.2.1 and the ADM section 4.2.3 | Accepted |
| 4-6 | 4.2.3 | para 2, line 4 | ed | Typo. | David S. Berry / NASA | From: "The recipient need to have..."  To: "The recipient needs to have..." | Accepted |
| 4-7 | 4.2.4 | line 2 | ed | Word choice | David S. Berry / NASA | From: "... a CDM gets..."  To: "... a CDM is..." | Accepted |
| 4-7 | 4.2.4 | line 3-4 | ed | Add acronym. | David S. Berry / NASA | From: "... Conjunction Assessment Risk Analysis."  To: "... Conjunction Assessment Risk Analysis (CARA)." | CARA acronym is specific to GSFC. Propose non-specific ‘conjunction assessment analysis’ |
| 4-7 | 4.2.4 | 2nd full para, line 1 | ed | Missing word. | David S. Berry / NASA | From: "... final product of CA results and intended..."  To: "... final product of CA results and **is** intended..." | Accepted |
| 4-7 | 4.2.4 | last para, line 1 | ed | Typo. | David S. Berry / NASA | From: "... primary means on notifying...  To: "... primary means of notifying ..." | Accepted |
| 4-9 | 4.3.1 | 2nd full para, line 3 | ed | Removing redundancy, improving flow. | David S. Berry / NASA | From: "It contains the specifications for an RDM designed for..."  To: "It contains specifications for ..." | Accepted.  Note: paragraph extracted directly from RDM section 1.2 |
| 4-11 | 4.3.2 |  | ed/te | I would add a bit more on the NEM. Suggested disposition here contains material from the Concept document. | David S. Berry / NASA | Consider adding after the existing text material from the NEM Concept Paper that is at the bottom of this CRM (so situated to facilitate understanding of formatting, etc.) | Accepted |
| B-1 |  |  | ed | I would remove "FDC" because it is not used in the document (it appeared in earlier draft versions of the Green Book) | David S. Berry / NASA | Consider removing. | Accepted |
| B-2 |  |  | ed | I would remove "NWG" and "OC" because they are not used in the document (they might have appeared in earlier draft versions of the Green Book) | David S. Berry / NASA |  | Accepted |
| B-1 |  |  | ed | I would remove "WG" because it is not used in the document (it might have appeared in earlier draft versions of the Green Book) | David S. Berry / NASA | Consider removing. | Accepted |
| 2-3 | 2.2.3 |  |  | In the paragraph on CA, I am not sure attitude information is exchanged? If not, I suggest removing ‘and attitude solutions’ in that paragraph. | J. Halverson/NASA | Suggestion | Sentence appears to be separate paragraph. Inserted carriage return. |
| 2-4 | 2.2.3 |  |  | The material starting with the sentence ‘For the most part, … ‘ to the end should be moved to the end of the previous paragraph on p. 2-3. It is out of place in a paragraph about CA. | J. Halverson/NASA | Fix | Accepted, see above. 2.2.3 may need expansion to better incorporate the newer messages: CDM, PRM, RDM |
| 3-5 | 3.3.2 |  |  | In the top left box of Figure 3-4, should it say ‘Operations Center’ like the box on the upper right? | J. Halverson/NASA | Fix | Accepted |
| 4-6 | 4.2.3 |  |  | Recommend the first full sentence begin with ‘The recipient needs to have, therefore, angular velocity data or the proper modeling of spacecraft attitude dynamics, atmospheric torque …’ | J. Halverson/NASA | Suggestion | Accepted |
| 4-6 | 4.2 3 |  |  | In the second to last paragraph of the section, it starts with ‘The APM allows for … as well as simple modeling of solar pressure and atmospheric torque…’. The APM does not allow for modeling of those torques, just a single maneuver torque. I think the words regarding solar pressure and atmospheric torques should be removed. | J. Halverson/NASA | Fix | (Words directly from ADM Blue Book). Take it to mean the effects of those forces can be modeled by recipient agency using APM info, not that the APM itself contains that info |
| 1-1 | 1.1 | 11 | GE | The Defn & Conventions Green Book is mentioned. Would it also make sense to mention the SANA registries in the midst of development? | C. Gramling/NASA GSFC | Consider adding text to refer the reader to the SANA registries on time systems, coordinate frames, element sets. | Accepted. Added bookmark for SANA normative annexes (modified other SANA bookmark to NDM XML schemas |
| 1-1 | 1.1 | 13 | GE | If the 3rd paragraph lists each type of nav data, what is the intent of the second paragraph? If the 2nd paragraph remains and lists “orbit, attitude, maneuver, and conjunction”, should the statement be broadened to include Reentry, Tracking Data, Pointing? | C. Gramling/NASA GSFC | Consider whether the statement of paragraph 2 is needed; if so, should each element of the message set should be included in the statement. | Accepted, added additional message types |
| 1-1 | 1.1 | 19 | TE | RE: “ground system information”, “ground system” is a broad term, and its use here really only refers to the network asset portion on the ground, not really the MOC/SOC. | C. Gramling/NASA GSFC | Consider replacing “ground system” with “network ground element” or “network ground system”. | Accepted, removed “ground”, as relay asset information is also passed. |
| 1-2 | 1.3 | 1,2 | TE | RE: “Section 2 provides a brief overview of the spacecraft navigation and flight dynamics processes, as well as the definition of terms relevant to this process.” Navigation and flight dynamics are not necessarily distinct. Since these are “navigation” data messages, suggest removing “and flight dynamics”. | C. Gramling/NASA GSFC | Consider removing the overlapping term “flight dynamics” from the statement. | Unchanged.  These can be distinct, and are discussed as such in 2.2.3. |
| 2-2 | 2.2.2 | Para 8 | TE | RE: “The GN&C system includes all the hardware (sensors and actuators) and software necessary for both onboard orbit and attitude determination and control.” The GN&C components can be used for ground-based OD & AD. | C. Gramling/NASA GSFC | Consider updating the statement to read: “The GN&C system includes all the hardware (sensors and actuators) and software necessary for both onboard or ground-based orbit and attitude determination and control.” | Accepted |
| 2-2 | 2.2.3 | 2, 6 | TE | It may be useful to clarify the term “reconstruction”. There are two interpretations: one is a near-real-time update, post-event, based on [telemetry] data available in that time-frame; the other is an update that occurs further out in time after a more comprehensive set of observations (sometimes from independent systems) is accrued and processed to obtain the new state. Many people call the second interpretation “calibration” instead of reconstruction, which is reserved for the first interpretation. | C. Gramling/NASA GSFC | Consider defining what is meant by “reconstruction” and/or introduce the term “calibration”. | Discuss. “Calibration of hardware” is already used later in the sentence. Implying the same thing or potential overload of info? |
| 3-1 | 3.2 | 1-3 | TE | In the Nav messages, “property” can also apply to a celestial object or environmental model (e.g. GM of body, deg/order of grav model, SolFlux level). The statement should include text on environment models. | C. Gramling/NASA GSFC | Consider changing the statement FROM: “...properties represent the physical attributes of spacecraft, rovers, equipment, and tracking stations that are needed...” TO: “...properties represent the physical attributes of spacecraft, rovers, equipment, tracking stations, and the relevant environment that are needed...” | Accepted |
| 3-1, + | 3.2, +; AppA | 19-26, + | TE, and GE | Given that CCSDS also has a NDM for XML, there is a possibility that the generically-used term “navigation data message” may be confused with the Recommended Standard NDM XML. (I recognize the term is in lower case, but that may still be open to mis-interpretation as the specific CCSDS message.) Also, under “participants”, the term “navigation data message” is used again; this may be mis-interpreted to infer that spacecraft would provide any navigation data in a CCSDS Recommended Standard format, which is not the case, nor expected. Similarly, for use of the phrase “Navigation data message” in the definition of the term “spacecraft”. This comment, in a general sense, applies to Section 4.4, also; clarification should be included to differentiate the XML structure from the general classification of NDM messages.  “participant” is also listed in the Glossary as an entity that receives or transmits nav data messages. Any correction to 3.2 should similarly be applied to the glossary term. | C. Gramling/NASA GSFC | For the term “navigation data message”, please consider an alternative term that won’t readily be confused for the CCSDS NDM XML format.  Please consider clarifying that the use of the phrase “navigation data message” in the definition of “participant” and of “spacecraft” does not necessarily imply that spacecraft implement the exact formats in CCSDS Recommended Standards. As the term “spacecraft” implies, the formats used may be optimized. | Discuss. It’s “XML Spec for NDMs”. Can this be readily confused with ndm?  Concur. For both, believe reducing to “navigation data” will be sufficient.  Updated glossary participant definition |
| 3-2 | 3.2 | 8 | TE | In the term “ground stations and space networks”, the definition should not include the term itself, “space network”. | C. Gramling/NASA GSFC | Please consider re-phrasing from “or a space network” to “or a network of space-borne assets with a ground-based terminal”. | Accepted |
| 3-2 | 3.2 | 14 | TE | To include space network situations, there should be a corollary explanation to the statement “Some agencies have multiple stations operated by a central entity, referred to as complex.” | C. Gramling/NASA GSFC | Please consider rephrasing from “Some agencies have multiple stations operated by a central entity, referred to as complex.” To “Some agencies have multiple ground stations operated by a central entity, referred to as complex. Similarly, multiple space-borne assets in a network operated by a central entity are referred to as a fleet.” | Accepted |
| 3-3 | 3.3.1 | 16 | ED | It may be helpful to move the following sentence earlier in the document to instruct the role of a spacecraft in data exchanges “In other words, spacecraft telemetry containing navigation data being downlinked to the ground is treated using separate CCSDS standards.” | C. Gramling/NASA GSFC | Please consider articulating these separate CCSDS standards for spacecraft telemetered/transmitted navigation data earlier in the document. | Accepted. Moved into first paragraph of 3.3.1 |
| 3-3 | 3.3.2 | 2-3 | ED | The following sentence could be cleaned up to remove multiple use of the same word: “It is not possible to describe every possible navigation session in detail, but navigation sessions generally have the following three general characteristics:” | C. Gramling/NASA GSFC | Please consider rephrasing the sentence from “It is not possible to describe every possible navigation session in detail, but navigation sessions generally have the following three general characteristics:” to “It is not possible to describe every conceivable navigation session in detail, but navigation sessions overall have the following three general characteristics:” or something similar. | Accepted |
| 3-5 | Fig 3-4 | Fig | TE | The figure lists some of the content of messages for three different messages, but does not refer to the message name itself. To be complete, Fig 3-4 should include the CCSDS Navigation message name. | C. Gramling/NASA GSFC | Please consider including the CCSDS Navigation message name in the message “content’ portion of the picture, e.g. OPM, APM. | Accepted |
| 4-2 | 4.1 | 19 | TE | Given where the NEM is going, the brief summary may be a bit too limited “The NEM provides a framework for the exchange of orbit and attitude events.” | C. Gramling/NASA GSFC | Please consider an addition to the statement to include related data “The NEM provides a framework for the exchange of orbit, attitude, and related events.” | Accepted |
| 4-2 | 4.2.1 | 2nd from bottom | TE | The TDM accommodates both ground-based and space-relay-based tracking data. To avoid repetition of types, suggest the opening phrase “ground-based radio metric tracking data types:” be broadened. | C. Gramling/NASA GSFC | Please consider changing the opening phrase from “ground-based radio metric tracking data types:” to “ground- and space-based radio metric tracking data types:” or something similar that distinguishes the data from a separate crosslink type of data. | Accepted |
| 4-3 | 4.2.1 | Para 1 | ED | The paragraph structure would make more sense to have the general statement “For any given TDM data type, the metadata keywords fall into three categories: required metadata, situation-specific required metadata, and completely optional metadata.” precede the details that start with “There are a few metadata keywords that are required for every TDM;” | C. Gramling/NASA GSFC | Please consider re-ordering the sentences from general to detailed per the comment. | Accepted |
| 4-5 | 4.2.2 | 12 | TE | Given the large list of specific spacecraft provided in the examples, it’d be judicious to include at least one specific mission from GSFC that uses ODM, such as MMS. | C. Gramling/NASA GSFC | Please consider adding the statement “The Magnetospheric Multiscale Mission (MMS) uses OEMs for definitive and predictive products for mission operations and science.” after “...Space Data Association.” and prior to “Several other implementations...” | Accepted |
| 4-6 | 4.2.3 | 1 | ED | Grammatical: from “The recipient need to have...” to “The recipient needs to have...” | C. Gramling/NASA GSFC | Please update the grammatical error per the comment. | Accepted - in David’s RIDs |
| 4-6 | 4.2.4 | Para 2 line 1 | TE | Not all entities use the NASA CARA office located at GSFC for their conjunction assessments. Suggest the acronym CARA not be used in the sentence “CARA considerations when assessing the risk include the...”. | C. Gramling/NASA GSFC | Please consider changing the references from the CARA office to the CA risk assessment process, from “CARA considerations when assessing the risk include the...” to “CA considerations when assessing the risk may include the...” | Accepted. I had already begun modifying CARA mentions, as those are GSFC specific. |
| 4-7 | 4.2.4 | 16; last para line 1 | ED | Grammatical: from “It is their primary means on notifying...” to “It is their primary means of notifying...” | C. Gramling/NASA GSFC | Please consider making the change in the comment. | Accepted - in David’s RIDs |
| 4-7 | 4.2.5 | Section line 6 | ED | Grammatical: from “The requestors just want to point...” to “The requestors may just want to point...” | C. Gramling/NASA GSFC | Please consider making the change in the comment. | Accepted with mods |
| 4-7 | 4.2.5 | Para 2 | ED/TE | The examples listed following the statement “The following are examples of science pointing requests:” are text-based representations of a request that would need to be translated into a PRM format. Given the previous two sentences, “PRMs could be transmitted from scientists who operate an onboard instrument to the operator of the spacecraft. These could be referred to as science pointing requests.”, the examples may be interpreted as representing actual PRMs. | C. Gramling/NASA GSFC | To avoid any confusion, please consider changing the sentence from “The following are examples of science pointing requests:” to “The following are text representations of examples of science pointing requests:” or similar. | Accepted. Also applies to Paragraph 3. |
| 4-8 | 4.3.1 | 4 | TE | RE: “These messages can be used to inform spacecraft owners/operators of predicted re-entries or warn civil protection agencies about potential ground impacts.” Couldn’t it also be the other way around – that the SC O/O informs the SSA/SST? | C. Gramling/NASA GSFC | If the comment is correct, that the RDM can be used to inform SSA/SST providers, then please consider adjusting the statement to “These messages can be used to inform spacecraft owners/operators of predicted re-entries or warn civil protection agencies about potential ground impacts, or conversely to inform SSA/SST providers of the prediction.” | Discuss |
| 4-5, 4-6, 4-9 | 4.2.2, 4.2.3, 4.3.2 |  | GE | If the NEM, which is in early development stage is included in section 4.3.2, then it seems that there should be similar mention of the OCM and ACM. Section 4.2.2 refers to the ODM 5-yr review, but doesn’t provide any content. For consistency, either remove the NEM of section 4.3.2, or add sections in 4.3 that offer insight into the OCM and ACM portion of the ODM and ADM, respectively. | C. Gramling/NASA GSFC | Provide parallel and consistent levels of content in the Message Definition Green Book. | Discuss. Thought would be for the latter – to add sections on the OCM and ACM |
| 4-9 | 4.4 | 5 | TE | Similar to comment above, in the statement “Although the use of ODMs and CDMs in the end-to-end CA and CARA processes...” the process itself is CA; CARA is a program office designation that performs CA. | C. Gramling/NASA GSFC | Please consider changing the text from “Although the use of ODMs and CDMs in the end-to-end CA and CARA processes...” to “Although the use of ODMs and CDMs in the end-to-end CA process...” | Accepted |
| 4-10 | 4.4 | 8 | TE | To perform an orbit or attitude maneuver, a PRM is not required as identified in the statement “...an exchange of a PRM is required for spacecraft orbit and attitude maneuver planning, execution, and reconstruction.” A PRM may instigate sc orbit/attitude mnvr planning, etc. | C. Gramling/NASA GSFC | Please consider changing the phrasing from “an exchange of a PRM is required for spacecraft orbit and attitude maneuver planning, execution, and reconstruction.” To “an exchange of a PRM acts as an instigator for spacecraft orbit and attitude maneuver planning, execution, and reconstruction.” | Accepted with mod to ‘catalyst’ |
| A-2 | AppA | 4 | TE | The glossary content for the term “navigation” includes redundant text (position and orbit) and overlapping information (orientation and attitude info included) “navigation: The process used to find the present and imminent future position, orbit and orientation of a spacecraft using a series of measurements (see also 2.2.1). For purposes of this document, attitude and maneuver information are included as part of the spacecraft navigation process.” | C. Gramling/NASA GSFC | Please consider updating the definition from “navigation: The process used to find the present and imminent future position, orbit and orientation of a spacecraft using a series of measurements (see also 2.2.1). For purposes of this document, attitude and maneuver information are included as part of the spacecraft navigation process.” To “navigation:  The process used to find the present and future orbit and orientation of a spacecraft using a series of measurements (see also 2.2.1).  For purposes of this document, attitude and maneuver information is included as part of the spacecraft navigation process.” | Accepted. Mod in second sentence. |
| B-1 | AppB | 6 | TE | To what does the acronym CARA refer? The term has different meaning per the associated context within different parts of the document. If CARA is the program at GSFC, the acronym stands for Conjunction Assessment Risk Analysis. If CARA refers to the process, (which, per the acronym definition, is Collision Avoidance Risk Assessment) then the distinction should be clarified in the document. | C. Gramling/NASA GSFC | Please clarify use of the term CARA (whether the process or the program) and provide a consistent usage throughout the document. | Process only, with the other RIDs in place, should now be clarified |

See Comment at p.4-11 relevant to the following material:

Satellite operational activities require the exchange of different kinds of data. In addition to the classical data types of orbit, attitude, and measurements that can be handled by the corresponding CCSDS standards, orbital events are another data type for which no standard currently exists. Orbital events (and more precisely predicted orbital events) constitute a major data type used in control centers for operations. Orbital events describe when and possibly how some situations (generally related to a satellite) occur. An orbital event describes when and possibly how a certain situation related to one (or maybe several) satellite(s) occur(s).

Typical events are for instance:

- when a satellite enters/leaves the Earth shadow or penumbra (i.e. beginning / end of eclipses),

- when the satellite becomes visible/invisible from some Earth ground station with a given elevation (ground station visibilities AOS/LOS),

- more generally, when some geometric condition is met (in relation to onboard sensors, celestial bodies, possibly other satellites, …),

- when some orbit parameter has some specific values (satellite crosses the Equator),

- and so on…