Subject: Summary of CCSDS Navigation Working Group SubCommittee Meeting 25-Apr-2007
Date: Tuesday, August 2, 2011 at 10:39:37 PM Pacific Daylight Time
From: Berry, David
To: moims-nav@mailman.ccsds.org
Attachments: TDM-SI-Units-final-changesaccepted.pdf, TDM-SI-Units-final-changestracked.pdf

All:

These minutes document the CCSDS Navigation Working Group Subcommittee Meeting held at ESOC/Darmstadt Wednesday 25-Apr-2007. There were also periodic brief discussions on CCSDS Navigation WG topics throughout the 3 day meetings, but the bulk of the CCSDS topics were held on 25-Apr-2007. These meetings were organized as "splinter sessions" off the main meeting set, the ESA/JPL Navigation Technical Interchange Meeting #10.

I should have put these out earlier, but it's been a crazy week...

Participants: Juergen Fertig (ESA), Jacques Foliard (CNES), Reinhard Kiehling (DLR), Siegmar Pallaschke (ESA), David Berry (NASA/JPL)

Planned Agenda:

25-Apr-2007
==========
0. Change of Telecon Plan
1. Discussion of Units in the TDM
2. Discussion of ODM updates
3. Discussion of TDM Prototyping
4. Discussion of TDM RID's
5. Other Topics
6. Establishment of next telecon

Proceedings:
==========

0. Change of Telecon Plan
==========
It was determined that the topics for the subcommittee meeting would not require a telecon later in the day with other members of the group, and only one person (John Van Eepoel) had expressed ability to participate. Accordingly, the tentative plan for a telecon on 25-Apr-2007 1600 UTC was cancelled. Juergen sent out email to cancel the telecon.

1. Discussion of Units in TDM
==========
The attendees reviewed the attachment on units in the TDM that had previously been distributed, and dealt with all of the open items. The following decisions were made, and are reflected in the attachments to this message:

CARRIER_POWER: units will be changed from "dBm" to "dBW", per discussion and confirmation with Enrico Vassallo.

Subsequently the 401 Modulation Standards Blue Book was checked to see the units that were used in that document, since we should be consistent with the 401 Standard. This confirmed the decision to use "dBW" as the units for carrier power. It was determined that there is no issue with the use of the reference for the units (i.e., we will use "dBW" instead of the unreferenced "dB").

PC_N0: Consistent with the discussion of units for CARRIER_POWER, the units for PC_N0 will continue to use the reference. Also, we will change from "dB-Hz" to "dBHz" (without a dash), to be consistent with the notation convention of "dBW".

PR_N0: Same argument/logic as PC_N0.

RANGE: "RU" will remain as the units. No issue.

STEC: "TECU" will remain as the units. The information about how the TECU converts to moles (SI unit for conveying the amount of a substance) will be added to the TDM text. No issue.

Based on these decisions, the applicable sections of the TDM document will be revised, and the matter of units for the TDM is now considered completely resolved.

2. Discussion of ODM updates
==========
There was significant discussion on the ODM Pink Book 0.3; several felt that this topic was not suitable for a telecon, and the proceedings tended to confirm this hypothesis given that we used the whiteboard and projeted displays of the document to focus discussion. The group confirmed the need to accommodate the TLE in some fashion, though Juergen pointed out that there were potential issues with one of the requirements in the ODM (specifically, to not require software from other agencies... for creating and propagating TLE's, the SGP4/SDP4 program must be used). David showed in Annex C where this requirement had not been accepted for the OTBDM, which is the message that was added to accommodate the TLE.

Siegmar suggested that there were 2 apparent choices: (a) incorporate the TLE exactly into the ODM, or (b) develop a new message type. The group rather quickly dismissed the notion of incorporating the TLE directly into the ODM. David then showed the group the Annex B of the Pink Book 0.3, which is shows a TLE "forced" into an OPM format. Also, the format of the OTBDM was shown. The group agreed that the OTBDM format described in Chapter 4 of the Pink Book was the preferred direction, rather than trying to force the TLE data into the OPM format. Accordingly, Annex B will be removed in Pink Book 0.4, and the development of the OTBDM in Chapter 4 will proceed.

Another significant decision about the OTBDM was that the covariance matrix would be based on the Cartesian state (epoch, x, y, z, xdot, ydot, zdot) instead of the arrangement currently in the book. Thus the covariance matrix in the OPM and OTBDM will have the same keywords and structure.

The final significant decision about the OTBDM is that the group felt the name of the new message should be "OTM", for "Orbit TLE Message"; this is one of the options proposed in Annex G of the TDM document.

David has the action item to convey the outcomes of these discussions to David Finkleman, so they can be considered by TC20/SC14/WG3 at their upcoming meetings in Beijing.

For the OEM, there was also discussion of the covariance matrix and how it could best be accommodated in the OEM format. Siegmar suggested that the data portion of the message be divided with new keywords COVARIANCE_START/COVARIANCE_END and EPHEMERIS_START/EPHEMERIS_END. Then within the covariance section, there would be one 6x6 covariance matrix associated with each solution that makes up the ephemeris data section.

3. TDM Prototyping Status

Norbert Schlecht of ESA Flight Dynamics has been working at comparing TDM's generated by JPL to official tracking data delivered by JPL. He has found very good correspondence between the JPL Orbit Data File and the representation of the data in a TDM. He has also coded a version of a program that can convert IFMS data for range, 2-way Doppler and angles into the TDM format. During the course of his presentation he raised a number of good questions. One of the more notable outcomes of the Technical Interchange Meeting is that JPL and ESA expressed a preference to use the TDM format for the exchange of Phoenix mission Delta-DOR between the agencies. The draft #1 version of the TDM Prototyping Plan was reviewed in some detail. David will publish an updated version of the plan.

4. Continued discussion of TDM RIDs

There was detailed discussion of the RID's filed by Trevor Morley on the TDM. The group will consider these further in the next telecon, however, we now have a great deal of understanding of the context within which the RID's were filed.

5. Other Topics

The group discussed the abstract submitted by John Van Eepoel for the Annapolis meeting of the ISSFD. David will contact John about the idea of offering other members of the group co-authorship opportunities.

6. Establishment of Next Telecon

Attendees set the next telecon for Wednesday 09-May-2007, 1500-1600 UTC. Probable agenda for next telecon:

(a) Action Item Status (revise target dates)
(b) ADM Prototyping Status
(c) TDM Prototyping Status
(d) Continued discussion of TDM RIDs
(e) Continued discussion of ODM updates
(f) Establishment of next telecon

Regards,
David

More Discussion of TDM Units With Respect to the SI System

(Updated with Results of Group Discussion)

Keyword	Units	Discussion	Issues
ANGLE_1	deg	Unit outside the SI that is accepted for use with the SI	
ANGLE_2	deg	Unit outside the SI that is accepted for use with the SI	
CARRIER_POWER	dBW	Unit outside the SI that is accepted for use with the SI per [4], but should be used only as “dB”, without the reference, per [3]. Based on group discussion, units will be changed from "dBm" to "dBW", per discussion and confirmation with Enrico Vassallo. Also, the 401 Modulation Standards Blue Book was subsequently checked and confirmed to use "dBW" as the units for carrier power. It was determined that there is no issue with the use of the reference for the units (i.e., we will use "dBW" instead of the unreferenced "dB").	
CLOCK_BIAS	s	Approved SI unit for time	
CLOCK_DRIFT	s/s	Approved SI unit for time	
DOPPLER_INSTANTANEOUS	km/s	Approved SI derived unit for velocity, approved SI prefix (kilo)	
DOPPLER_INTEGRATED	km/s	Approved SI derived unit for velocity, approved SI prefix (kilo)	
DOR	s	Approved SI unit for time	

Keyword	Units	Discussion	Issues
PC_N0	dBHz	Unit outside the SI that is accepted for use with the SI per [4], but should be used only as “dB”, without the reference, per [3]. Consistent with the discussion of units for CARRIER_POWER, the units for PC_N0 will use the reference. Also, we will change from "dB-Hz" to "dBHz", to be consistent with the notation of "dBW".	
PR_N0	dBHz	Unit outside the SI that is accepted for use with the SI per [4], but should be used only as “dB”, without the reference, per [3].Consistent with the discussion of units for CARRIER_POWER, the units for PC_N0 will use the reference. Also, we will change from "dB-Hz" to "dBHz", to be consistent with the notation of "dBW".	
PRESSURE	hPa	Approved SI derived unit for pressure, approved SI prefix (hecto)	
RANGE	km	Approved SI unit for length, approved SI prefix (kilo)	
RANGE	RU	Function of Hz, which is an approved derived SI unit for frequency. Group determined no issue.	
RECEIVE_FREQ	Hz	Approved SI derived unit for frequency	
RECEIVE_FREQ_n (n = 1, 2, 3, 4, 5)	Hz	Approved SI derived unit for frequency	
RHUMIDITY	%	Defined as “0.01”, thus just a number, per reference [3], [4]	

Keyword	Units	Discussion	Issues
STEC	TECU	A quantity of electrons per square meter, which is a mixture of information with units, deprecated practice per [3]. To be strictly SI, the TECU should be redefined in terms of the "mole", i.e., moles per square meter. 1 TECU = 10^{16} electrons/m^2 = 1.661 x 10^{-8} mol/m^2 "TECU" will remain as the units, however, the information about how the TECU converts to moles (SI unit for conveying the amount of a substance) will be added to the TDM text. No issue.	
TEMPERATURE	K	Approved SI unit for thermodynamic temperature	
TRANSMIT_FREQ_n (n = 1, 2, 3, 4, 5)	Hz	Approved SI derived unit for frequency	
TRANSMIT_FREQ_RATE_n (n = 1, 2, 3, 4, 5)	Hz/s	Approved SI derived unit for frequency, approved SI unit for time	
TROPO_DRY	m	Approved SI unit for length	
TROPO_WET	m	Approved SI unit for length	
VLBI_DELAY	s	Approved SI unit for time	

References:

[1] IEEE/ASTM SI 10™-2002, "American National Standard for Use of the International System of Units (SI): The Modern Metric System", 30-Dec-2002.

[2] http://physics.nist.gov/cuu/Units/units.html, website of US National Institute

[3] http://physics.nist.gov/Pubs/SP811/ , Guide for the Use of the International System of Units (SI)

[4] ISO-80000-3, "Quantities and units Part 3: Space and time", 2006.

More Discussion of TDM Units With Respect to the SI System

(Updated with Results of Group Discussion)

Keyword	Units	Discussion	Issues
ANGLE_1	deg	Unit outside the SI that is accepted for use with the SI	
ANGLE_2	deg	Unit outside the SI that is accepted for use with the SI	
CARRIER_POWER	~~dBm~~dBW	Unit outside the SI that is accepted for use with the SI per [4], but should be used only as “dB”, without the reference, per [3]. Based on group discussion, units will be changed from "dBm" to "dBW", per discussion and confirmation with Enrico Vassallo. Also, the 401 Modulation Standards Blue Book was subsequently checked and confirmed to use "dBW" as the units for carrier power. It was determined that there is no issue with the use of the reference for the units (i.e., we will use "dBW" instead of the unreferenced "dB").	~~Maybe~~
CLOCK_BIAS	s	Approved SI unit for time	
CLOCK_DRIFT	s/s	Approved SI unit for time	
DOPPLER_INSTANTANEOUS	km/s	Approved SI derived unit for velocity, approved SI prefix (kilo)	
DOPPLER_INTEGRATED	km/s	Approved SI derived unit for velocity, approved SI prefix (kilo)	
DOR	s	Approved SI unit for time	

Keyword	Units	Discussion	Issues
PC_N0	~~dB-Hz~~dBHz	Unit outside the SI that is accepted for use with the SI per [4], but should be used only as “dB”, without the reference, per [3]. Consistent with the discussion of units for CARRIER_POWER, the units for PC_N0 will use the reference. Also, we will change from "dB-Hz" to "dBHz", to be consistent with the notation of "dBW".	~~Maybe~~
PR_N0	~~dB-Hz~~dBHz	Unit outside the SI that is accepted for use with the SI per [4], but should be used only as “dB”, without the reference, per [3].Consistent with the discussion of units for CARRIER_POWER, the units for PC_N0 will use the reference. Also, we will change from "dB-Hz" to "dBHz", to be consistent with the notation of "dBW".	~~Maybe~~
PRESSURE	hPa	Approved SI derived unit for pressure, approved SI prefix (hecto)	
RANGE	km	Approved SI unit for length, approved SI prefix (kilo)	
RANGE	RU	Function of Hz, which is an approved derived SI unit for frequency. Group determined no issue.	~~Maybe~~
RECEIVE_FREQ	Hz	Approved SI derived unit for frequency	
RECEIVE_FREQ_n (n = 1, 2, 3, 4, 5)	Hz	Approved SI derived unit for frequency	
RHUMIDITY	%	Defined as “0.01”, thus just a number, per reference [3], [4]	

Keyword	Units	Discussion	Issues
STEC	TECU	A quantity of electrons per square meter, which is a mixture of information with units, deprecated practice per [3]. To be strictly SI, the TECU should be redefined in terms of the "mole", i.e., moles per square meter. 1 TECU = 10^{16} electrons/m^2 = 1.661 x 10^{-8} mol/m^2 "TECU" will remain as the units, however, the information about how the TECU converts to moles (SI unit for conveying the amount of a substance) will be added to the TDM text. No issue.	~~Maybe~~
TEMPERATURE	K	Approved SI unit for thermodynamic temperature	
TRANSMIT_FREQ_n (n = 1, 2, 3, 4, 5)	Hz	Approved SI derived unit for frequency	
TRANSMIT_FREQ_RATE_n (n = 1, 2, 3, 4, 5)	Hz/s	Approved SI derived unit for frequency, approved SI unit for time	
TROPO_DRY	m	Approved SI unit for length	
TROPO_WET	m	Approved SI unit for length	
VLBI_DELAY	s	Approved SI unit for time	

References:

[1] IEEE/ASTM SI 10™-2002, "American National Standard for Use of the International System of Units (SI): The Modern Metric System", 30-Dec-2002.

[2] http://physics.nist.gov/cuu/Units/units.html, website of US National Institute

[3] http://physics.nist.gov/Pubs/SP811/ , Guide for the Use of the International System of Units (SI)

[4] ISO-80000-3, "Quantities and units Part 3: Space and time", 2006.