Progress on Cislunar CCSDS Standards as a Foundation for Interoperability

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CCSDS in a nutshell

- CCSDS = Consultative Committee for Space Data Systems

- CCSDS is an international standardisation committee tasked with developing and maintaining interoperable standards for space systems
  - 11 Member Agencies
  - 33 Observer Agencies, 139 Commercial Associates
  - > 1000 missions are flying with CCSDS standards
  - CCSDS acts as ISO/TC20 (Aircraft and Space)/SC13 (Space Data and Transformation Systems) → All CCSDS standards are also ISO standards!
  - Primary Focus of CCSDS standards: Interoperability!, Secondary: Reducing mission cost and risk, boosting the industrial ecosystem
  - CCSDS drives innovation (e.g., adoption novel technologies such as DTN, optical communication, CFDP, and others)

Background

- <u>Situation at last year's Cislunar PNT workshop:</u>

- Joined Cislunar PNT & related communication support standards are essential to achieve inter-agency interoperability for Lunar missions

- Existing specifications from various PNT-related groups and communities including LunaNet are currently not promoted as formal international standards resulting in two key issues:
  - Limited outreach/ applicability outside participating agencies & programmes
  - Standards currently not published & maintained within a formal standardisation organisation

→ To start addressing this, CCSDS has formed a Special Interest Group (SIG) in the Spring 2025 meeting

CCSDS LunaNet Special Interest Group (SIG)

- CCSDS has worked with LunaNet and formed a Special Interest Group (SIG) with the objective to to coordinate and promote the standardisation, and interoperability of communication, PNT, and networking services and technologies for lunar exploration and operations within CCSDS
  - Acting as a broker between LunaNet and other PNT standards developers and the CCSDS working groups
  - Coordination directly with LunaNet, IOAG, and industrial vendors + inviting involvement of other players
  - Interfacing with relevant CCSDS working groups, injecting standards requirements and priorities
  - First step (ongoing): Assessment of existing CCSDS standards and their relevance for PNT, identification of gaps and priorities, and adoption strategy for LunaNet PNT standards (e.g. AFS)

CCSDS LunaNet SIG – List of initial topics

CCSDS STD	CATEGORY	CCSDS WG	DESCRIPTION
CCSDS 414.1, 211.0, 211.1, 211.2 and 235.1, 401.0-B (Vol 1 and Vol 2), 415.1	Comms needed for PNT	RFM, C&S, SLP	Incorporate support for lunar proximity links and all work required for space-to-space links
No number assigned yet	PNT broadcast	LunaNet SIG, RFM, C&S	LNIS AD1 Vol A (Augmented Forward Signal) publication as vertically integrated standard
Observation Data Message Update	PNT related message product	Navigation	enable information exchange amongst spacecraft for conveying different PNT observables
Conjunction Data Message Update	PNT related message product	Navigation	A concise version of the conjunction data message is needed with representations and parameters optimized for Lunar env.
TBD	PNT related message product	Navigation	Accurate and low weight (information bits) ephemerides are required for enabling in-situ PNT services and for contact coverage planning

CCSDS LunaNet SIG – Comms Topics (for completeness)

CCSDS STD	CATEGORY	CCSDS WG	DESCRIPTION
No number assigned yet	Comms	DTN	Bundle-in-Bundle Encapsulation (Tunelling) Basic OB
No number assigned yet	Comms	DTN	Bundle-in-Bundle Encapsulation (Tunelling) Segmenation OB
No number assigned yet	Comms	DTN	Network management Book
CCSDS 734.1-B-1	Comms	DTN	Modify LTP Blue Book
CCSDS 734.2 BB	Comms	DTN	Complete Standard for **Bundle Protocol v7** (Orange and Blue)
CCSDS 734.5-R-2 (red but need for orange)	Comms	DTN	Complete DTN **BPSec** Orange Book and Blue Book
No number assigned yet	Comms	DTN	Complete DTN Custody Transfer and Compressed Reporting **(CT/CRS)** Standard
No number assigned yet	Comms	DTN	Complete DTN Custody Transfer and Compressed Reporting **(CT/CRS)** Standard
CCSDS 414.1	RFM	RFM	Consider providing a Green Book or alternate document that establishes recommended boundaries and or specific data rates used in conjunction with PN ranging.

Conclusions

- CCSDS is committed to support the Cislunar PNT community with the production of PNT and PNT-support standards
  - No duplication of competence is thought with existing PNT groups
  - CCSDS is however offering its core competence (space data, comms, messages) and standardisation expertise to synergise and complement the work of the PNT community

- A special interest group has been formed to act as a broker between the community and the various CCSDS working groups
  - So far focusing on LunaNet but open to other interfaces as well

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