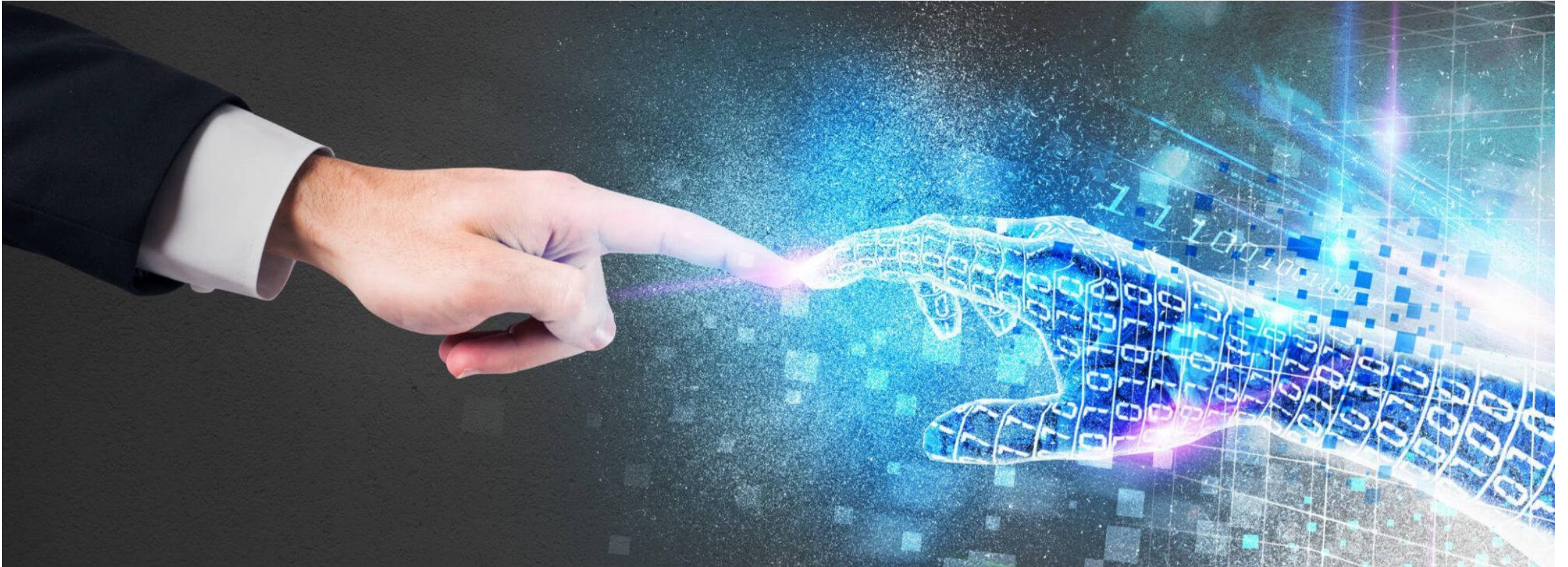


# CCSDS SPRING 2025 TECHNICAL PLENARY



# AGENDA

Time (UTC)	Duration	Topic	Presenter
08:40-08:45	5 minutes	Welcome Address	Sami Asmar & Ed Birrane
08:45-09:05	20 minutes	Opening Remarks	Steve Krein, Deputy Mission Area Executive for Civil Space Flight at APL
09:05-09:20	15 minutes	Keynote Remarks	Janice Staryzk, Acting Director for NOAA Office of Space Commerce
09:20-09:25	5 minutes	CCSDS Chair	Sami Asmar, NASA/JPL, Management Council Chair, General Secretary, NASA Delegate
09:25-09:40	15 minutes	Standards For Lunar Exploration	Cheryl Gramling (NASA/SCaN & CCSDS)
09:40-09:55	15 minutes	Standards For MARS Exploration	Jim Schier (NASA/SCaN & IOAG)
09:55-10:10	15 minutes	Cis-Lunar PNT	Daniel Fischer (ESA)
10:10-10:15	5 minutes	CESG Report	Daniel Fischer & Tim Pham, CCSDS Engineering Steering Group
10:15-10:20	5 minutes	SEA Workplan	Jim Lux, Systems Engineering Area Director
10:20-10:25	5 minutes	MOIMS Workplan	Mehran Sarkarati, Mission Operations & Information Management Services Area Director
10:25-10:30	5 minutes	CSS Workplan	Erik Barkley, Cross Support Services Area Director
10:30-10:35	5 minutes	SOIS Workplan	Simon Somendra, Spacecraft Onboard Interface Service Area Director
10:35-10:42	7 minutes	SLS Workplan	Ignacio Aguilar, Space Link Services Area Director
10:42-10:47	5 minutes	SIS Workplan	Tomaso de Cola, Space Internetworking Services Area Director
<b>BREAK</b>			
11:10-11:20	10 minutes	Success Stories	Tim Pham, CESG Deputy Chair
11:20-11:50	30 minutes	Boot camp Overview	Jim Lux (includes introduction of new Editors and Process)

# Lunar Standards Update

Presented by: Cheryl Gramling  
NASA Space Communications and Navigation

June 9, 2025  
CCSDS Spring 2025 Meetings Plenary  
Laurel, MD

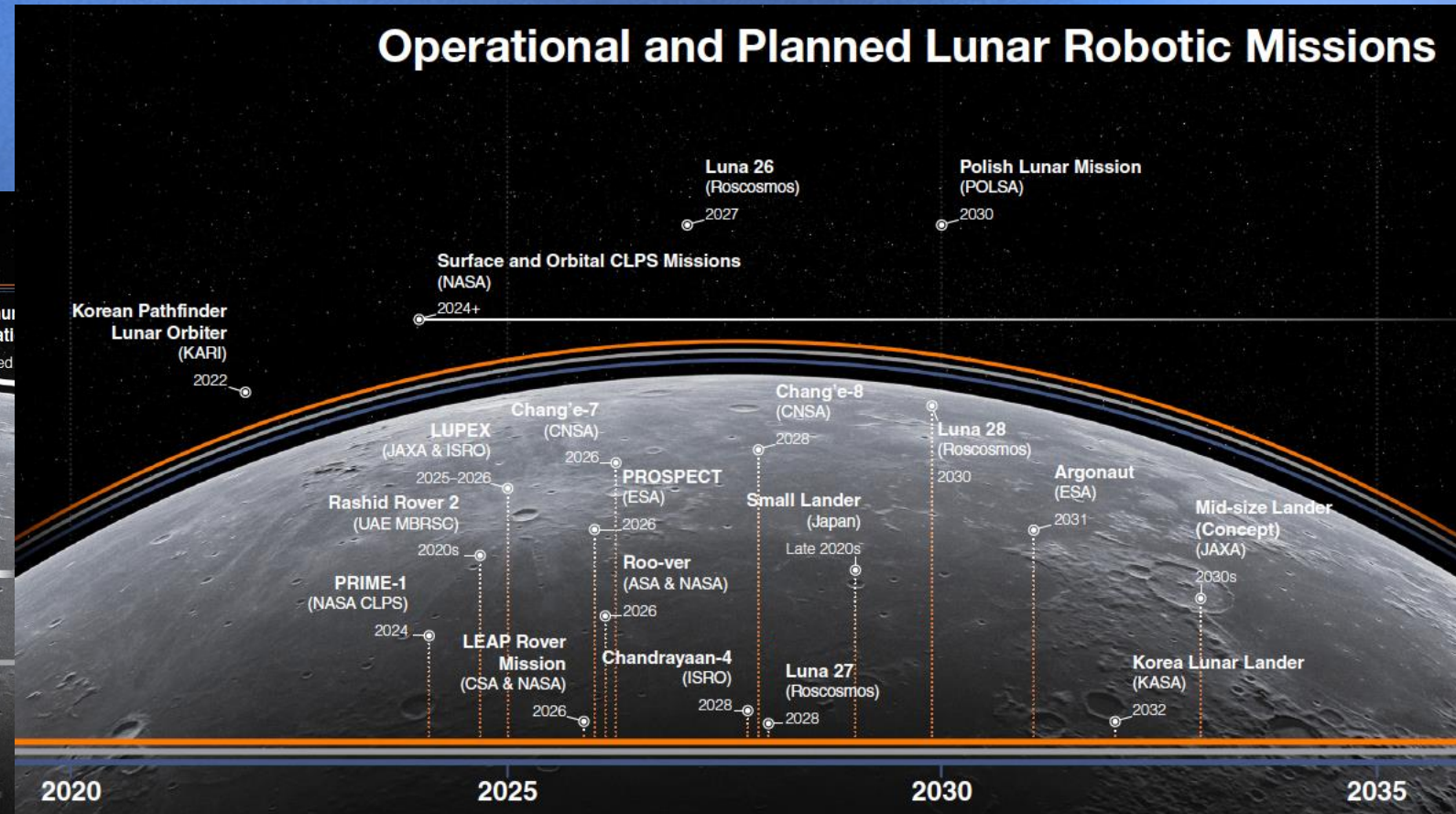
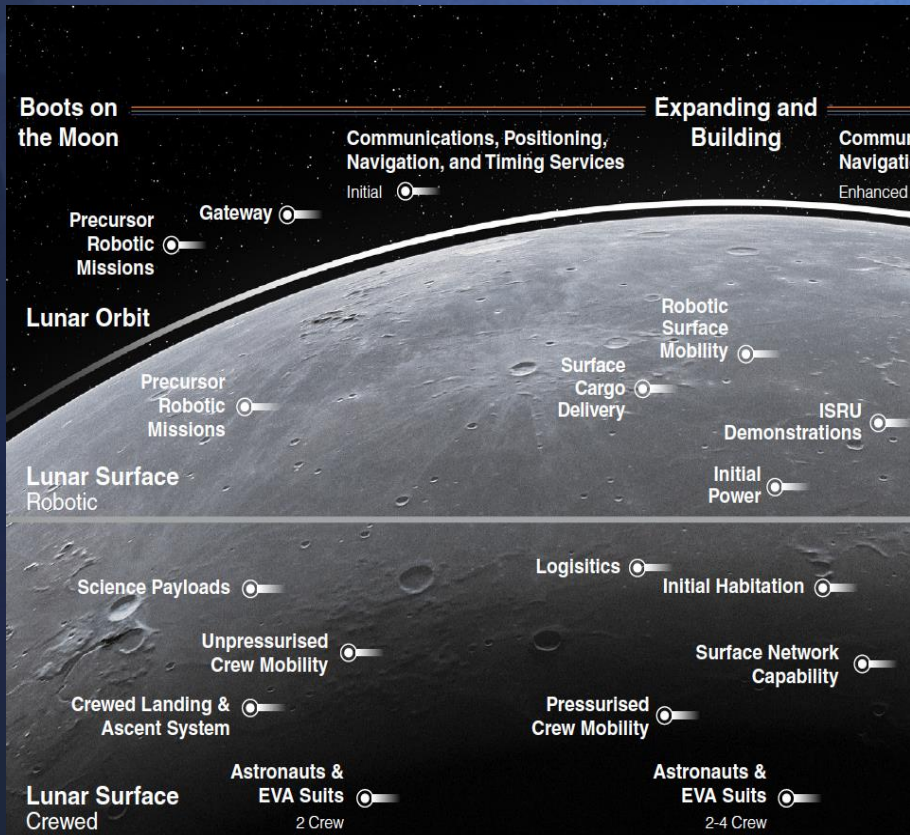


# Topics

- Drivers for Cislunar Standards
- Other Standards Organizations
- ICG-IOAG Cislunar PNT Workshop
- LunaNet and the LunaNet Interoperability Specification (LNIS)
- LunaNet ↔ CCSDS

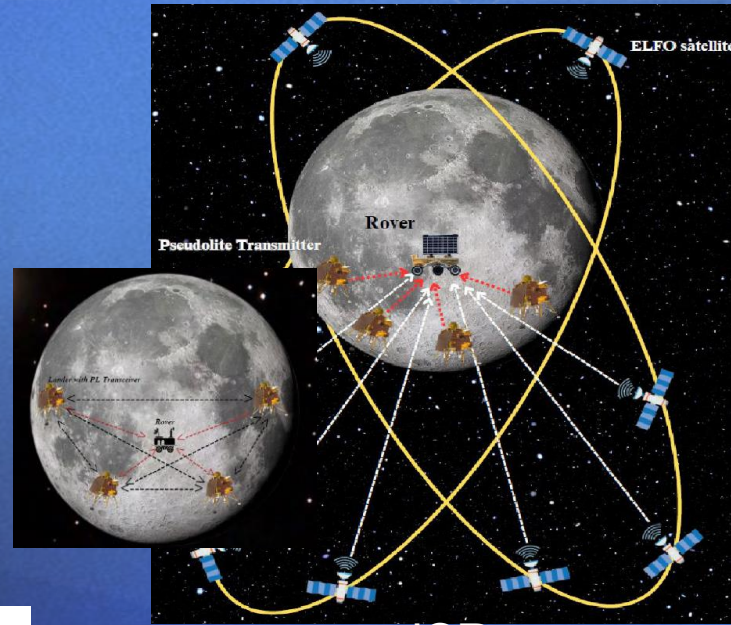
# Mission Set

As identified in ISECG Report and openly available media, there are many nations with existing and/or planned missions to the Moon or cislunar space (e.g. E-M Lagrange).



# Lunar C&PNT Systems

In addition, many nations are deploying infrastructure for comm and PNT systems and services. Other nations are considering plans.

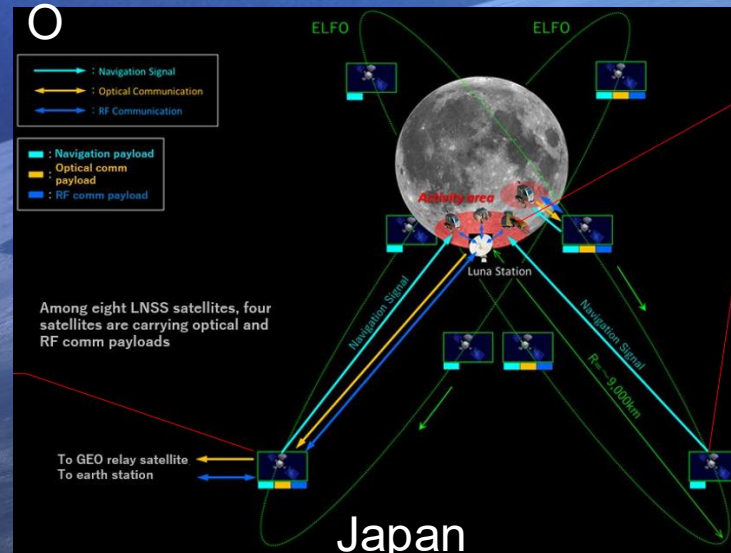


ESA

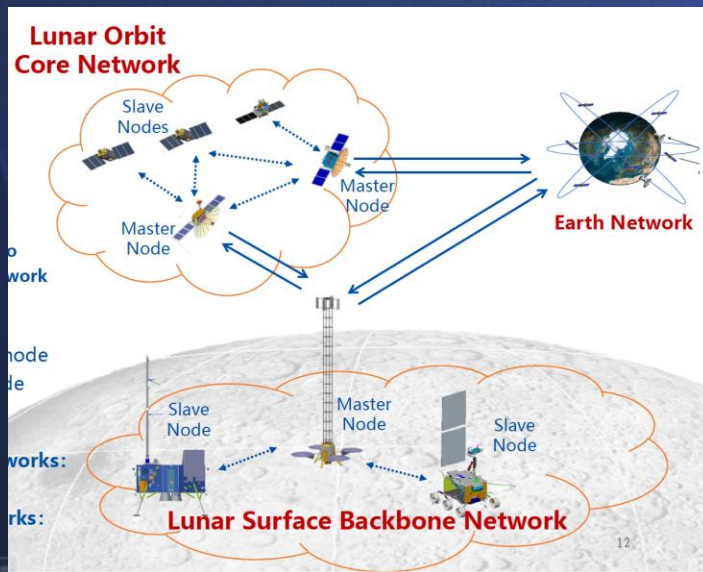


NASA

ISR



Japan



China

# Organizations Beyond Space Agencies

Several [non-space agency] organizations involved to assure interoperability, compatibility among the different systems.

## Space Agency Based



Other/Future  
Lunar  
C&PNT



- Commission A3, Fundamental Standards
- WGCCRE
- Time & Frequency



Body-specific Celestial System  
Coordinate Time, Lexicon

Body-fixed Reference  
System (frame, gravity  
model, equipotential  
surface, shape;  
transforms)  
Time Scales: Coordinate  
and equipotential surface

Spectrum; Time

PNT systems  
Interoperability  
(Recommendations)

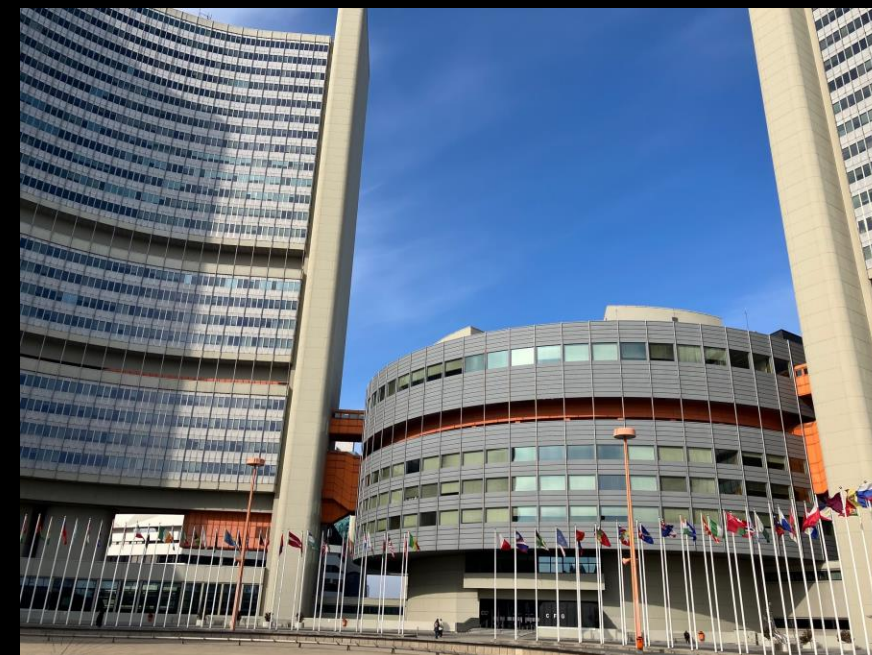
Telecomm



# Joint ICG-IOAG Multilateral Cislunar PNT Workshop

11–13 February 2025 | Vienna, Austria and broadcast

- Held at UN Vienna International Centre (VIC), 11–13 Feb 2025
- Approx. 100 in-person + 100 online attendees
- Approx. 20 countries & international organizations represented, including industry
- Approx. 45 speakers & presentations
- Final agenda and artifacts:  
<https://www.ioag.org/SitePages/Cis-Lunar-Workshop.aspx>



## From survey to workshop participants:

- **Overall positive appreciation (96%) of the workshop and organization (99%\*) which met (57%) or exceeded (36%) expectations**
- **Recommend to organize workshop in the future (97%) with a yearly cadence (64%) and similar duration (76%)**
- **Remote participation could be improved (10%\*\* including better monitoring of the chat (7%\*\*)**
- **Length of the sessions (97%\*) and the technical content (99%\*) were perceived well**

\*Includes neutral

\*\*Includes only remote participants

# LunaNet

- LunaNet is a framework for standards- based interoperable communications/network, PNT, and Alert services.
  - Scalable in the environment (expand service volume, capacity/capability)
  - Extensible to other regimes
  - Incorporates cyber security
- LunaNet Interoperability Specification (LNIS) document set establishes the standards, protocols, interfaces for a network of interoperable networks. Complemented by a Concept of Operations
- Developed by the international partners in the LNIS Working Group.
- Use existing standards, when applicable; Develop standards where needed.

Direct With Earth (Earth Ground Stations to lunar region user)

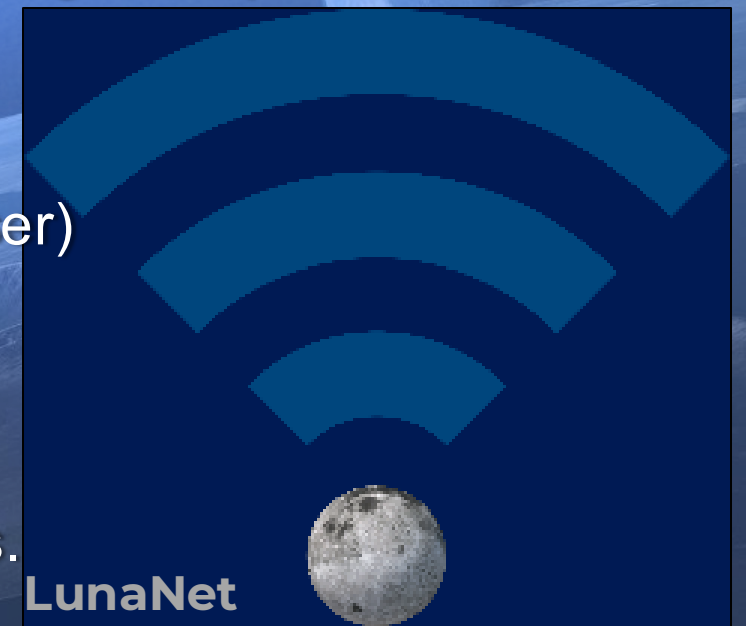
Proximity links (via systems in the lunar region to lunar region user)

- Point-to-Point (relay to user)
- Broadcast (relay(s) to user(s))
- Future: Surface

Currently adopts several CCSDS Standards;

Ongoing work with CCSDS to update specific existing Standards.

>>Not limited to CCSDS Standards (e.g. RFC 9172, 3GPP) <<



# LNIS

- **Publication Jan 2025: LNIS main v5 and AD1 Vol A v1**
- **Future LNIS update to complete LunaNet 1.0 specification to cover near term needs.**
- **LNIS Document Set:**
  - Main Document
  - AD1 Volume A LunaNet Signal-In-Space Recommended Standard (LSIS) Augmented Forward Signal (AFS)
  - AD1 Volume B LunaNet Signal-In-Space Recommended Standard (LSIS) Point-to-Point Signals
  - AD2 LunaNet Measurement Schema and Parameters
  - AD3 LunaNet Detailed Message Definition Document
  - AD4 LunaNet Location Services for Users (not LunaNet 1.0)
  - AD5 Lunar Reference System and LunaNet Reference Time System Standard
  - AD6 LunaNet Data Services Document
  - AD7 LunaNet LunaSAR Definition Document (not LunaNet 1.0)
  - AD8 LunaNet Interoperability Security Specifications



**LNIS version 5 and AD1VolA LSIS-AFS version 1  
available online.**

[https://www.nasa.gov/directorates/somd/space-communications-navigation-program/lunanet-interoperability-specification/#\\_blank](https://www.nasa.gov/directorates/somd/space-communications-navigation-program/lunanet-interoperability-specification/#_blank)

# LunaNet and CCSDS

The following efforts are underway to apply or align CCSDS standards with LNIS:

## DTN:

- BPv7 Blue Book
- Custody Transfer and Compressed Reporting (CT/CRS) OB and BB
- BPsec OB and BB

## Work related to space-to-space links:

- Prox-1 Standard extension to S-band and Ka-band (211.2 Coding & Sync BB, 211.0 Data Link Layer BB, 211.1 Physical Layer BB), including the addition of ranging
  - S-band extensions: books' drafts creation is currently on-going
  - Ka-band conversations starting in the Spring 2025 CCSDS meeting
- 235.1 Generic Session Control BB for proximity links
- 401.0 RF Modulation Volume B for space to space links
- Update to 414 and 415 to incorporate support for lunar proximity (e.g. local) links (including ability to transfer time)

**NOTE:** It is not incumbent on every LunaNet Service Provider to provide every service defined within the LNIS.

# Other Topics in CCSDS wrt LNIS

These topics are in discussion for potential coordination between LNIS and CCSDS:

1. Possible Green Book for recommended operating parameters and/or data rate/PN ranging combinations, with rationale.
2. Message products that would be suitable for LNIS services, such as:
  - a. Contact Schedule and updates for space-to-space link exchange
  - b. Version of Nav WG CDM suitable for space-to-space link exchange
3. Updating standards to designate the upper portion of the VCID number range as “Reserved”.
  - a. LNIS AD6 has identified application for a few high-numbered VCIDs specifically for provider-to-user use, rather than the normal solely mission-determined use of VCIDs.
4. Discussions on possible approach wrt CCSDS and LNIS that meets Agency objectives.
  - a. Request CCSDS feedback in writing on AD1 Vol A differences wrt a CCSDS Blue Book Standard format.
  - b. **Potential process for CCSDS to endorse select LunaNet specifications (as Blue Book, or other)** when LNIS Working Group identifies them as sufficiently mature.
5. **Future need: Lunar Surface communications with PNT protocol.**



National Aeronautics and Space Administration



# Standards For Mars Exploration

CCSDS Spring Workshop

June 2025

Johns Hopkins APL

**SCaN** Space Communications  
and Navigation

Science and Exploration, Enabled. Together.

**Jim Schier**

Mars and Deep Space Strategist  
Space Communications and Navigation (SCaN) Office  
National Aeronautics and Space Administration

6/9/2025

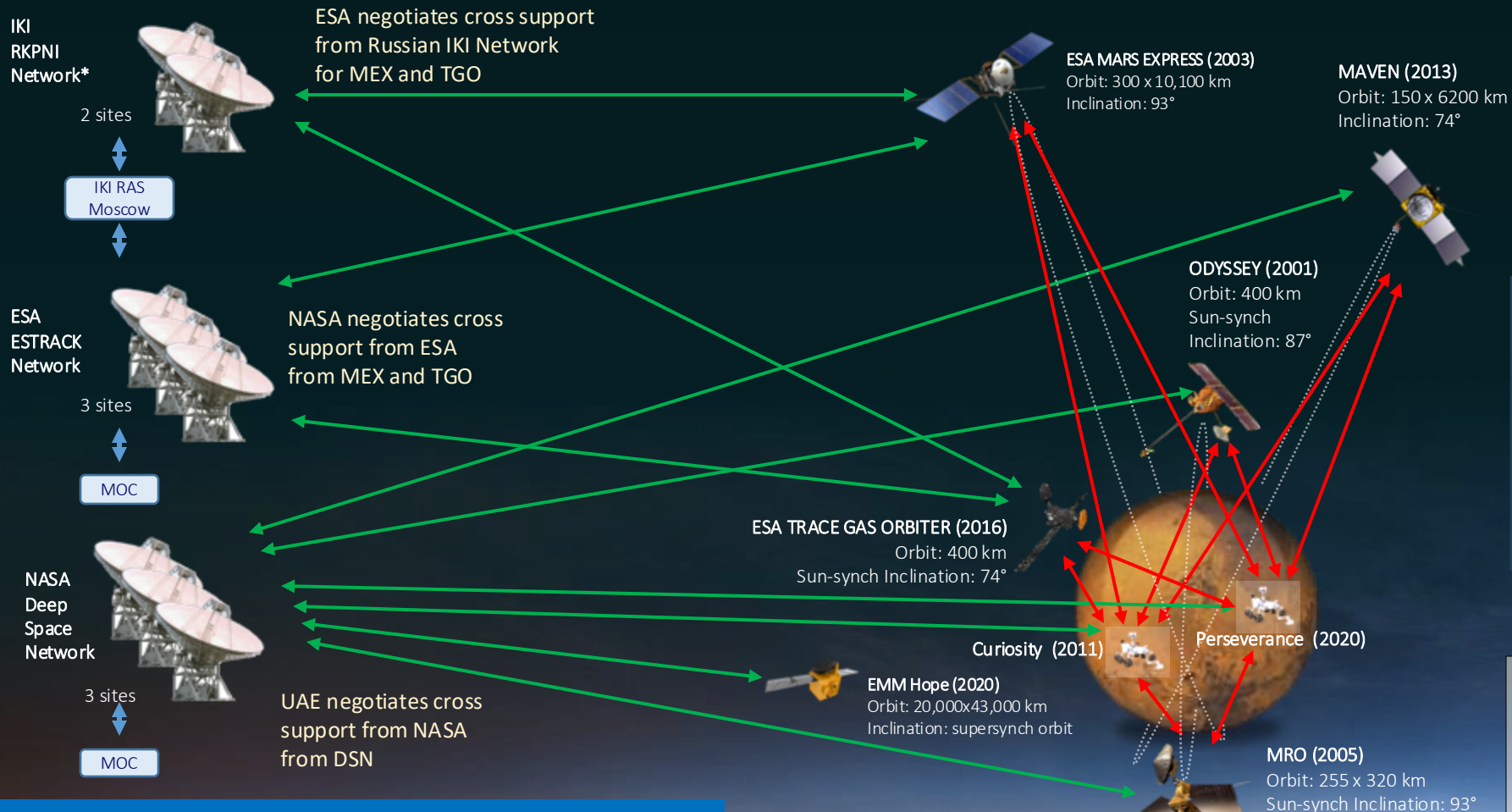
# Topics



- Current NASA/ESA Mars mission set and Mars Relay Network (MRN)
- New NASA Fiscal Year 2026 Budget Direction for Mars
  - Based on *President's Budget Request* and *NASA Fiscal Year 2026 Budget Technical Supplement* → *Not approved yet!*
- MarsNet Strategy Depends on the LunaNet Strategy
- CCSDS Impacts
- Closing Observations



# Mars Relay Network Today



**Evolving Network: 5 Hybrid Science/Relay orbiters from 2 Agencies**

- Science-driven orbit selection → low SSO

**Relay support via UHF Proximity Link**  
with omni antennas support 2 rovers:  
Perseverance (M2020) and Curiosity (MSL)

- 1-2 contacts/sol
- ~10 min per contact
- ~450 Mb/sol avg data return
- 20 Mb/W-hr energy efficiency

**LEGEND:**

- X-band Earth links (7.2 GHz up; 8.4 GHz down)
- UHF relay link (435-450 MHz up; 390-405 MHz down)
- Terrestrial Comm
- Mission Ops Centers (MOC)

\* Russia: Ground network (RKPNI) run by Space Research Institute (IKI), Russian Academy Of Sciences

Not Shown: China Tianwen-1 orbiter, Zhurong rover & ground stations

**8 ground stations from 3 networks from 3 agencies**

## PERFORMANCE

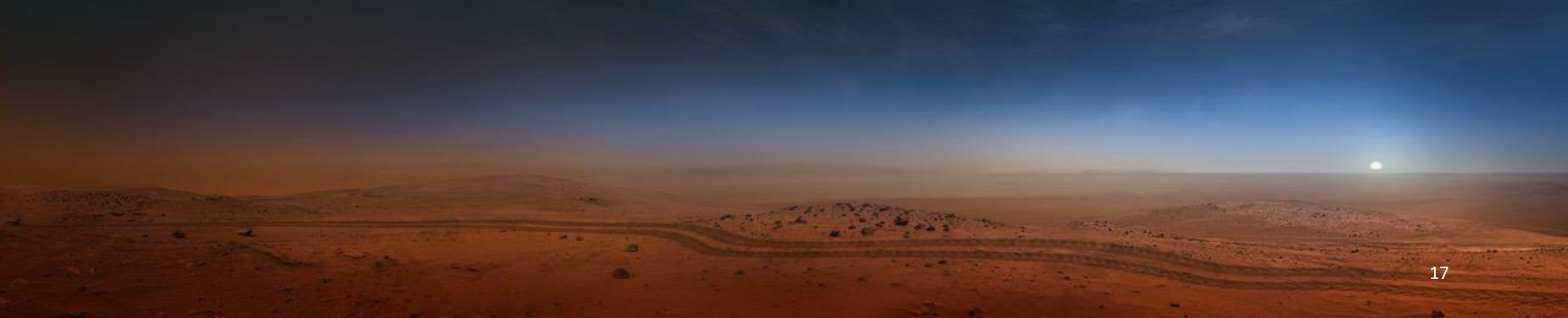
Aggregate Relay & DTE Volume	1.5 Tb/yr & 40 Tb/yr	Proximity Links (rover-relay) @ UHF	128 kb/s to 2048 kb/s
Max Data Rate @ Max Distance	MRO 500 kb/s X-band DSN 34m	Most Capable X-band Subsystem	MRO 3m HGA and 100W TWTA
Max Data Rate @ Min Distance	MRO 5 Mb/s X-band DSN 34m	DSN 2-way Doppler/Range + VLBI	< 10m non-real-time position accuracy at Mars

# FY26 Budget Changes to Mars Missions (1/4)



Assuming President's Budget Request is enacted:

- **Science (SMD)** Missions cancelled: Odyssey, MAVEN, MSR, & support for ESA Mars Express & Rosalind Franklin ExoMars missions
  - Retire 2 of 3 orbiters that are part of the Mars Relay Network (MRN)
- Planetary Science/Mars Exploration Program technology development areas of near-term interest include new techniques for Mars EDL, surface and aerial mobility with wireless links, autonomy, and telecommunications



# FY26 Budget Changes to Mars Missions (2/4)



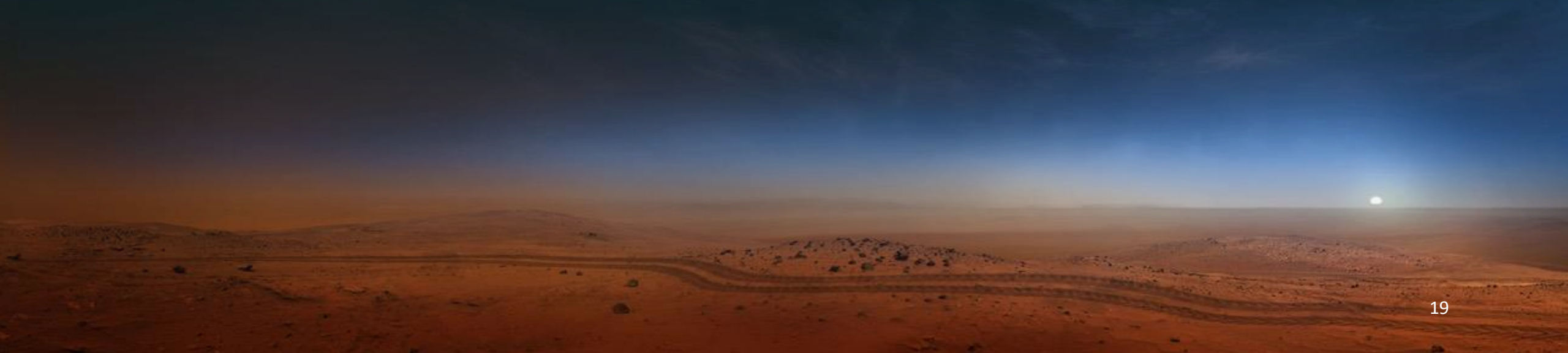
- **Exploration (ESDMD)** will begin development of comm relay capabilities leveraging commercial capabilities
  - Using Space Comm and Navigation (SCaN) Program as capability provider
  - Per interoperability & standardization goals, SCaN has implemented Delay Tolerant Networking (DTN) to the NSN and DSN & will implement for lunar & Mars relays
- A Commercial Mars Payload Services (CMPS) will begin launching precursor missions and technology demos to the Martian surface
  - Near-term will focus on maturing commercial robotic Mars lander concepts
  - (CMPS is based on Commercial Lunar Payload Services (CLPS) which is transferred from **Science** to **Exploration**)



# FY26 Budget Changes to Mars Missions (3/4)



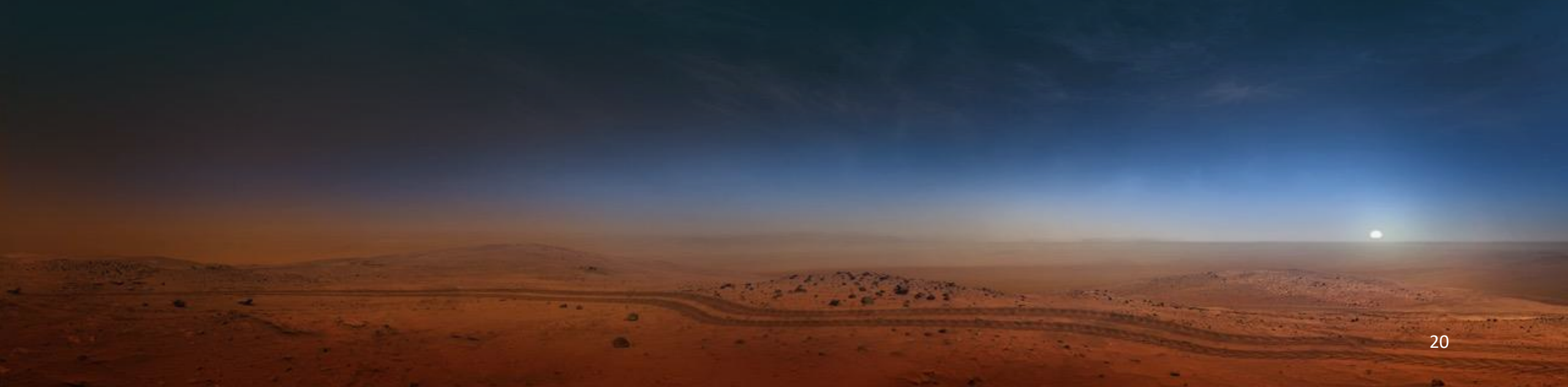
- New **Exploration** Mars-related initiatives with potential standards impacts include:
  - Leverage HLS to conduct a near-term Entry, Descent, and Landing (EDL) demo for a human-class Mars lander → *Will need PNT landing accuracy equal to lunar requirements (100x better than current Mars capability)*
  - Lay the groundwork for a Commercial Martian surface suit → *Surface CPNT*
  - Initiate industry studies and accelerate high priority technology development for crewed missions to Mars → *Includes CPNT*



# FY26 Budget Changes to Mars Missions (4/4)



- **Space Technology** initiatives include:
  - Advanced technologies for autonomous systems and robotics
  - Adaptations to commercial terrestrial telecom technology (e.g., 3GPP)
  - Develop very high data rate deep space optical trunkline
  - Analyze clock technologies & establish technology performance metrics for coordinated lunar time technology → *Extensible to Mars*





# What is MarsNet?



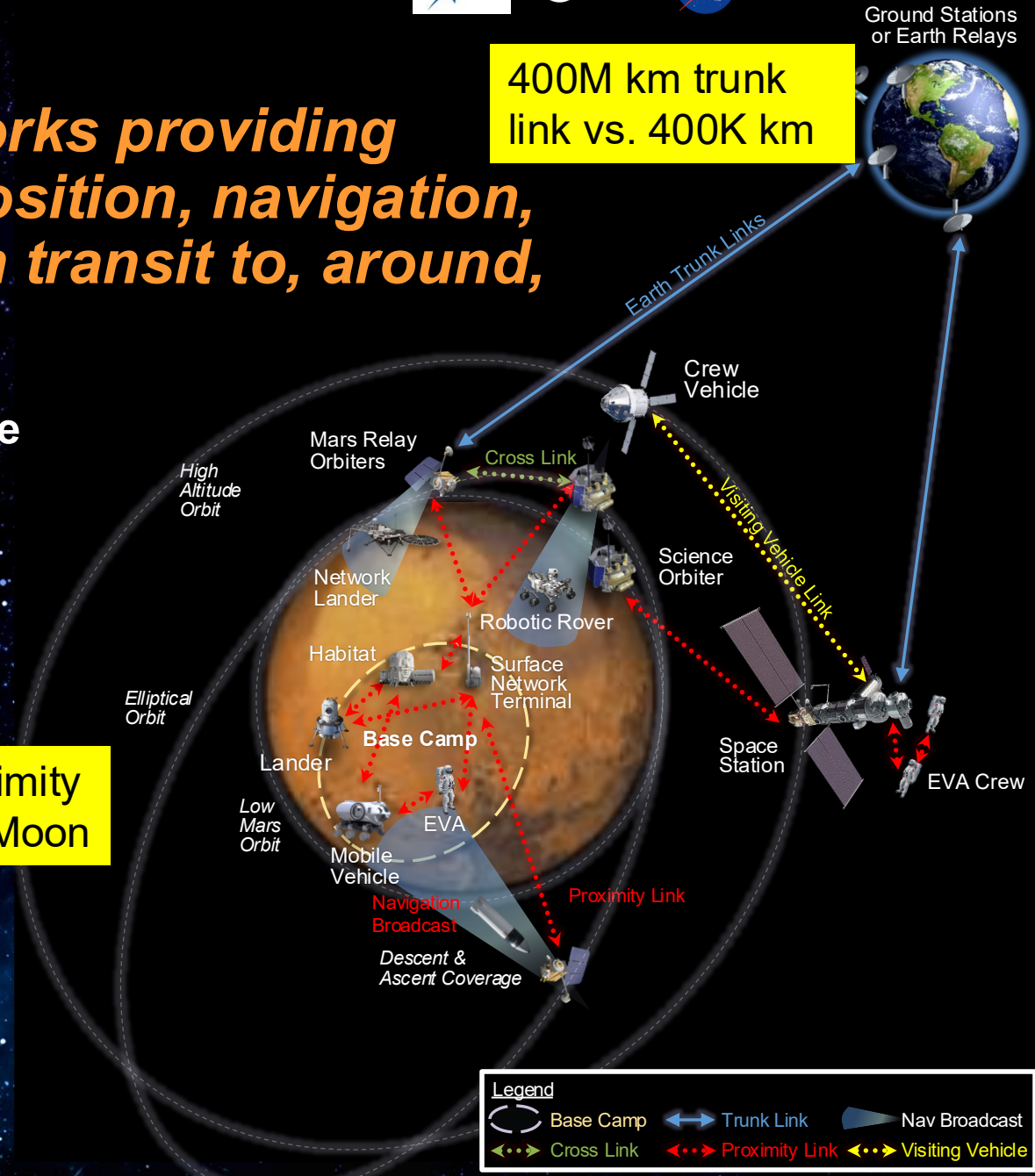
**MarsNet is a set of cooperating networks providing interoperable communications and position, navigation, and timing (PNT) services for users in transit to, around, and on Mars.**

- Based on a framework of mutually agreed-upon standards, protocols, frequency bands, and interface requirements that enable interoperability.
- Allows many Mars mission users to engage the services of diverse commercial and government service providers in an open and evolvable architecture.
  - Service-Oriented
  - Scalable
  - Open
  - Resilient
  - Secure
  - Extensible

*MarsNet consists of Earth Ground Stations (for Direct with Earth links), Mars orbital relays (Mars proximity and Earth trunk links), and surface assets.*

“Same” proximity services as Moon

400M km trunk link vs. 400K km



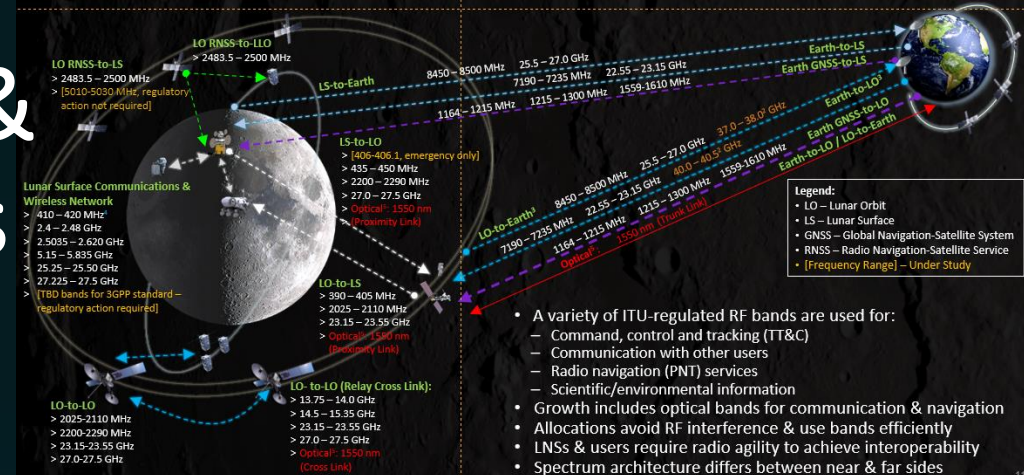
# CCSDS work related to Moon and Mars



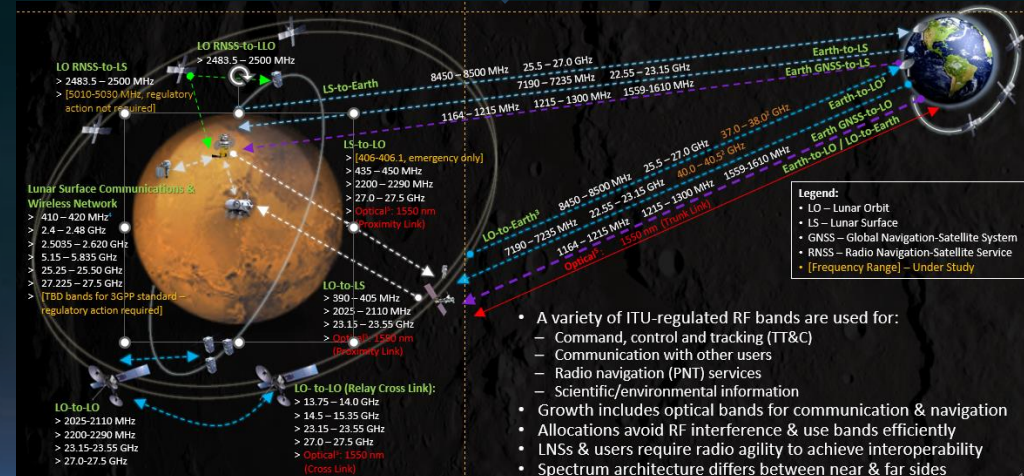
- Proximity: 1 extension work for Moon and Mars (3 books). Extension to S-band, Ka-band, including ranging
- Space-to-space Radio Frequency Modulation (RFM) 401 Part B
- Service Package Data Formats
  - Other funding: ESA, DLR
- DTN work: applicable to Moon and Mars
  - Blue Book for BPv7
  - Blue Book for BPsec
  - Blue Book for Network Management
  - Orange Book for Compressed Reporting and Custody Transfer
- Voice and Video Protocols: high quality HD video over long distances for crewed and robotic missions
- Conjunction Data Message Book revision publication
- Intergovernmental Cloud based Certification Authority
  - Other funding: ESA, DLR
- DDOR: PN DOR tones essential for EDL on Mars and other deep space locations
- Time Management and Time Distribution: develop standards for time exchange, time correlation, and time synchronization for interoperable missions. Applicable to Moon and Mars.
- 3GPP Green Book and Orange Book: lunar surface communications. Applicable to Moon and Mars?
- Enterprise Service Management: support for scheduled & unscheduled (on demand) services across multi-service provider topology

# Maximize Commonality of Moon & Mars Standards for Proximity Uses

- Where agencies expand into new regions & standards do not exist, expect bi/multilateral agency development of core capabilities prior to CCSDS engagement
- SFCG evaluating common frequency bands for prox & surface links
- Expect international standards for reference system/frame, geodetic & gravity models, & time for each celestial body based on common processes
- CCSDS should develop lunar standards with Mars & Beyond in mind
- Expect increasing emphasis on commercial vendors & service providers → Increase industry participation in standards
- Agencies with Mars missions need to work with other standards organizations to encourage the same approach
  - Cheryl's PNT list + IETF, 3GPP, ...
- Consider ability of multiple providers to implement & operate systems that provide aggregate capability & appear as a single infrastructure for users
- Allow for incremental build-up of capabilities and coverage
- International collaboration leads to need for agreements on technical coordination to support operations

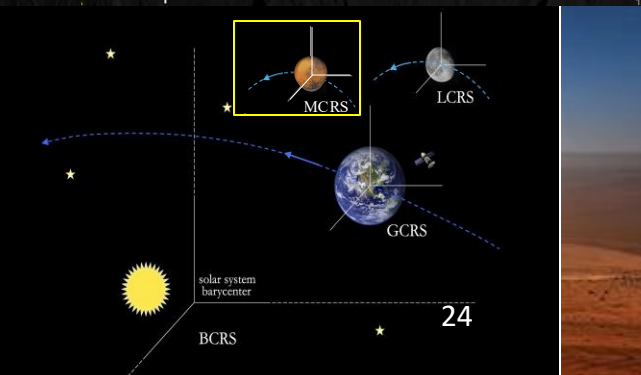


- A variety of ITU-regulated RF bands are used for:
  - Command, control and tracking (TT&C)
  - Communication with other users
  - Radio navigation (PNT) services
  - Scientific/environmental information
- Growth includes optical bands for communication & navigation
- Allocations avoid RF interference & use bands efficiently
- LNSs & users require radio agility to achieve interoperability
- Spectrum architecture differs between near & far sides



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- Spectrum architecture differs between near & far sides

Common basis for Reference Systems & time





# CCSDS & CisLunar Positioning, Navigation & Timing (PNT) ?

CCSDS Spring 2025 Opening Plenary



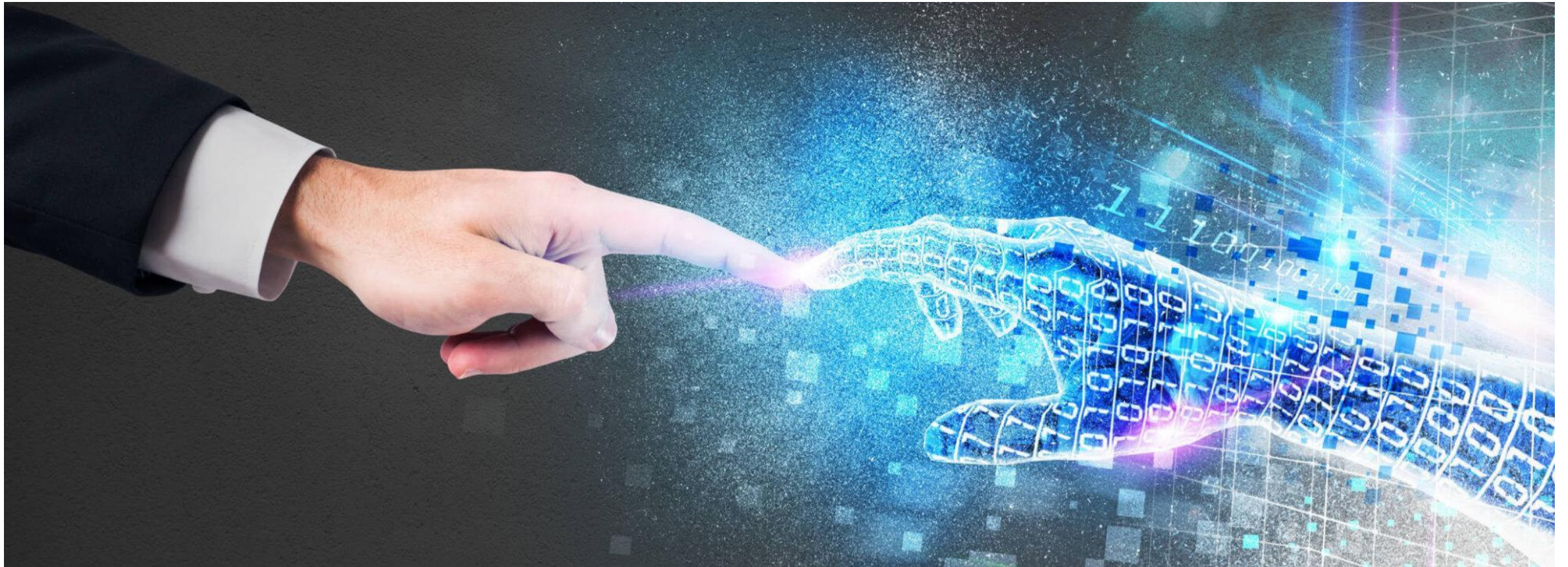
## Background

- **Joined Cislunar PNT standards are essential to achieve inter-agency interoperability for Lunar missions**
- **Many specifications already exist or are under preparation within various expert fora (e.g. the International Committee on Global Navigation Satellite Systems (ICG))**
  - **Adoption also in LunaNet Interoperability Specification → Interoperability is established the level of LunaNet participating agencies & programmes**
- **These Cislunar PNT specifications are currently not promoted as formal international standards**
  - **Outreach/ applicability outside of LunaNet participating agencies & programmes limited**
  - **Currently not published & maintained within a formal standardisation organisation**

## Could CCSDS help?

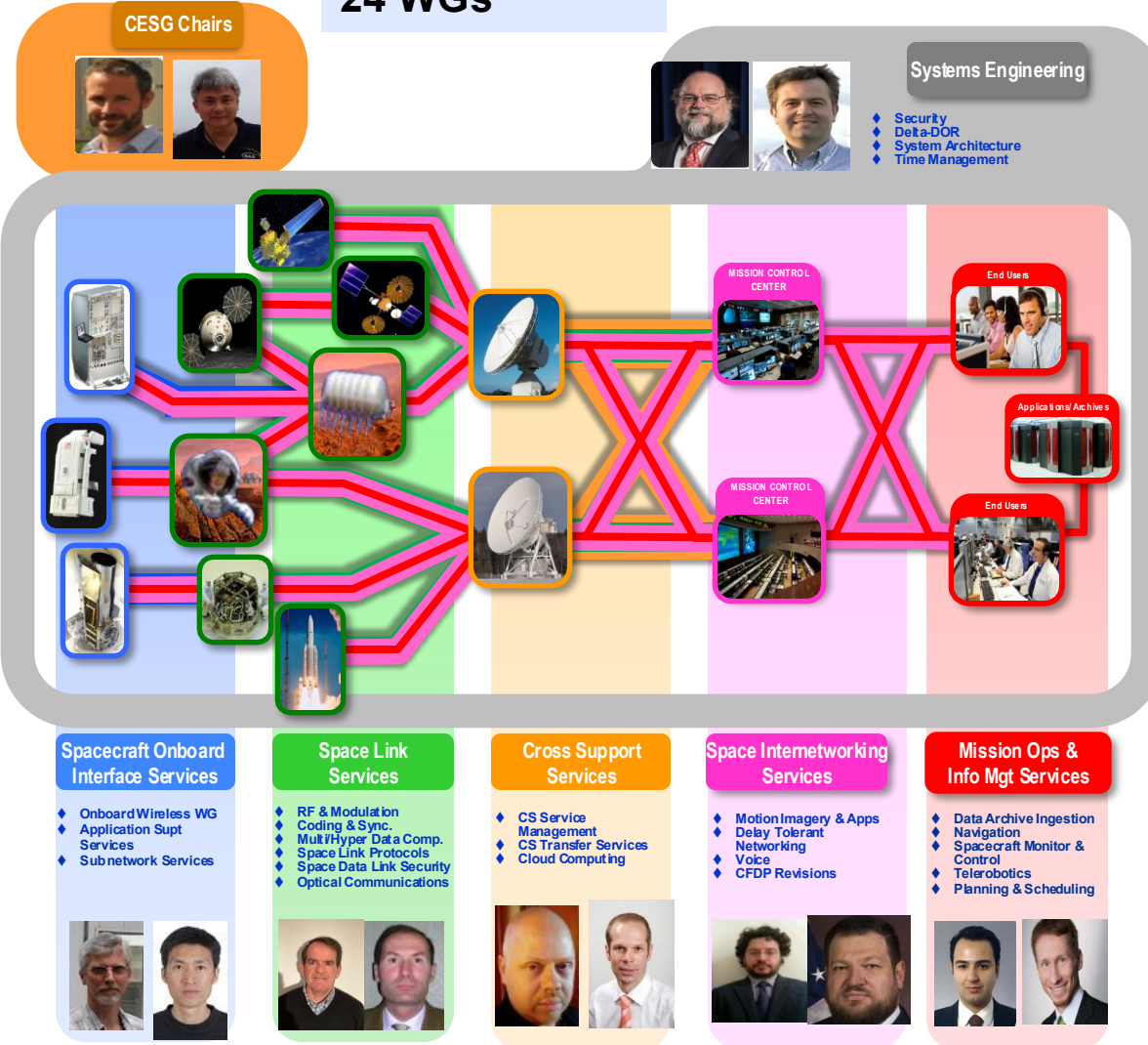
- **CCSDS as a standardisation body and ISO sub-committee could provide for a formal framework to achieve publication of CisLunar PNT specifications as international standards**
- **A discussion around this took place at the IOAG/ICG CisLunar PNT workshop in Vienna in February 2025, outcomes were:**
  - **CCSDS could potentially be an appropriate vessel for promotion of Cislunar PNT specifications as international standards**
  - **The technical authority for the specifications should remain with the existing expert groups (ICG groups and others), duplication of technical expertise deployment in CCSDS should be avoided**
  - **Synergies exist with existing CCSDS competencies (e.g. in the SLS area and in the Time Management WG) and could be exploited**

# CCSDS FALL 2025 TECHNICAL PLENARY



# CESG – CCSDS Technical Areas

6 Areas  
 24 WGs



**CESG Chair**  
*Deputy*

**Daniel Fischer**  
*Timothy Pham*

**SEA Area Director**  
*Deputy*

**Jim Lux**  
*Matthew Cosby*

**MOIMS Area Director**  
*Deputy*

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**Erik Barkley**  
*Holger Dreihahn*

**SLS Area Director**  
*Deputy*

**Ignacio Aguilar Sanchez**  
*Gilles Moury*

**SIS Area Director**  
*Deputy*

**Tomaso de Cola**  
*'Vinny' Ivica Ristovski*

**SOIS Area Director**  
*Deputy*

**Simon Singh**  
*Xiongwen He*

## Orange Books

- **CCSDS 131.5-O-1 : Erasure Correcting Codes for Use in Near-Earth and Deep-Space Communications TECHNICAL CORRIGENDUM 1 (December 2024)**
- **CCSDS 357.1-O-1 : INTERGOVERNMENTAL CERTIFICATION AUTHORITY (December 2024)**

## Magenta Books

- **CCSDS 311.0-M-2 : REFERENCE ARCHITECTURE FOR SPACE DATA SYSTEMS (December 2024)**
- **CCSDS 650.0-M-3 : REFERENCE MODEL FOR AN OPEN ARCHIVAL INFORMATION SYSTEM (OAIS) (December 2024)**
- **CCSDS 652.0-M-2 : AUDIT AND CERTIFICATION OF TRUSTWORTHY DIGITAL REPOSITORIES (December 2024)**
- **CCSDS 652.1-M-3 : REQUIREMENTS FOR BODIES PROVIDING AUDIT AND CERTIFICATION OF CANDIDATE TRUSTWORTHY DIGITAL REPOSITORIES (December 2024)**
- **CCSDS 653.0-M-1 : INFORMATION PREPARATION TO ENABLE LONG-TERM USE (December 2024)**

## Approval to publish:

- **CCSDS 734.20-O-1, CCSDS Bundle Protocol Version 7 Specification (Orange Book, Issue 1)**
- **CCSDS 211.2-B-3 Cor. 1, Technical Corrigendum 1 to CCSDS 211.2-B-3, Issued October 2019**
- **CCSDS 142.0-B-2, Non-Coherent Optical Communications Coding and Synchronization (Blue Book, Issue 2)**
- **CCSDS 120.4-G-1, Robust Compression of Fixed-Length Housekeeping Data Packets—Summary of Concept and Rationale (Green Book, Issue 1)**
- **CCSDS 141.0-B-2, Optical Communications Physical Layer (Blue Book, Issue 2)**
- **CCSDS 320.0-M-7, CCSDS Spacecraft Identification Field Code Assignment Control Procedures : Corrigendum 2 (Magenta Book, Issue 7)**
- **CCSDS A02.1-Y-4, Organization and Processes for the Consultative Committee for Space Data Systems : Corrigendum 3 (Yellow Book, Issue 4)**
- **CCSDS 131.5-O-1 Cor. 1, Technical Corrigendum to CCSDS 131.5-O-1.**

## Agency Reviews:

- **CCSDS 131.0-P-5.1, TM Synchronization and Channel Coding (Pink Book, Issue 5.1) for CCSDS Agency review**
- **CCSDS 722.1-P-1.1, CFDP Unitdata Transfer Layers (Pink Book, Issue 1.1) for CCSDS Agency review**
- **CCSDS 522.2-R-2. Mission Operations—Mission Data Product Distribution Services( Red Book. Issue 2)**

## New Appointments:

- SLS (Space Link Services) Area Director – Clemens Heese (ESA-OPS)
- MOIMS (Mission Operations and Information Management Services) Area Director : Mehran Sarkarati (ESA-OPS)
- SEA (Systems Engineering Area) Deputy Area Director - Matthew Cosby (UKSA)
- CSS -CLOUD (Cross Support Services-Cloud Data Delivery Standards) Working Group Chair – Holger Dreihahn (ESA-OPS)

## Request for Nominations:

- MOIMS-SM&C Working Group Chair : Olivier Churlaud (CNES)
- CSS -CSTS (Cross Support Services-Cross Support Transfer Services) Working Group Chair - Alexander Kalkhof (DLR)

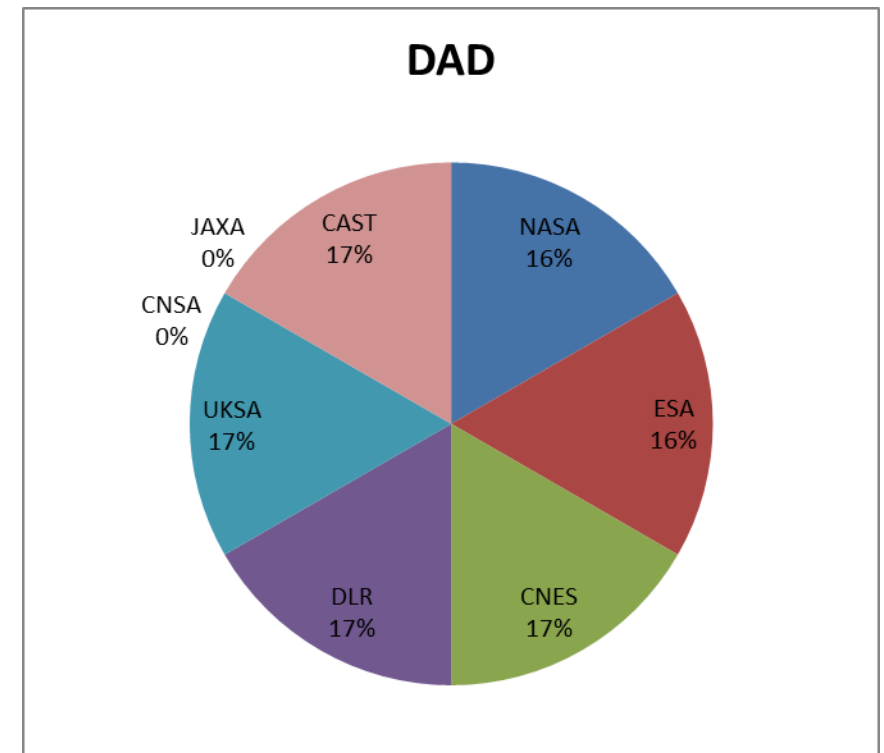
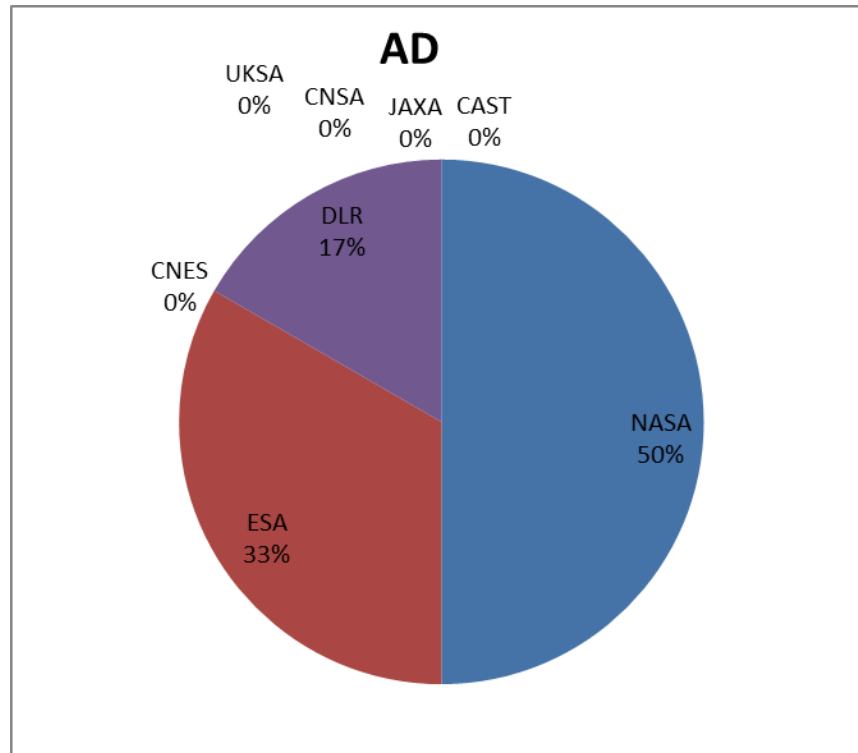
## Outlook / Vacant Positions:

- SEA-SA (Systems Engineering Area- Systems Architecture) Working Group Chair
- SEA-SA (Systems Engineering Area- Systems Architecture) Working Group Deputy Chair
- SEA-TIME (Systems Engineering Area- Time Management) Working Group Deputy Chair

# CCSDS Resources

				NASA						ESA						CNES						DLR						OTHER									
Area	WG	C	Co	BB	P1	P2	GB	MB	OB	BB	P1	P2	P3	GB	MB	OB	BB	P1	P2	P3	GB	MB	OB	BB	P1	P2	GB	MB	OB	BB	P1	P2	GB	MB	OB		
SEA	SA	NASA					1	1																													
SEA	Security	NASA	ESA				1	1		1	1			1	1																				1	MB=UKSA	
SEA	Time	NASA	ESA				1																														
SEA	D-DOR	ESA	NASA			1		2		1	1																										P3=JAXA
MOIMS	DAI	UKSA	NASA		1			1				1															1			1						GB, BB=UKSA	
MOIMS	NAV	NASA	ESA	4	5						1	4					1	1								1			1							BB, P2=UKSA, other	
MOIMS	SM&C	ESA	NASA			1				3	3	1		1			1	1	1							1		1									
MOIMS	MP&S	ESA	CNES							1	1			1	1												1										
CSS	SM	NASA	ESA	1		1				1	1	1	1		1									1	2	1											
CSS	CSTS	ESA		3	1					1		1																									
CSS	CDDS	ESA	NASA																																		
SOIS	APP	NASA	UKSA						1																												
SOIS	WIR	NASA	FSA				1		1															1					1								OB=NASA, P2=CSA (1) and JAXA (1), P1=DLR
SOIS	SNW	NASA	ESA					5																													
SLS	RFM	ESA	NASA			1				1	1																										
SLS	C&S	ESA	NASA	1	1	2				2	3	1			1																						
SLS	MHDC	NASA	ESA	1	1	2				1	1			1						2																	
SLS	SLP	NASA	UKSA	6	2		2	1				1																		1							P2=UKSA
SLS	SDLS	CNES	NASA	1						1	2																										
SLS	OPT	NASA	ESA	1	1							3		1										2					1								
SIS	MIA	NASA	DLR	1		1	2																	1													
SIS	DTN	NASA	JAXA	4	3	1	2		3		2	1				2								1	1			1		1							P1=JAXA
SIS	VOICE	DLR	FSA																																		
SIS	CFDP	ESA	UKSA							1					1																						
				23	15	10	10	11	5	14	17	14	1	5	4	3	2	2	1	2	0	0	1	7	4	0	1	1	3	1	3	1	1	0		162	
				74 % 45.68						58 35.80						7 4.32						14 8.64						9 5.56 CNSA, UKSA, AFRL, FSA, Japan, JAXA, NASA						162			

# Area Directors / Deputy Area Directors - Overview



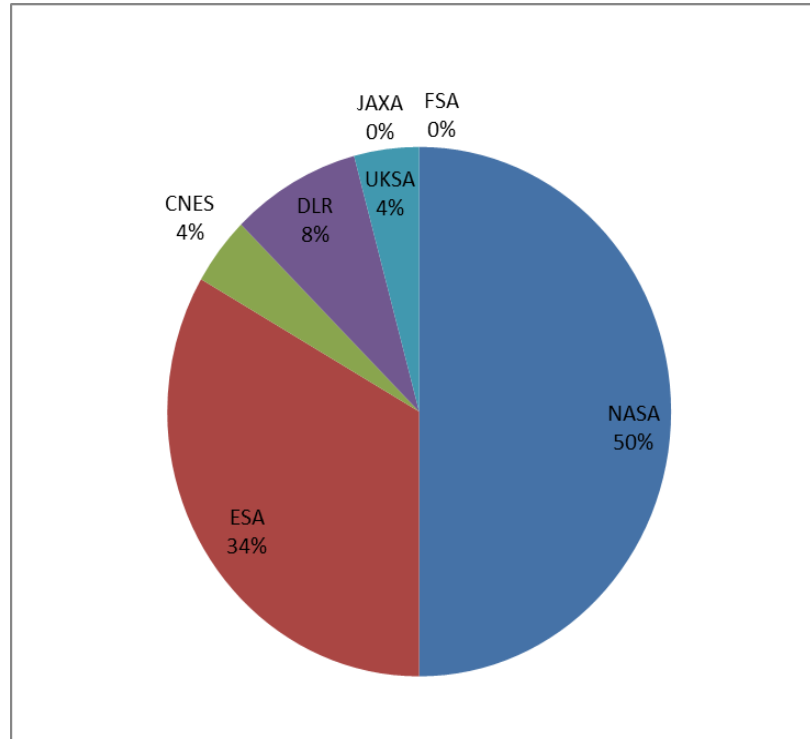
	AD	DAD
<b>NASA</b>	<b>3</b>	<b>1</b>
<b>ESA</b>	<b>2</b>	<b>1</b>
<b>CNES</b>		<b>1</b>
<b>DLR</b>	<b>1</b>	<b>1</b>
<b>UKSA</b>		<b>1</b>
<b>CNSA</b>		
<b>JAXA</b>		
<b>CAST</b>		<b>1</b>
<b>Total</b>	<b>6</b>	<b>6</b>

# WG Chair / Deputy Chair - Overview

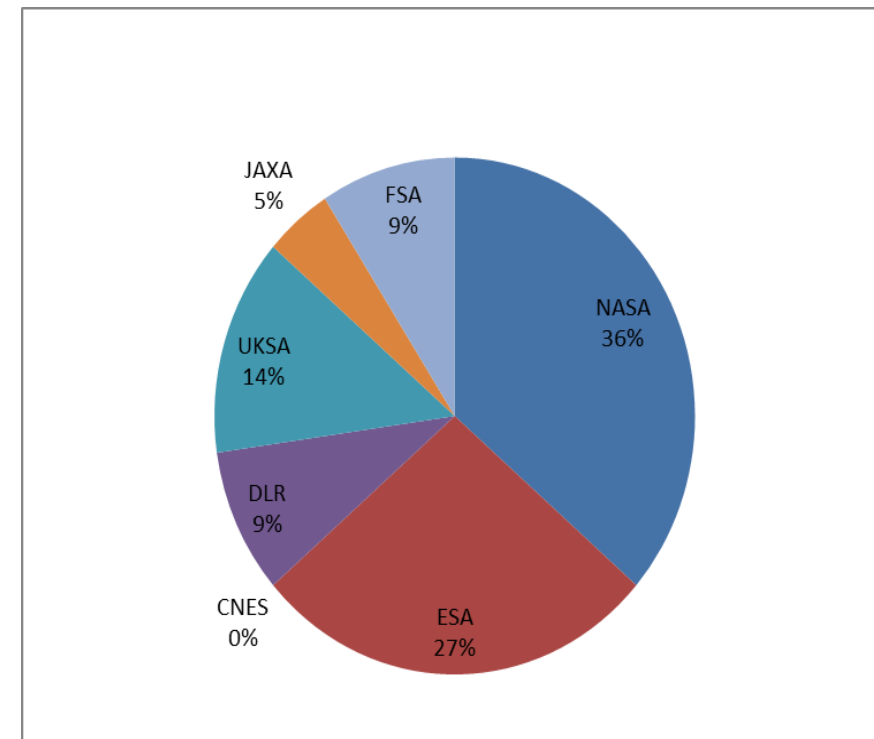
Area	WG	C	Co
SEA	SA	NASA	0
SEA	SEC	NASA	ESA
SEA	Time	ESA	0
SEA	D-DOR	ESA	NASA
MOIMS	DAI	UKSA	NASA
MOIMS	NAV	NASA	ESA
MOIMS	SM&C	ESA	NASA
MOIMS	MP&S	ESA	NASA
CSS	SM	NASA	DLR
CSS	CSTS	ESA	DLR
CSS	CDDS	ESA	NASA
SOIS	APP	NASA	UKSA
SOIS	WIR	NASA	FSA
SOIS	SNW	NASA	ESA
SLS	RFM	NASA	ESA
SLS	C&S	ESA	NASA
SLS	MHDC	NASA	ESA
SLS	SLP	NASA	UKSA
SLS	SDLS	CNES	NASA
SLS	OPT	NASA	ESA
SIS	MIA	DLR	NASA
SIS	DTN	NASA	JAXA
SIS	VOICE	DLR	FSA
SIS	CFDP	ESA	UKSA

	WG Chair	WG Deputy Chair
NASA	12	8
ESA	8	6
CNES	1	0
DLR	2	2
UKSA	1	3
JAXA	0	1
FSA	0	2
<b>Total</b>	<b>24</b>	<b>22</b>

**WG CHAIR**



**WG DEPUTY CHAIR**



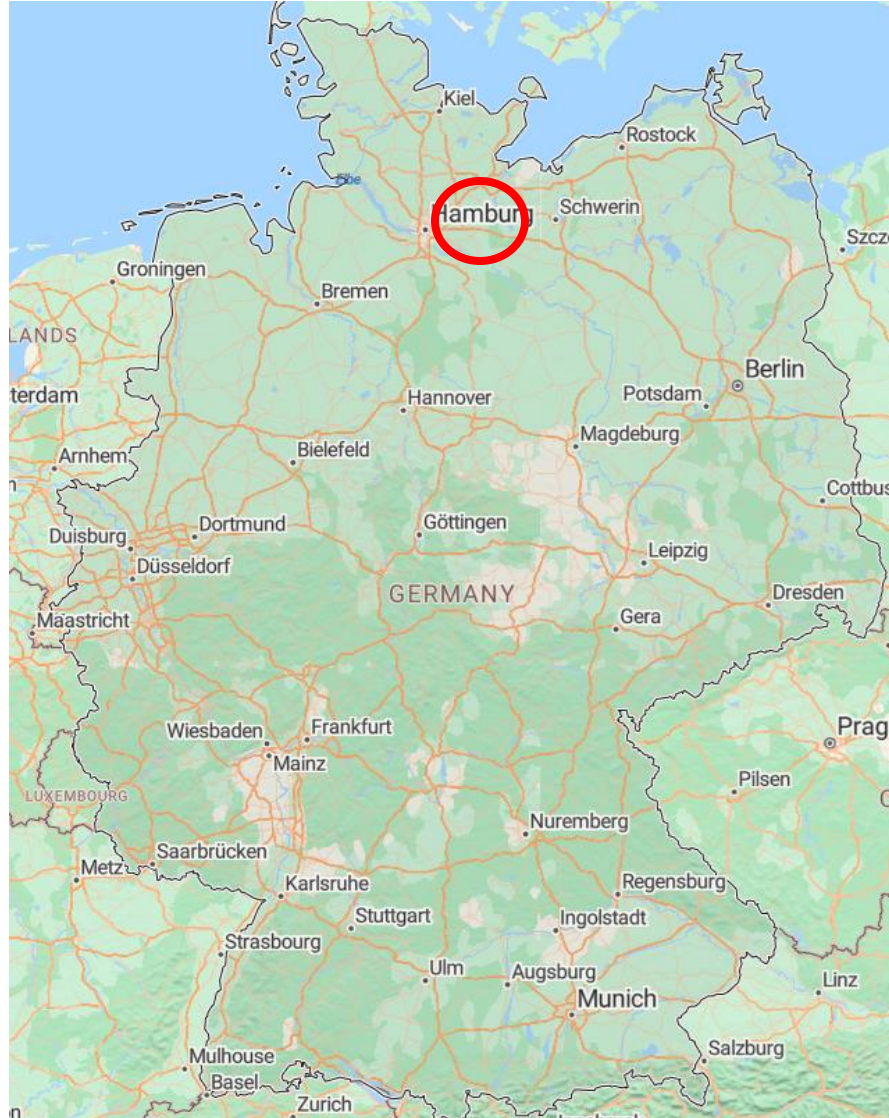
# CCSDS Fall Meetings 2025

Hosted by ESA/ESOC  
in Hamburg/ Germany

CCSDS Fall 2025  
Technical Meetings:  
15.-19. Sep 2025

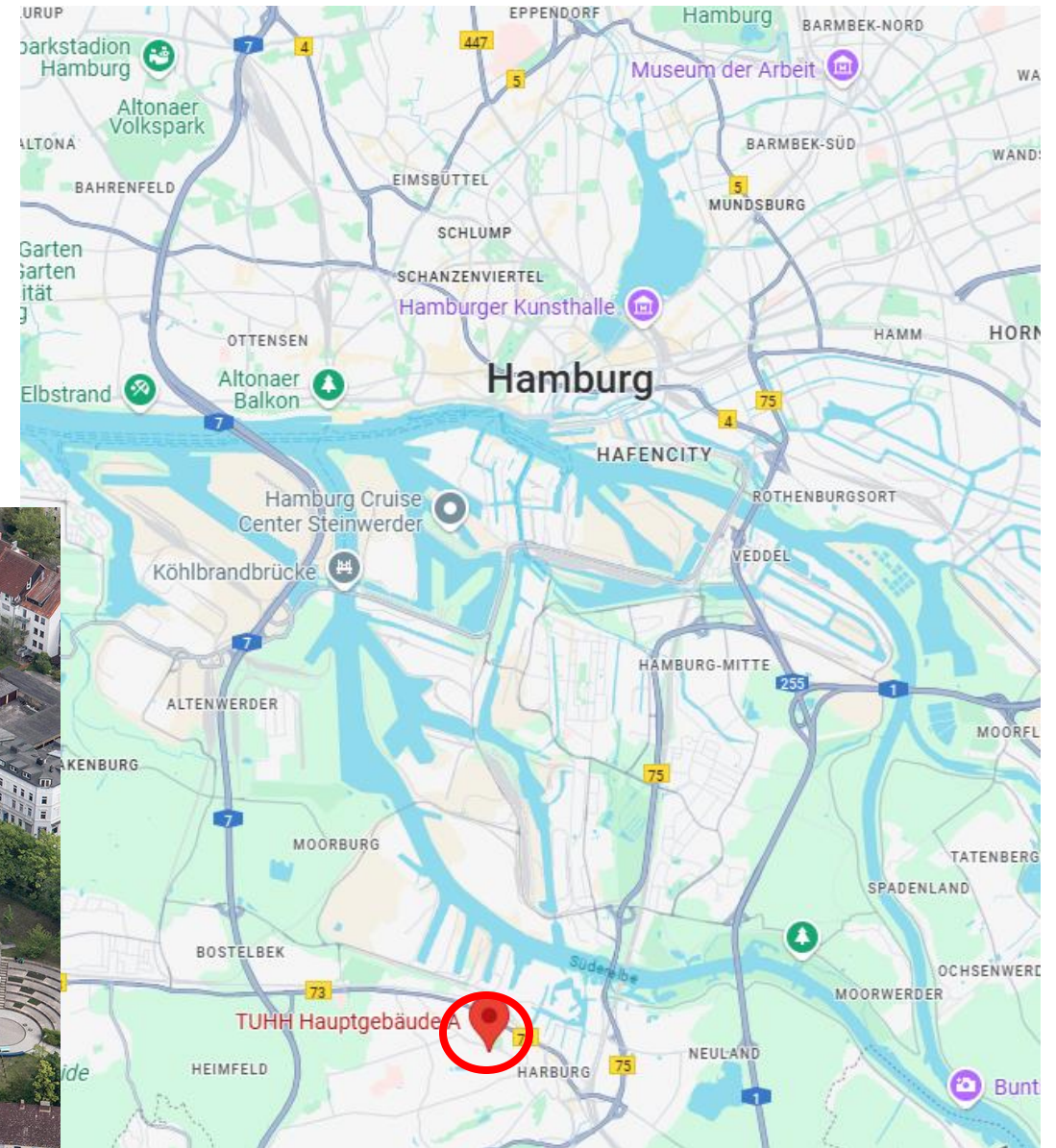
CESG Meetings:  
22.-23. Sep 2025

CMC Meetings:  
24.- 25. Sep 2025



Event Venue:

Technical University of  
Hamburg (TUHH)



# Thank you, Ignacio!!!



# System Engineering Area Main Items and Preview

**Area Director: Jim Lux (NASA/JPL), Deputy Area Director: Matt Crosby(UKSA)**

- Highlights since last meeting:
  - SE WG – Reference Architecture Doc (ARD), RASIM (Information Management)
  - SEC WG - Lots of activity – threat modelling, zero trust, coordination with DTN, Algorithm updates
  - DDOR WG – 2 books close to release, GB starting review
  - Time WG – Making progress on BB “Time Transfer, and clock correlation protocols, clock synchronization”
  
- Technically most significant items to be worked
  - Area – Mapping Standards (present or needed) to Lunar Networks and other standards; what new standards might be needed?



# System Engineering Area Main Focus Areas For The Week

## SE – System Engineering

- **Make some progress on RASIM – coordinated with Cross Support Services**
- **Discuss alignment of CCSDS stds with other evolving standards**

## SEC – Security

- **Lots of updates to books to organize**
- **Joint meeting with DTN**
- **New crypto (quantum)**
- **Even more – SEC is going to be very busy this week.**

## DDOR – Delta DOR

- **Architecture Magenta finished Agency Review, Raw Data Exchange going for Agency Review, Ops Magenta working, DDOR GB Tech starting revision**
- **Fully remote (but feel free to join from here!)**

## TIME – Time Management

- **Time Transfer, and clock correlation protocols, clock synchronization**
- **Plethora of new time standards proposed for Lunar (and Mars in the future)**

## MOIMS Main Items and Preview

**Area Director: Mehran Sarkarati, Deputy Area Director: Stefan Gärtner**

- Highlights since last meeting:
  - **New SM&C WG Chair** – CMC Poll closing 09 June
  - **Published Books:** Reference Model for OAIS, (Requirements for) Audit and Certification of Trustworthy Digital Repositories, Information Preparation to Enable Long Term Use
  - **Getting ready for publication after AR:** Mission Planning & Scheduling Service, Mission Product Distribution Service, MO Monitor and Control Services, Navigation Data Message, Conjunction Data Message
  - **CCSDS Delivery Agent** concept advancing
- Issues to be resolved
  - Increase mission adoption of SM&C standards – More alignment within CCSDS



# MOIMS Main focus areas for the week

## DAI

- Finalise the OAIS-IF BB and YB – some work will probably be needed after the meeting to complete the YB.
- New Project Proposal: Maturity Model for digital preservation and information use and sustainability

## MPS

- MP&S Information Model Magenta Book drafting (new book)
- MP&S Green Book drafting (5-year revision)
- Joint session with SM&C on topics of common interest

## NAV

- **GB:** 500.0 Navigation Data – Definitions and Conventions - Discussions with SANA for adoption
- **BB:** 503.0 Tracking Data Message (TDM - NASA, ESA): 5y revision - Pink Book 2.0.3 - Drafting in progress
- **BB:** 505.0 Navigation Data Message XML Specs (NDM - no prototype): 5y revision - AR completed, RIDs completed, testing
- **BB:** 507.0 Navigation Events Message (NEM) - White Book 1.0 Drafting in progress
- **BB:** 507.1 Launch Data Message (LDM)- White Book 1.0 Drafting in progress
- **BB:** 508.0 Conjunction Data Message (CDM): 5y revision - AR completed, Test Plan in progress
- **BB:** 508.2 Fragmentation Data Message (FDM)- White Book 1.0 Drafting in progress
- **BB:** Navigation Composite Message (NCM) - White Book 1.0 Drafting in progress

## SM&C

- Close open topics
  - SANA update, closing RIDs (M&C Services, Mission Product Distribution Service, HTTP Binding)
  - Finish LunaNet document on how MAL can be useful / to be shared with the NAV WG for further consultations
- Make the standard more understandable and “acceptable”: Security in MO / Green Book 5Y Review
- Open new topics: CCSDS Delivery agent

# Cross Support Services Area Main Items and Preview

**Area Director: Erik Barkley (NASA/JPL), Deputy Area Director: Holger Dreihahn (ESA/ESOC)**

- Highlights since last meeting:
  - CSSM WG (Service Management) – Production of Best Practices (MB)
  - CSTS WG (X-Support Data Transfer) – Production of SC-CSTS (BB)
  - CDDS WG (Cloud Data Delivery) – Production of Concept (GB)
- Technically most significant items to be worked
  - Area – Process/procedure for Functional Resource Model Management



# Cross Support Services Area Main Focus Areas For The Week

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## **CDDS – Cloud Data Delivery Standards**

- **“Bless” Concept (GB) book for publication**
- **Progress Blue Book**
- **Develop prototype plan**

## **CSSM – Cross Support Service Management**

- **“Bless” Best Practices book for publication**
- **Begin work toward standardized API for managing services**
- **Review prototype plan for Service Agreement and Configuration Profile**

## **CSTS – Cross Support Transfer Services**

- **Release Service Control (standard for real-time MOC <- -> GS communications related to control of GS services) for publication polling**
- **Look at inclusion of functional resource and parameter related to Optical Comm into the Functional Resource Model**

**Area Director: Simon Singh (NASA/GSFC), Deputy Area Director: Xiongwen He (CAST)**

## **Application Support WG**

- **New Area Director, Simon Singh (NASA GSFC), has been selected and active since Fall meetings**
- **Ongoing and productive discussions with agency and industry mission engineers to infuse SOIS standards**
- **Ongoing discussion with Artemis Program and missions on new standard for software component and device configuration objects**
- **Meeting Objectives**
  - **Review interoperability tests and documentation for 876.0-P-1.1 XML Specification for Electronic Data Sheets (Book was updated to incorporate feedback from mission users)**
  - **Support meetings with SEA, DTN, and CSS area**
  - **Discuss first hop/last hop application standard for DTN**

## **Subnet WG**

- **Suspended until support from missions and second agency is obtained**
- **There is significant value for subnet standards for device discovery, enumeration, and configuration for crewed spacecraft and surface systems but we need mission support**

## SOIS-WIR WG

- **Completed publication of CCSDS 883.0-B-2, Spacecraft Onboard Interface Services—High Data Rate Wireless Proximity Network Communications (Blue Book, Issue 2)**
- **SOIS-WIR will meet virtually during Spring 2025 Spring Meetings at APL**
  - **Zoom meetings for any CCSDS offsite participants (email SOIS-WIR WG chair for online meeting link)**
- **Establishing lunar surface communications interoperability test capability at NASA-JSC (JEWL, GEM testbed activities)**
- **Discuss updates on relevant CCSDS agency wireless activities as participation allows**
- **Discuss CCSDS Activities and Projects**
  - **CCSDS-880 GBv4 (Include additional material on 5G, modernize, *work is in progress*); goal to publish GBv4 prior to Fall 2025 meetings**
  - **Discuss a NASA proposed SOIS-WIR Orange Book for lunar communications management and operational capabilities utilizing *QUIC, WebTransport, WebRTC, and Low Latency, Low Loss, and Scalable Throughput (L4S)* as FY2026 activity**

## Space Link Services (SLS) Main Items and Preview

Area Director: ***I. Aguilar Sánchez***, Deputy Area Director: ***G. Moury***

- Highlights since last meeting:
  - RFM, C&S: Proximity-1 C&S and RFM blue books (updates), 2 GHz CDMA blue book updates
  - SLP: Proximity-1 Generic Session Control White Book, Lunar Prox-1 Directives
  - SDLS: 3KEM
  - DC: SAR Data Compression
  - OPT: Coherent communications, GFP Octet streaming prototyping approach
- Issues to be resolved
  - Area Director - smooth and effective handover
  - CCSDS Communications standards updates - completion towards LunaNet/Moonlight (LNIS)
  - LunaNet/Moonlight Advanced Forward Signal (AFS) – approach for publication as a CCSDS Standard
  - SLS Priorities for CCSDS Technical Editors



# Space Link Services (SLS) Main focus areas for the week

## RFM

- Proximity-1 RFM Pink Book
- PN Ranging extension for Prox-1
- 2 GHz CDMA Pink Book updates

## C&S

- Proximity-1 C&S Pink Book
- Proximity-1 C&S extension to Ka/K (new project)

## SLP

- Lunar S-band additions to Prox-1 Generic Session Control White Book
- Prox-1 Link Protocol White Book
- AOS topics (SCID ripple effects, use on LunaNet)

## DLS

- Progress specification of Key Exchange procedure (3KEM)
- Progress specification of Extended Procedures to support 3KEM

## DC

- Raw SAR Compression (*met on June 2*)
- Low-Complexity Lossless and Near-Lossless Multispectral and Hyperspectral Image Compression Blue Book (Is. 3)

## OPT

- Coherent Communications
- GFP Octet Service

# Space Internetworking Services (SIS) Main Items and Preview

**Area Director: Tomaso de Cola, Deputy Area Director: Vinnie Ristovski**

- Highlights since last meeting:
  - BPv7 Orange Book ready for CESG publication approval
  - New features for BPv7 subject of several orange books
  - Progress with the re-elaboration of the RTP over DTN draft Blue Book
  - Agency Review of CFDP Unitdata Transfer Layer Magenta Book completed and book will be finalised for publication
- Issues to be resolved
  - Merge of MIA and VOICE WGs to be organised by Q2-2025
  - LTP reaffirmation to be closed in Q1/Q2-2025, as it is pending since long
  - Converging the many DTN orange books into a blue path at some point



## SIS Main focus areas for the week (1)

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### CFDP

- Discussion of the RIDs from the CFDP Magenta Book
- Finalisation of the CFDP v6 draft book towards agency review and related planning of interoperability testing

### MIA

- Finalisation of the RTP over DTN book and related interoperability testing revision towards CESSG approval
- Preparation of the content for an upcoming video quality magenta book (project still to be formalised)
- Next steps towards the merging of MIA and VOICE into the new MIVA WG (discussion planned also at CESSG)

### VOICE

- Merge with MIA (see MIA last point)

## SIS Main focus areas for the week (2)

### DTN

- **BPv7 Blue Book and related:**
  - **Interoperability testing**
  - **Endpoint naming**
- **Progress and planning for the existing orange books:**
  - **Compressed status reporting / Custody Transfer**
  - **Multicast**
  - **BIBE**
  - **QoS**
  - **DTN Reference Scenarios**
  - **DTN Network management → see next point**
  - *HPRP → postponed to Q3-2026*
- **DTN Network Management**
  - **BPv7 Management Information Draft Orange Book**
  - **Management policy**
  - **Management MIBs/ADMs**
  - **LTP Protocol management info**
  - **Alignment CCSDS-IETF**
- **Synergies with Security WG and related activities:**
  - **BPsec Orange Book**
  - **BPsec Blue Book Interoperability Testing**
  - **BPsec COSE context**
  - **IGCA Discussion**
  - **Key management update**
  - **Crypto audit log for BPsec**

# CCSDS Success Stories

(Selected examples cited, not exhaustive)

**Timothy Pham & Daniel Fischer**

**(with contribution from Erik Barkley, Clemens Heese, Jon Hamkins)**



# Past Examples

- ESA XMM mission emergency contact, 2008
  - Issue with onboard antenna switch resulted in significant SNR loss, prompting the need for DSN 70-m support
  - Ease of cross support enabled because of XMM compliance with CCSDS specifications (also true with numerous other missions)
    - SLS Coding & Synchronization, Space Link Protocol, RF Modulation
    - CSS Space Link Extension



XMM-Newton: European Space Agency (ESA) Mission  
 -- X-ray Multi-Mirror; a very capable X-Ray Observatory

- Faulty microwave switch caused very bad degradation in communications (signal attenuation of ~56 dB)

- ESA lost ability to command spacecraft on 18 October 2008
- Only real chance to get commands into spacecraft was at XMM perigee, only over a NASA DSN ground station
- XMM mission had never planned to use a NASA network
- But the mission was using CCSDS/international standards
- NASA's DSN was using the same standards

**It should work, right?**

**YES**  
 Very Happy  
 Mission Operations Team



A relieved XMM-Newton mission control team at ESOC receives the long awaited radio signals from the spacecraft through NASA's Goldstone ground station, in California, on 22 October 2008. Radio contact was previously lost on Saturday 18 October. (courtesy: ESA)  
 --ESA Press Release, 23 October 2008



Dietmar Heger, XMM-Newton Deputy Spacecraft Operations Manager at ESOC, talks to the NASA Goldstone ground station, in California, during the recovery action that re-established communication with the spacecraft on 22 October 2008. Radio contact with XMM-Newton was previously lost on Saturday 18 October. (courtesy: ESA)  
 --ESA Press Release, 23 October 2008.

1



# Recent Examples

- Psyche mission's Deep Space Optical Communications
  - NASA OGS demonstrated in 2024-2025
    - Achieved data rate up to 267 Mbps
  - ESA OGS demonstration pending in July 2025
  - Interoperability achieved because of CCSDS specifications
    - CCSDS 141.0-B-1 Optical Communications Physical Layer
    - CCSDS 142.0-B-1 Optical Communications Coding and Synchronization
- TetraByte InfraRed Delivery (TBIRD)
  - NASA OGS demonstration 2022-2023 at 200 Gbps
    - CCSDS 141.10-O-1 Optical High Data Rate Communications, 1550 nm
- KPLO's and PACE's use of DTN Bundles protocols
  - CCSDS 743.2-B-1 CCSDS Bundle Protocol Specification
- JAXA Navigation support to Artemis-1 (and upcoming Artemis-2)
  - Use of JAXA antennas to provide 3-way Doppler data for Artemis navigation
    - CCSDS 502.0-B-3 Orbital Data Message
    - CCSDS 503.0-B-2 Tracking Data Message



~1550 NM DOWNLINK



# Near Future Examples

- Commercial sector - Intuitive Machine's 1st Lunar Relay Satellite (~2026)
  - DTN Bundle-based architecture
    - CCSDS 734.20-O-0 CCSDS Bundle Protocol Specification (BP7)
- DLR GSOC Free space Optical Ground Antenna Taberna (FOGATA)
  - Use of standard scheduling interface
    - CCSDS 902.1-B-1 Cross Support Service Management - Simple Schedule



# Bootcamp Overview

Jim Lux, who took over for Peter Shames, who did the training and bootcamp for decades

- Process and getting new docs out
- New Editing Team!
  - Natalya Stepanova (started on BPv7 Orange book)
  - Lee M. Stablein (started on TM Sync and Coding Pink book)
- Consensus
- All those colors
- Iteration at multiple levels
- Things to remember

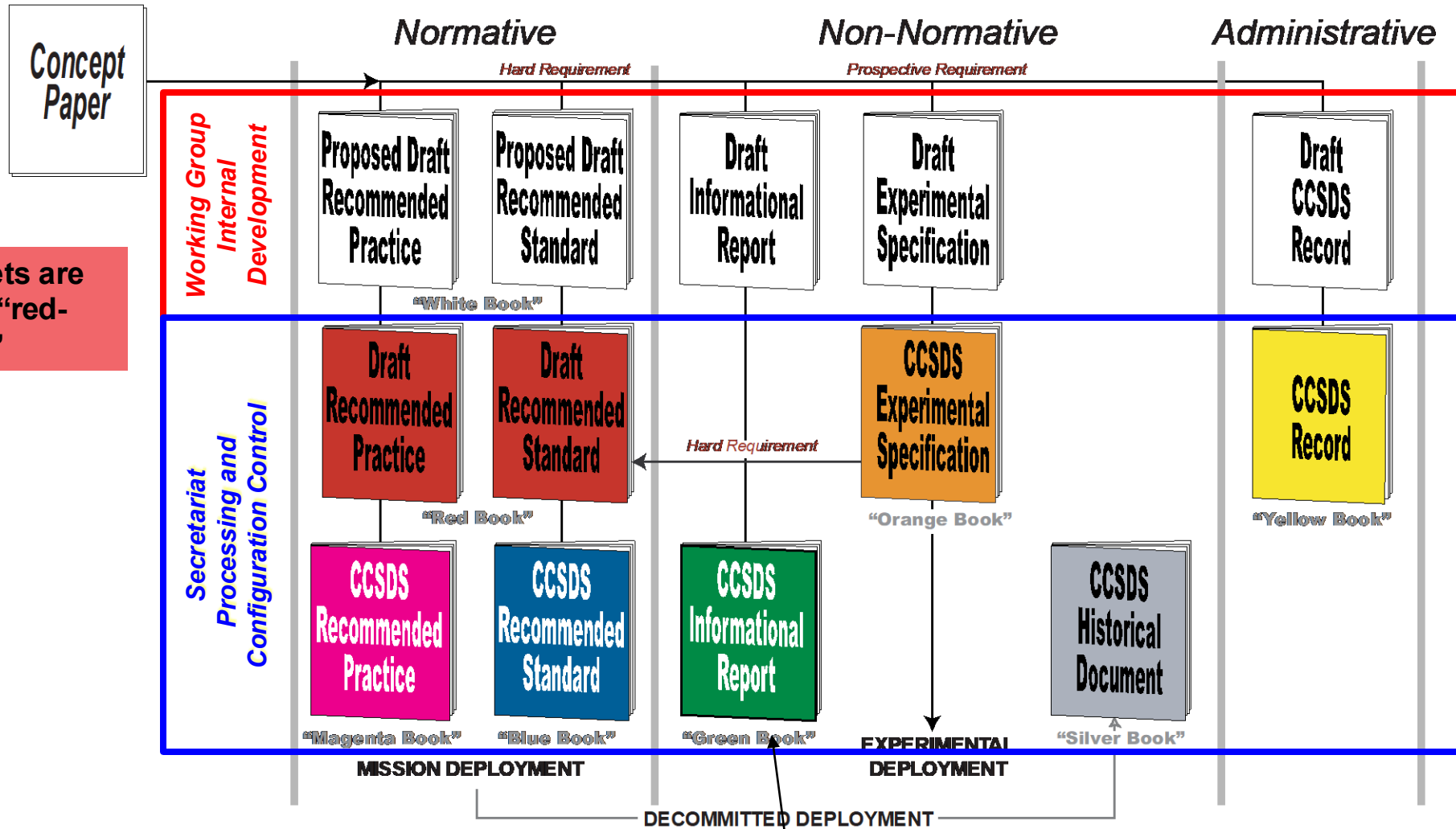


## We need deliberate, but rapid progress

- **A night to remember, 15 April 1912, The *Titanic***
  - **CQD (1904, Marconi, General Call, Distress) – “Industry standard” and *de facto* universal because Marconi provided all commercial ship’s radios and required its use**
  - **SOS (1905, German standard Notzeichen) – proposed 1906 International Radiotelegraph Conference, finally effective in 1908**
  - **Took some years to be used universally (resistance from entrenched users)**
  - **CQD essentially became unused after Titanic**
- **And the messages didn’t get through**
  - **Shut down for night**
  - **Too much other commercial traffic to handle on board Titanic, so they didn’t get message (a CDM?) from *SS Californian*, warning of icebergs**
- **Led to International Convention for the Safety of Life at Sea (SOLAS) in 1914**

10 years in development, final 2 years after a disaster

# The Colors

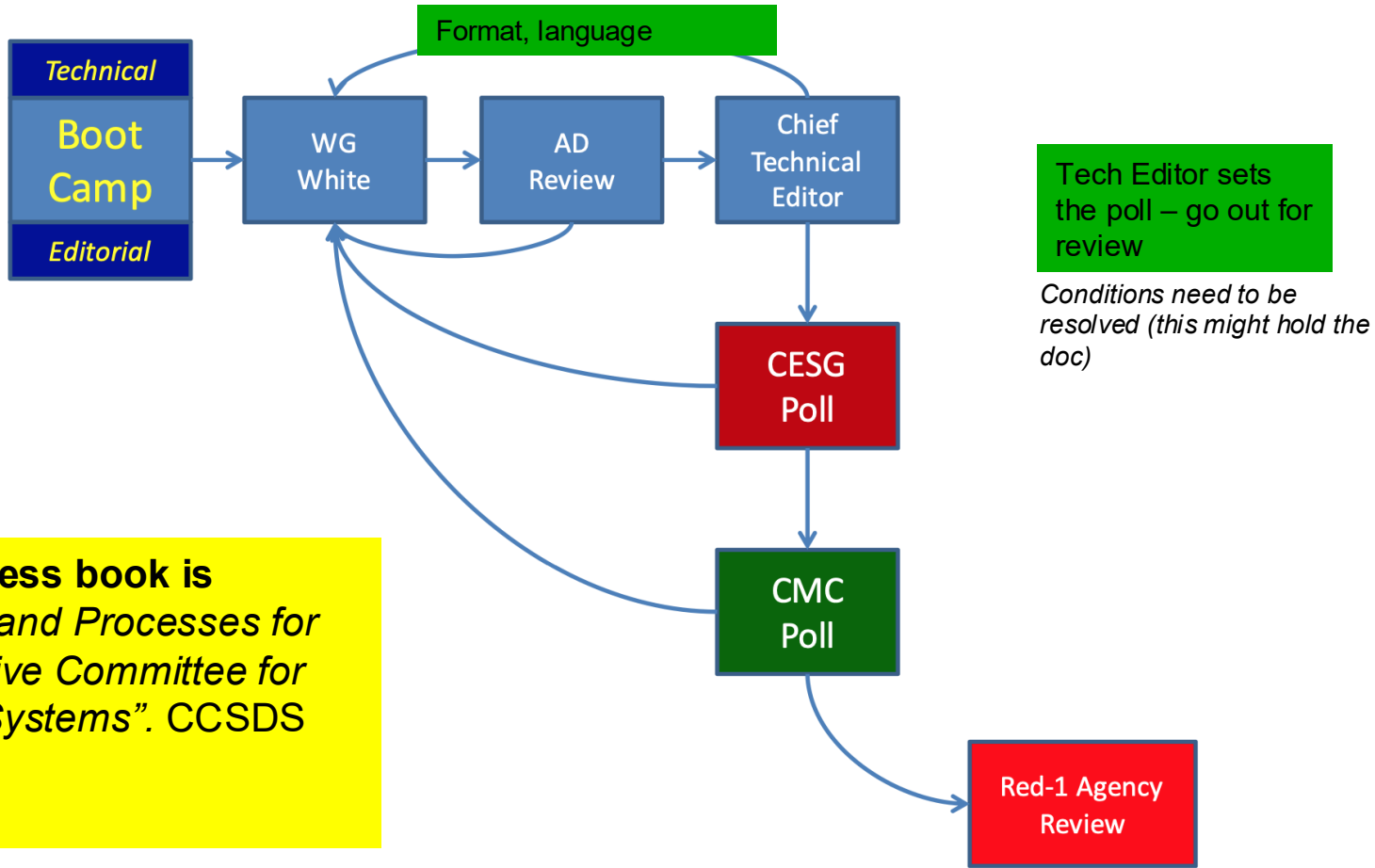


Pink sheets are kind of a "red-book-lite"

"the bible": CCSDS A02.1-Y-4 (Apr 2014)  
 Also yellow books: Test procedures, Test Plans, Reports

Important, and needs work!

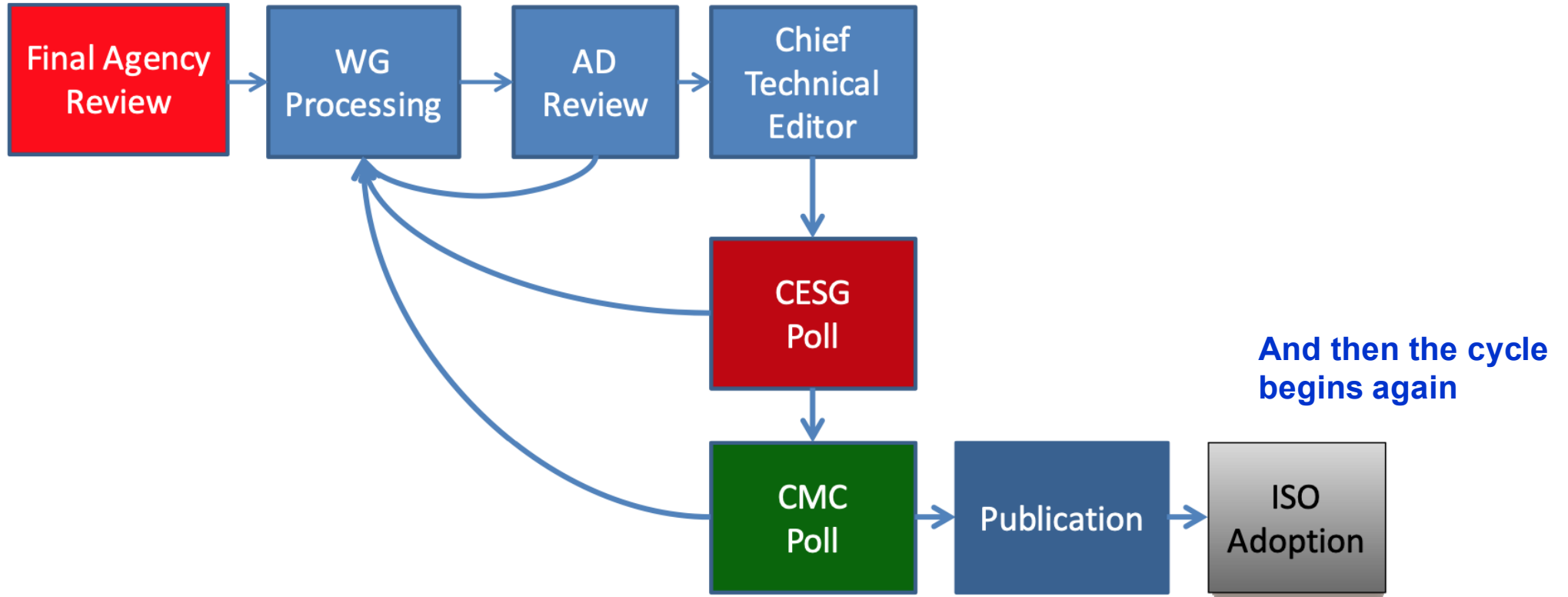
# Process – up to Agency Review



**The big process book is**  
*Organization and Processes for the Consultative Committee for Space Data Systems*". CCSDS A02.1-Y-4 (Apr 2014)

# After Agency Review

Inevitably, there are changes requested,  
So the same process is followed



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# IT Updates – Tech Writer Support

- The CCSDS CWE was migrated to SharePoint Online on December 30, 2024.
- **All working group draft documents should be hosted in the CWE in their appropriate areas.**
- **New SharePoint features are now being developed to assist the Technical Editor processes.**
  - **Online Archive of Historical Technical Editor Work (Completed)**
    - The previous Tech Writer's Database has been migrated to the CWE Framework
    - Preserve legacy editorial work in a structured, searchable format
    - Enable Secretariat, CESG, and CMC members to reference historical publication data
  - **New Request & Tracking System for Technical Editor Support (In-Progress)**
    - Enhance transparency in the request process
    - Standardize the information submitted for review/publication
    - Enable real-time status updates and notifications
    - Provide stakeholders with up-to-date progress tracking and reporting
  - **Enhancements to CMC & CESG Polling Systems (Coming Soon)**
    - Automate poll notifications and reminders
    - Simplify communication by decoupling alerts
    - Improve result compilation and export options
    - Reduce confusion and manual workload for the Secretariat and poll participants.

Microsoft 365 ⚙️ ? 👤

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	📁	Meeting Materials	... February 23, 2007	<input type="checkbox"/> System Account	October 30, 2014	<input type="checkbox"/> System Account		📄

Drag files here to upload

## Parting comments

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- **Style**
  - Be careful about distinguishing “normative” (shall, will, ”do this”) from non normative (explanations, rationale)
- **Drafts can be anything (put them in CWE!)**
  - Need \*original\* artwork in scalable form (think about this early)
  - SVG, vector formats, PPT, Visio
  - Don’t draw pictures in MS Word! (they auto scale poorly)
- **When it comes to “getting ready to submit”**
  - Text, figures, etc. go to the secretariat (e.g. editing team)
  - Don’t obsess on formatting – it inevitably will change anyway