

The background of the slide is a composite image. On the right side, there is a curved horizon of the Earth, showing continents and clouds. The rest of the background is a dark space filled with numerous small, glowing orange and yellow dots, representing satellites or space debris. Several green lines of varying lengths and orientations are scattered across the space, representing satellite tracks or orbital paths.

Best practices for sustainability of space operations

Dan Oltrogge

Space Safety Coalition

23 May 2023

SSC SPACE
SAFETY
COALITION

Space Safety Coalition (SSC)

- <https://spacesafety.org>
- Most operators support space sustainability
 - “It’s just good business sense”
 - Especially important for new large constellations
- SSC is an ad hoc coalition of willing space operators and relevant industry stakeholders
 - Formed to assemble aspirational best space operations practices
 - Not a legal entity
- SSC can make a difference, in advance of:
 - Space governance treaties and consensus guidelines
 - Standards
 - National regulations
- Signatories endorse and strive to implement best practices
 - To ensure safety and commercial viability of space activities

What is SSC's “Best Practices for the Sustainability of Space Operations” ?

- A ground-breaking “living” best practices document that:
 - **Part 1:** Endorses existing international guidelines, standards (IADC, UN, ISO, CCSDS)
 - **Part 2:** Contains **over forty additional specific best practices** to further enhance and secure the long-term sustainability of space operations
 - Initially motivated by perceived unpreparedness for LEO large constellations
 - Originally developed by 36 space operators and relevant industry stakeholders
- **Spans all phases of design and spaceflight, orbit regimes, spacecraft form factors, life cycle phases, and mission types**
- Although **non-normative**, signatories “endorse and agree to promote and strive to implement” these best practices to preserve the space operations environment for current and future generations.
 - Commercial willingness to follow these best practices alleviates need for heavy-handed regulations

Space Safety Version 2

- Endorsement of over forty additional best practices not captured in current IADC, UN or ISO documents that are seen as critical to maintaining safe space operations in all orbital regimes (both NGSO and GSO), including:
 - **Operator exchange of information** relevant to safety-of-flight and collision avoidance with other space operators and stakeholders in accordance with each operator's country export regulations;
 - Satellite operator **selection of launch vehicles** with due consideration of sustainability of the space operating environment;
 - Responsible **mission and constellation design** to prioritize space safety for spacecraft & constellations;
 - Commitment to **spacecraft designs** that facilitate successful disposal (striving for a probability of successful disposal of 95%), actively avoid collisions, minimize casualty risk, mitigate risk of post-mission fragmentation, ensure sensor trackability and facilitate spacecraft servicing and removal;
 - Commitment to **space operations** that actively avoid collisions, properly passivate satellites either upon end-of-mission or after a suitable active collision avoidance phase has been completed, incorporate "Rules of the Road," dispose the satellites within 5 years of end-of-mission for manoeuvring spacecraft and maintain accurate spacecraft positional knowledge.

Comparison of SSC Best Practices Versions 2.0 and 1.47

	2023 SSC Best Practices (v 2.0)	2019 SSC Best Practices (v 1.47)
IADC guidelines	Revision 3 (2021)	Revision 1 (2007)
ISO international standards	ISO 24113 (2019) [et al]	ISO 24113 (2011) [et al]
21 UN COPUOS LTS Guidelines	June 2019	June 2019
Aspirational best practices	42	42
Rules of the road	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Avoiding intentional fragmentation	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Exchange of ephemerides and planned maneuvers	<input checked="" type="checkbox"/> and additional ephemeris traits, covariance, and widespread adoption of CCSDS NavWG standards	<input checked="" type="checkbox"/>
Use of launch systems that seek to minimize environmental impacts	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Post-mission disposal goals	95% for 5 yr and 99% for 25 yr life	95% for GEO and LEO
Post-mission passivation guidance	More detailed guidance and goals, depending upon post-mission lifetime	Recommends it be done
Post-mission collision avoidance	Encouraged if post-mission life < 5 yrs	<input type="checkbox"/>
Positional knowledge and errors	Conduct regular ongoing assessments	<input type="checkbox"/>
Spacecraft anomaly assessment	Anomaly/failure root cause investigation	<input type="checkbox"/>
Security	Cybersecurity, prevent unauthorized access	<input type="checkbox"/>

How you can participate

- Legal entities that have a direct and material interest in space safety and sustainability are encouraged to participate in the Space Safety Coalition by simply emailing the following content to info@spacesafety.org:
 - Confirmation of your entity's endorsement of the SSC's current set of best practices, posted at spacesafety.org.
 - Provide a narrative statement of approximately 250 words describing how your organization is a space operations stakeholder interested in sustainability.
 - Your entity's full legal name.
 - Your designated point of contact, phone and email.
 - A quality logo, suitable for incorporating into the best practices document as well as for posting on the SSC website.



International standards development activities supporting space operations

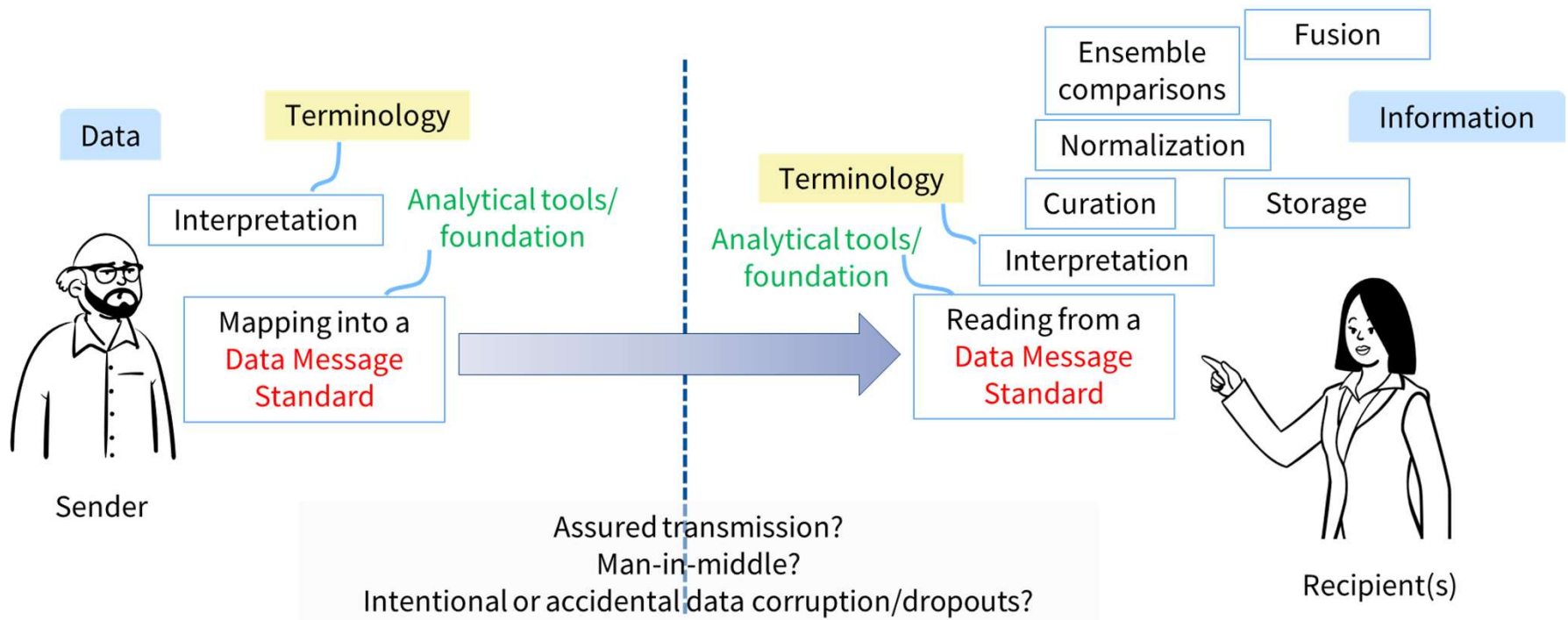
Dan Oltrogge, COMSPOC Corporation

26 June 2024

SDA AGM

Data exchange must be accompanied by integrity (security + quality)

- Ensuring data exchange integrity between and within space systems includes:
 - Data creation, data format, interpretation, exportation, transmittal, ingestion, re-interpretation, normalization, curation, comparison, analysis/fusion, and storage.



CCSDS & SC13 develop international space data standards

- Consultative Committee for Space Data Systems (**CCSDS**) operates **ISO TC20/SC13**

- Comprised of 11 space agencies

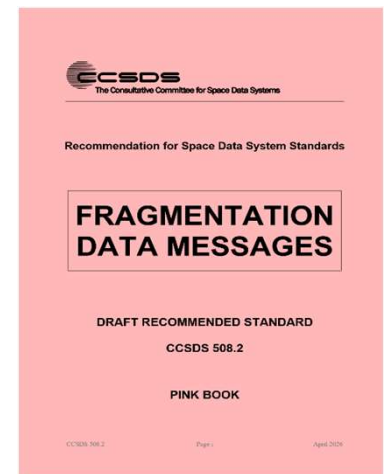
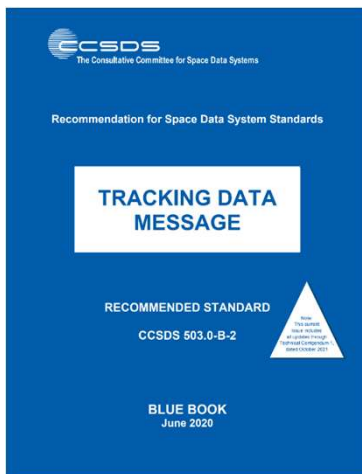
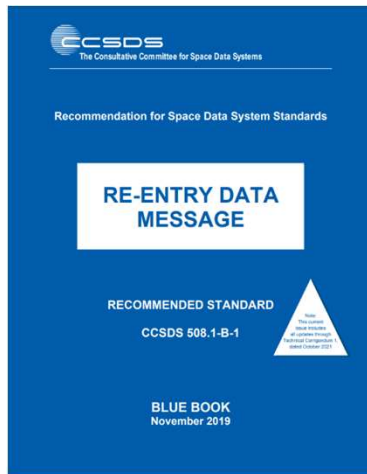
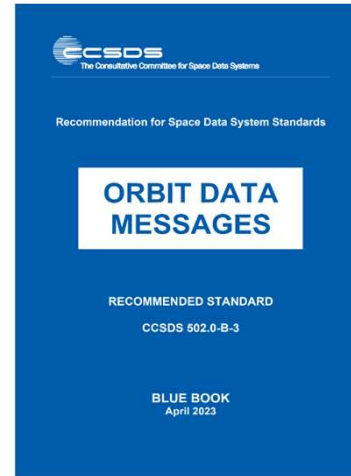


- Standards available through ISO and also at: <https://public.ccsds.org/default.aspx>

- CCSDS navigation data exchange messages:

- Attitude Data Message (ADM)
- Conjunction Data Message (CDM)
- Events Data Message (EDM)
- Orbit Data Message (ODM)
- Pointing Request Message (PRM)
- Reentry Data Message (RDM)
- Tracking Data Message (TDM)
- In development: Launch Data Message (LDM)
- In development: Fragmentation Data Message (FDM)

Space safety-relevant data exchange standards



Mapping of CCSDS data exchange standards to Space Traffic Coord.

	Published CCSDS messages and standards									Devel			Proposed	Potentially useful new CCSDS messages for STC										
	Attitude Data Message	Conjunction Data Message	Digital Motion Imagery	Orbit Data Message	Pointing Request Message	Radio Freq & Mod. Systems	Re-entry Data Message	Space Data Link Security Stds	Time Code Formats	Tracking Data Message	Events Message	Fragmentation Data Message	Launch Data Message	Navigation Composite Message	Anomaly Message	Earth Orientation Parameters Msg	Geolocation Data Message	EMI Data Message	RF Characteristics Message	RPO/OOS Data Message	Situation Report Message	Space Catalog Mapping Msg	Space Weather Data Message	Spacecraft CAD Message
Attitude	•			•	•				•				•											
Conjunctions	•	•		•	•				•	•			•		•								•	
Maneuvers				•						•			•		•						•			
Orbit & errors "Phonebook"				•						•			•		•							•		
Reentry													•											
RF, RFI, Geoloc						•							•		•	•								
RPO/OOS			•	•		•		•					•		•			•	•			•	•	•
Space catalog				•	•								•		•							•	•	•
Space events	•	•		•	•		•		•	•	•	•	•		•		•			•		•	•	•
S/C chars, SoH				•					•	•			•				•	•		•				•
Sensor track/obs					•				•	•			•		•					•				
STC system	•	•		•			•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	

A photograph of an astronaut in a dark space suit floating in the void of space. The Earth's horizon is visible at the bottom, showing a blue atmosphere and a vibrant green aurora borealis. The background is a deep black space filled with numerous small white stars.

**Thanks for your
attention!**

Dan Oltrogge
dan@comspoc.com