



Join us on December 19 at 2 p.m. EST  
for the **TraCSS** listening session on  
**Space Data Standards and Formats**





# Housekeeping for Listening Session

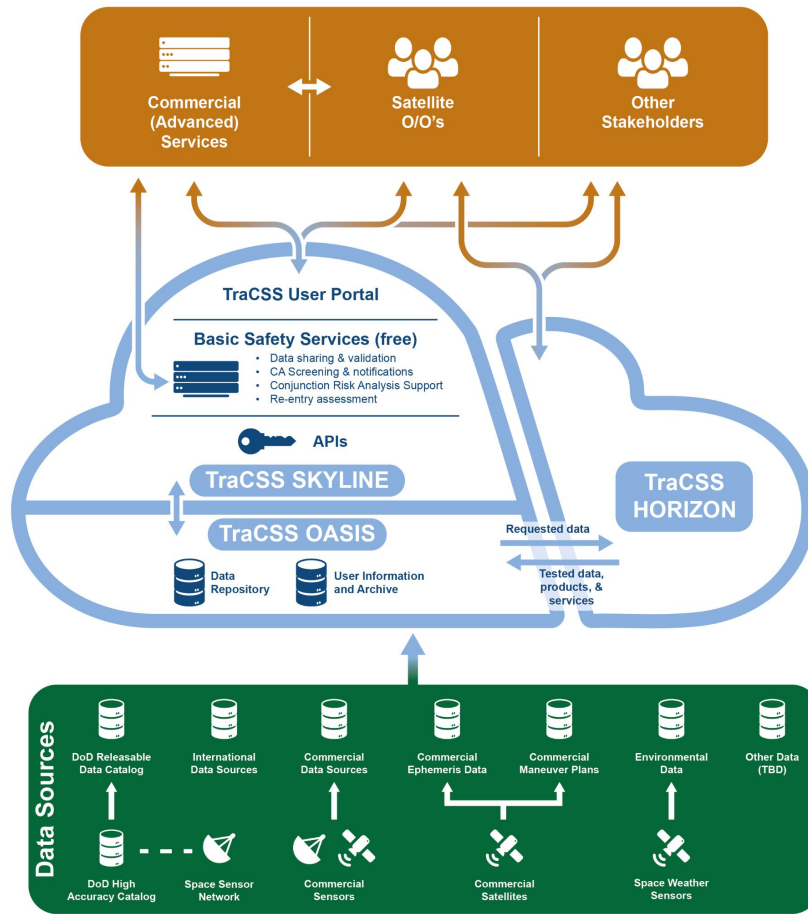
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- The listening session is for 1 hour total time.
- Will be recorded and posted online to the TraCSS website afterwards
- Will be taking feedback but no Q&A in this session
- Agenda:
  - Welcome & Brief Overview of TraCSS - Christine Joseph, OSC
  - TraCSS Data Exchange & Recommendations - Dr. Dianne Poster, OSC, NIST
  - Feedback Time
    - Registered Participants - 3 minutes each
  - Closing & Wrap-Up
  - Adjourn
- Next steps:
  - Written comments may be submitted per the guidelines in the posted document on the TraCSS webpage until 5:00 pm ET, January 18, 2024
    - [tracss.commerce@noaa.gov](mailto:tracss.commerce@noaa.gov)
  - Future listening sessions are planned for 2024 - will be announced on TraCSS webpage and via email blasts



# Traffic Coordination System for Space - TraCSS





# Phase 1 Capability Roll-Out Plan

Phased delivery of commercial functionality



**Phase 1.0: Q4FY24**

- Platform
- Improved O/O Ephemerides
- Generate CDMs
- CDMs posted to Space-Track
- Operator Display
- Beta Users
- Offload some DOD O/O support

**Phase 1.1**  
Bug fixes & software refinement

**Phase 1.2: Q2FY25**

- Data Quality Monitoring

**Phase 1.0**

- Platform
- Improved O/O Ephemerides
- Generate CDMs
- CDMs posted to Space-Track
- Operator Display
- Beta Users
- Offload some DOD O/O support

**Phase 1.3: Q3FY25**

- Mission Planning
- SSA Data
- O/O Presentation Layer

**Phase 1.2**

- Data Quality Monitoring

**Phase 1.0**

- Platform
- Improved O/O Ephemerides
- Generate CDMs
- CDMs posted to Space-Track
- Operator Display
- Beta Users
- Offload some DOD O/O support

**Phase 1.4: Q4FY25**

- Conjunction Analyses
- Public Presentation Layer

**Phase 1.3**

- Mission Planning
- SSA Data
- O/O Presentation Layer

**Phase 1.2**

- Data Quality Monitoring

**Phase 1.0**

- Platform
- Improved O/O Ephemerides
- Operator Display
- Beta Users
- Offload some DOD O/O support



# TraCSS Data Exchange

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- Data exchange between the Department of Commerce (DOC) Office of Space Commerce (OSC) Traffic Coordination System for Space (TraCSS) and other platforms is essential for DOC and the receiving platforms to perform their space traffic coordination (STC) functions operations.
- Identifying and defining the communication and data handling standards is necessary for enhanced government and commercial interoperability and cross-support, while also improving capability and providing a clear path for technology insertion to TraCSS and other platforms.
- By identifying and defining space situational awareness (SSA) data types and standardized approaches for data exchange, STC and SSA functions will be easier to manage.





# TraCSS Data Exchange

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## Standards

- OSC has identified and described SSA data types that will be provided by TraCSS to other SSA platforms and satellite operators.
- In addition, recommendations are provided for published standards to represent and transmit these data types out from TraCS
- Recommended standards support provision of SSA data from TraCSS to other SSA platforms and satellite operators.
- These standards are open and internationally viable for a diverse set of users to enhance interoperability and enable cross-support participating entities.





# TraCSS Data Exchange

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## Standards

- As commercial satellite communication providers are not inherently interoperable, it is essential to achieve desired interoperability to the best extent possible.
- Rules for data exchange can be formally specified by two ways:
  - Standards that codify norms of behavior that are expected or accepted through best practices, or
  - Standards that establish international consensus formats, terminology and content for data exchange
- International standards developing organizations provide the essential forums for the development of commercial standards that help ensure successful interoperability.





# TraCSS Data Exchange

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## International Standards Developing Organizations

- Standards are often developed via consensus building on what the standard addresses
  - International Organization for Standardization (ISO)
  - Consultative Committee for Space Data Systems (CCSDS).
- ISO Technical Committee 20 develops and maintains standards for aircraft & space vehicles
  - TC20/Subcommittee 13 (SC13):Data and info sharing standards (data exchange)
  - TC20/Subcommittee 14 (SC14):Best practices, norms of behavior standards (STC)
  - OSC is focused on products from SC 13, which are identical to products from the CCSDS
- CCSDS is a multi-national organization of international space agencies
  - products are available ISO and at the CCSDS website through working groups
  - Navigation Working Group family of space data messages are most applicable to SSA
  - Many space data exchange standards already exist in different formats
  - Reviewed via a periodic review cycle of no more than 5 years



# TraCSS Data Exchange

Table 1. Data types determined by OSC relevant for TraCSS data exchange w/ published standards

<u>Data Type</u>	<u>Published Applicable CCSDS Standard</u>
Conjunction Assessments	Conjunction Data Message (CDM)
Owner/Operator (O/O) Ephemeris	Orbit Data Messages (ODM): Ephemeris Message (OEM), Comprehensive Message (OCM)
O/O Contact Information	OCM; may be able to use Space Data Standard User Profile Message
O/O-satellite characteristics	ODM; + Satellite Catalog Message for additional information
O/O Maneuver Plans	ODM: Orbit Parameter Message (OPM) and OCM
Satellite Identification	ODM: there is an opportunity for a free-text field
Deployment Schedules	ODM: OCM includes field for deployment times
Launch Trajectories	ODM
Satellite Characterization Data	ODM: OCM or can combine into the LDM when standard is available
DOC/Commercial State Vectors	ODM: OPM
DOC/Commercial Element Sets	ODM: OMM
Reentry Assessments	Re-entry Data Message (RDM)
O/O Spectrum Use Information	Radio Frequency and Modulation Systems—Part 1(RFMS-I): Earth Stations and Spacecraft
Commercial Metric Observations	Tracking Data Message (TDM)

# TraCSS Data Exchange

Table 2. Data types determined by OSC relevant for TraCSS data exchange w/ draft standards

<u>Data Type</u>	<u>Draft (Under Preparation) Applicable CCSDS Standard</u>
Satellite Anomaly Notification/Information	Anomaly Message (AM)
Breakup/Debris Generating Event Notification	Fragmentation Data Message (FDM) and Navigation Events Message (NCM). There is also a proposed CCSDS standard Navigation Composite Message (NCM)
Breakup/Debris Generating Event Reports	FDM and NEM under development; NCM proposed.
Launch Information (R-15 Form)	There is a draft Launch Data Message (LDM) under development.
Launch Updates	LDM under development
O/O Spectrum Use Information	There are 2 CCSDS drafts: Radio Frequency Interference Data Message (RFIDM) and Radio Frequency Characteristics Message (RFCM) under development.
Mission CONOPS	Currently no specific CCSDS standard for Mission CONOPS but this information could be readily captured in a text file.

When documents are open for review, they are available on CCSDS website for comments: <https://public.ccsds.org/review/default.aspx>; instructions on how to submit comments are on website



# TraCSS Data Exchange

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**Comments are welcome to our determinations listed in Tables 1 and 2 on:**

- Applicability of the published CCSDS standards to the listed data types;
- Applicability of the draft CCSDS standards to the listed data types;
- Availability of other published or draft standards that are currently not provided by CCSDS,
  - suggestions may include published or draft standards available from other standard developing organizations, material that is available as published best practices or guidance; or
  - availability of other published or draft standards that are not considered in Table 1.
- We additionally request comments about the following formats (see next slide) currently not used in CCSDS standard messages:
  - JSON versions of CCSDS standard messages or binary serialization versions of CCSDS standard messages; or
  - Combination of JSON and/or binary serialization versions of CCSDS standard messages





# TraCSS Data Formats Slide 1 of 2

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- OSC requests comments on the following formats currently not used in CCSDS standard messages:
  - JSON versions of CCSDS standard messages or binary serialization versions of CCSDS standard messages; or
  - combination of JSON and/or binary serialization versions of CCSDS standard messages
- CCSDS participants are required to test all formats. To prevent numerous considerations for testing, CCSDS formats are in key/value notation (KVN) and extensive mark-up language (XML):
  - KVN: original CCSDS message format representing basic key/value data structures as legible strings: example: `TIME_SYSTEM = UTC`
  - XML schema: added to CCSDS messages in approximately 2010 and used since then: example: `<TIME_SYSTEM>UTC</TIME_SYSTEM>`
- Selection of KVN or XML format is something that is mutually agreed between message exchange partners in advance of using the CCSDS standard. In the immediate future, OSC is planning to leverage the existing KVN or XML formats





# TraCSS Data Formats Slide 2 of 2

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- Other possible formats for CCSDS standards could include the following:
  - Java Script Object Notation (JSON) - a collection of name/value pairs and an ordered list of values: example: '{"object": "plate", "shape": round, "pattern": null}'
  - Flatbuffers – an efficient cross platform serialization library for C++, C#, C, Go, Java, Kotlin, JavaScript, Lobster, Lua, TypeScript, PHP, Python, Rust and Swift.
    - It was originally created at Google for game development and other performance-critical applications.
    - It represents hierarchical data in a flat binary buffer in such a way that it can still be accessed directly without parsing/unpacking, while also still supporting data structure evolution (forwards/backwards compatibility).
- OSC is considering supporting development of JSON and binary serialization formats for CCSDS messages and welcomes feedback on these and other formats.





# Bibliography 1 of 3

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## CCSDS Published Standards:

CDM - Conjunction Data Message Recommended Standard CCSDS 508.0-P-1.0.4, Issue 1. (2023, CCSDS, Washington D.C.). Available at

[https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Draft%20Documents/Conjunction%20Data%20Message%20\(CDM\)/508x0p1.0.4\\_CDM\\_Changes\\_Accepted.pdf](https://cwe.ccsds.org/moims/docs/MOIMS-NAV/Draft%20Documents/Conjunction%20Data%20Message%20(CDM)/508x0p1.0.4_CDM_Changes_Accepted.pdf)



ODM - Orbit Data Messages Recommended Standard CCSDS 502.0-B-3, Issue 3 (2023, CCSDS, Washington, D.C.). Available at <https://public.ccsds.org/Pubs/502x0b3e1.pdf>



RFMS-I - Radio Frequency and Modulation Systems—Part 1: Earth Stations and Spacecraft Recommended Standard CCSDS 401.0-B-32, Issue 32 (2021, CCSDS, Washington, D.C.). Available at

<https://public.ccsds.org/Pubs/401x0b32.pdf>



TDM - Tracking Data Message Recommended Standard CCSDS 503.0-B-2, Issue 2. (2020, CCSDS, Washington, DC). Available at <https://public.ccsds.org/Pubs/503x0b2c1.pdf>



RDM - Re-entry Data Message Recommended Standard CCSDS 508.1-B-1, Issue 1. (2019, CCSDS, Washington, D.C.). Available at <https://public.ccsds.org/Pubs/508x1b1c1.pdf>



# Bibliography 2 of 3

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## CCSDS Standards Under Development

AM - Anomaly Message. Under development



FDM – Fragmentation Data Message. Under development



LDM – Launch Data Message. Under development



NEM – Navigation Events Message. Under development

NCM – Navigation Composite Message. Under development



RFCM - RF Characteristics Message. Under development



RFIDM - RFI Data Message. Under development



# Bibliography 3 of 3

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## Additional Sources

Barry, D. (2014) Using CCSDS Standards for Space Situational Awareness. Presented at the American Institute of Aeronautics and Astronautics SpaceOps Conference, June 5 – 9, Pasadena, California.

Barry, D; Oltrogge D. (2018) The Evolution of the CCSDS Orbit Data Messages. Presented at the American Institute of Aeronautics and Astronautics SpaceOps Conference, May 28 – June 1, Marseille, France.

Knoblock, EJ. (2020) Interoperability and Concepts of Operation Assessment for Space Relay Services and Partnerships. National Aeronautics and Space Administration (NASA) Report NASA/TM-20205003461, NASA Glenn Research Center, Cleveland, Ohio.

Morrison, J. (1989) The Future of Space Systems – The Challenges of Standards and Interoperability. Presented at the American Institute of Aeronautics and Astronautics 27th Aerospace Sciences Meeting, January 9 – 12, Reno, Nevada.

Oltrogge, D; Koury, TJ; Leonard, SA; Mulholland M; Bates, B; Poster DL. (2023) Survey of Open Access, Space Traffic Coordination Relevant Data Exchange Standards (National Institute of Standards and Technology, Gaithersburg, MD). Under development.

Oltrogge, D. (2022) ISO and CCSDS Standards. Presented to the GEOINT Interagency Working Group, December 8, 2022, Washington D.C.





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