Satellite Orbital Safety Best Practices

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2023-05-22

Agenda

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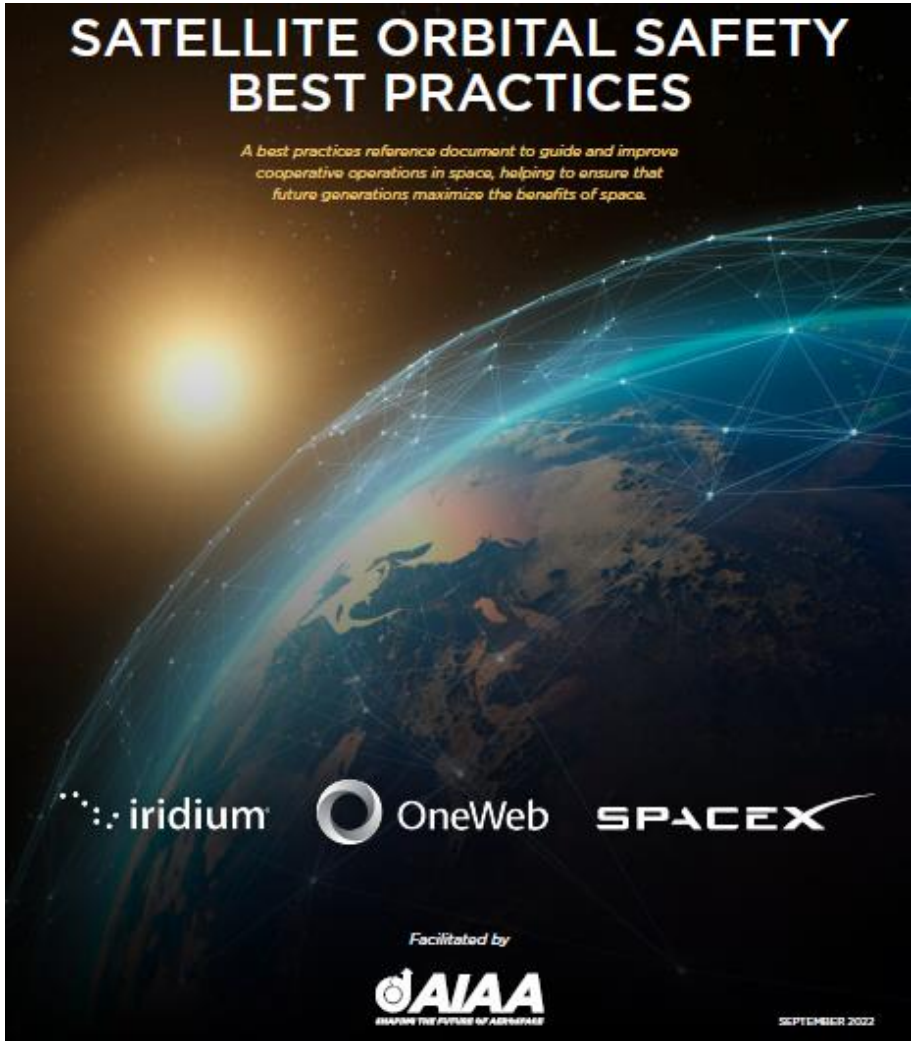


Background

- This document was kickstarted as a combined effort from a couple of AIAA and CARA members.

- CARA and OneWeb have been collaborating for the past years in SSA-related topics.
  - Weekly meeting to coordinate possible encounters between NASA and OneWeb vehicles.
  - On-demand meetings to discuss other more technical matters (accurate modelling, etc).

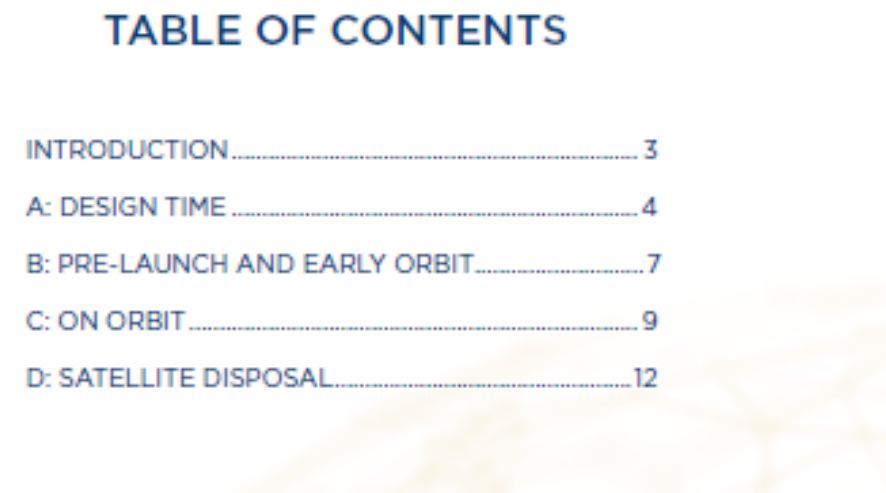
- OneWeb has explicit coordination agreements with Iridium and SpaceX.
  - Naturally, encounters with SpaceX are more frequent and our pre-coordinated Concept of Operations has proved extremely useful to streamline reactions and responsibility of maneuvering.
  - NDA in place lets us share low level details of our system.

- OneWeb proactive commitment to Space Safety is internationally recognised.

- CARA & AIAA invited us to participate on this document to push forward a series of high-level best practices that could foster safer space operations at **all levels** and with an **international** vocation.

Document purpose and overview

- **Wholistic set of best practices by largest operators**
  - Drawn from thousands of sat-years of operational experience
  - The understanding that comes from actually working together to maintain sustainable orbits.
- **Regulations** must strike the appropriate **balance:**
  - Maintaining **sustainable operations**
  - Without stifling innovation or preventing new applications that bring tangible benefits to the public and governments.
- Designed to be **applicable** to any operator **anywhere in the world**.
- Ideally, the best practices contained herein can provide a **foundation for discussions** leading to a global consensus of behaviors.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- "NASA Spacecraft Conjunction Assessment and Collision Avoidance (CARA) Best Practices Handbook"
- Secure World Foundation's "Handbook for New Actors in Space"
- U.S. Space Force's "Spaceflight Safety Handbook for Satellite Operators"
- Space Safety Coalition's "Best Practices for the Sustainability of Space Operations"

Design Time

- Consider collision avoidance (CA) implications when choosing **injection and final orbits**.
  - Collocation with other objects
  - Separation with respect to other constellations
  - Coordination with neighboring vehicles
  - System-level analysis on risk level and encounter rates

- Ensure the adequacy of **spacecraft hardware** features to support safety of flight best practices
  - Need for maneuvering capability above human-spaceflight altitudes
  - Trackable, either passively or any form of GNSS
  - Deorbit and Reentry considerations
  - Operations team 24/7 availability

- Ensure the adequacy of **satellite / ground system software** to support safety of flight best practices.
  - High-fidelity predicted ephemeris
  - Capability to perform Conjunction Assessment

Pre-Launch and Early Orbit

- Create and expeditiously publish your **transfer strategy** yourself to your **final orbit**
  - Be open about your mission profile so that other Owner/Operators are aware
  - Create clear communication channels with other major space Owner/Operators sharing the same orbital regions
  - Make basic information on your platform available for Conjunction Assessment purposes (hard body radius, maneuverability)

- Perform **Launch Collision Avoidance** (LCOLA) against (crewed) space assets
  - Very important against crewed missions

- **Coordinate with your cataloguing entity** before launch and provide facilitating products during launch and early orbit
  - Establishing cataloguing number/ids for common reference
  - Quick generation of post-launch ephemeris and send to the cataloguing agency
  - Prioritise spacecraft commissioning to enable Collision Avoidance

On Orbit

- Maintain **quality O/O predicted ephemerides and spacecraft status** information and submit/update this information regularly to the CA screening authority
  - High-fidelity prediction ephemeris, including covariances, following international CCSDS standards and CARA recommendations
  - Keep up to date maneuverability status and capacity to generate high-precision ephemeris

- Perform CA risk assessment to **identify high-risk conjunctions** that require mitigation
  - Use Probability of Collision as the main metric for CA.
  - Develop internal Concept of Operations that clearly and unambiguously addresses high-interest events via active response or coordination with the other operator.

- Pursue adequate mitigation actions to **avoid high-risk conjunctions**
  - Mitigation action should both clear the high-risk conjunction at hand and not cause any other close to the Time of Closest Approach
  - Coordinate with the Owner/Operators of the secondary vehicle and develop long-term, standardised response logic

Satellite Disposal

- Actively and expeditiously **manage the deorbit of LEO satellites** that are reaching the end of their useful mission life
  - In case of satellite failure, keep up to date maneuverability and ephemeris-production capabilities status
  - Controlled reentry can be avoided if complete immolation of the satellite is guaranteed
  - If satellite operating orbit does not meet a natural reentry within 5 years (goal of 1 year), the satellite should be transited to an orbit that does meet that criteria.
    - This transit needs to be ruled by the same recommendations previously mentioned
  - Passivation of the platform prior to lose of maneuverability

Q & A