Conjunction Assessment & Automated Collision Avoidance at Constellation Scale

Pillar: Constellation Scale | **Basis:** 18th SDS / NASA ODPO / FCC Part 25 | **Primary Source:** 18th SDS / NASA / FCC | **As Of:** As of Nov 2026 (ESA 2026: ~46,110 Tracked Objects)

With ~46,110 regularly tracked objects in orbit (ESA 2026 Space Environment Report, data through end of 2025), constellation operators rely on 18th Space Defense Squadron (Space-Track) Conjunction Data Messages (CDMs) and automated maneuver thresholds (~10^-4 to 10^-5 Pc) to prevent collisions.

Documented Instrument & Engineering Record

• Catalog growth: ESA's 2026 Space Environment Report (data through end of 2025) counts ~46,110 regularly tracked objects (up from ~40,000 in the 2025 report) and ~16,100 functioning payloads.

• CDM screening: The U.S. 18th Space Defense Squadron (via Space-Track.org) distributes Conjunction Data Messages (CDMs) when predicted miss distances cross screening volumes.

• Action thresholds: NASA and commercial constellation operators commonly trigger collision-avoidance maneuvers when Probability of Collision (Pc) reaches 10^-4 (red) or 10^-5 (yellow/constellation-tight) thresholds.

• FCC EOM link: Under 47 CFR § 25.283(e), losing the ability to execute collision-avoidance maneuvers defines End of Mission for propulsive satellites—starting the 5-year disposal clock.

Conjunction Assessment & Maneuver Parameters

Parameter	Operational Practice	Sustainability Impact
Ephemeris Sharing	Publish predictive ephemerides to Space-Track	Reduces covariance uncertainty across fleets
Pc Maneuver Threshold	Typically 10^-4 (NASA) to 10^-5 (constellations)	Prevents catastrophic breakups
Automated Execution	Onboard / ground-automated burn planning	Scales across thousands of satellites
Propellant Budget	Tracked against EOL deorbit reserve	Triggers EOM when reserve floor is hit

Mission Designer, Compliance Lead & Founder Takeaways

• High-drag solar-storm events alter atmospheric density rapidly, degrading orbit predictions and increasing false-alarm CDM rates.

• Manual spreadsheet-based conjunction screening fails above a few dozen satellites; automated CDM pipelines are mandatory for constellation licenses.

• Every avoidance burn consumes delta-v that must be accounted for in the end-of-life disposal propellant budget.

Cross-Cluster Links & Primary Sources

• **Tracked Objects vs. Modeled Debris (2026):** https://bcesg.org/wa-space-orbital-esa-nasa-debris-counts-2026/

• **SpaceX Redmond Constellation Disposal:** https://bcesg.org/wa-space-orbital-spacex-redmond-starlink-disposal/

• **End-of-Life Propellant Margin Budgeting:** https://bcesg.org/wa-space-orbital-propellant-margin-budgeting/

• **Space-Track.org (18th SDS Catalog & CDMs):** https://www.space-track.org/

• **ESA Space Debris Office (2026 Report):** https://www.esa.int/about-us/directorates/operations/space-safety/space-debris

• **NASA ODPO:** https://orbitaldebris.jsc.nasa.gov/

Provenance Note: Tracked object count (~46,110, up from ~40,000) and active payloads (~16,100) cited from ESA 2026 Space Environment Report (data through end of 2025).