Standards and Processes for Enabling COPUOS and Other Guidelines

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COPUOS

- The Committee on the Peaceful Uses of Outer Space was set up by the General Assembly in 1959 (resolution 1472 (XIV)) to:
  - ***review*** the scope of international cooperation in peaceful uses of outer space
  - ***devise*** programmes in this field to be undertaken under United Nations auspices
  - ***encourage*** continued research and the dissemination of information on outer space matters, and
  - ***study*** legal problems arising from the exploration of outer space.

IADC

- The Inter-Agency Space Debris Coordination Committee (IADC) is an international governmental forum for the worldwide ***coordination*** of activities related to the issues of man-made and natural debris in space.
- The primary purposes of the IADC are to ***exchange information*** on space debris research activities between member space agencies, to ***facilitate opportunities for cooperation*** in space debris research, to ***review the progress*** of ongoing cooperative activities, and to ***identify debris mitigation options.***

INFERENCE

- ***Neither of these bodies has authority or the charter to implement any program or process.***
- They:
  - Review, devise, encourage, and study
  - Coordinate, exchange, facilitate, review, and identify

KEY ELEMENTS THAT ARE MISSING:

IMPLEMENTATION
OPERATIONAL FEASIBILITY
OBJECTIVE VALUE PROPOSITION

Questions

- **How will debris mitigation and management practices be established, demonstrated, and verified?**
- **What technical and administrative authorities will be responsible for implementation and validation?**
- **What criteria will be used to judge debris minimization and mitigation sufficiency?**

All of these must be addressed before codes of conduct, conventions, treaties, or national laws can be developed.

How will debris mitigation and management practices be established, demonstrated, and verified?

- Agency guidelines and practices
  - NASA Technical Standard 8719.14
    - August 2007, Process for Limiting Orbital Debris
- Individual program provisions
  - End of life disposal plans
- National laws and regulations
  - FCC debris mitigation plan required for licensing
- International standards

Establishment, Demonstration, and Verification Issues

- Agency rules apply only to the agency and its programs.
- Individual programs and contracts may consider only measures that are convenient or inexpensive.
- National laws and regulations must be founded on demonstrated practice and sound technology.
  - Some environmental regulations disregard technology and science
- International Standards development and application are voluntary.

What technical and administrative authorities will be responsible for implementation and validation?

- Program authorities or commercial customers are ultimately responsible for assuring that products they accept meet requirements.
- Providers and vendors are responsible for demonstrating to their customers that requirements have been satisfied.

Issues with Implementation and Validation

- Few customers have the skills and experience to guide implementation or validate the outcome.
- Providers suffer a conflict of interest between offering the most efficient mission solution and debris mitigation.
- Independent validating organizations eventually suffer institutional cancer, growing and expanding for their own sake.

What criteria will be used to judge debris minimization and mitigation sufficiency?

- Microscopic Criteria
  - Material and coating selection
  - Shielding and survivability measures
- Macroscopic Criteria
  - Structural sufficiency
  - System hazard and consequence analyses
  - Orbit and constellation design

International Diversity

	Action	IADC Guidelines	UN Guidelines	ISO (DIS24113)	JAXA (JMR-003A)	European CoC
Mission Related Objects	Operational Debris	○	○（Rec-1）	○	○	○
	Tether	○			○	
	Slag from solid motor			○		slag ＜ 0.01mm （revised to 1mm？）
	Pyrotechnics			○		same above
	secondary ejecta					○(SD-DE-07)

International Diversity

	Action	IADC Guidelines	UN Guidelines	ISO (DIS24113)	JAXA (JMR-003A)	European CoC
Mission Terminated Systems	GEO	Reorbit of GEO S/C	235 km+ (1,000・Cr・A/m) e<0.003	○（Rec-7）	235 km+ (1,000・Cr・A/m) e<0.003、 success rate>0.9 non-interference: 100 years	235 km+ (1,000・Cr・A/m) (e<0.003will be added in 2009)
		○	○（Rec-4）	○	○	○(SD-DE-04)
		○	○（Rec-2）	Probability < 10^{-3}	○	Probability < 10^{-3} (SD-DE-05)
	Residual Propellants	○	○（Rec-5）		○	○Required generally Also; ① Pressure vessels: pressure < 50% of Cr Pres. ② To be passivated within one year after EOM, Success probability>0.9

CREATING THE ENVIRONMENT FOR FEASIBLE DEBRIS MITIGATION REGIMES

- Voluntary national and international standards stipulate essential elements of process implementation, verification, and documentation.
- Voluntary standards are driven by user needs.
  - They are self-prioritizing
- Voluntary standards are developed ecumenically, working groups chosen by virtue of technical expertise not national origin.

You cannot bring a horse to water – unless there is water.
Whether he drinks is still his choice, but he has no choice without water.

What ISO is trying to accomplish

- Institutionalize consensus based on feasible technology and engineering
- Establish a hierarchy and framework for implementing and verifying debris mitigation measures.
- Develop detailed standards for critical debris issues.
  - Standards that can be adopted wholly or in parts and that can be tailored to need.

Space Systems: Space Debris Mitigation

- Acquiring organizations shall … explicitly include requirements for managing a space debris mitigation programme within the development.
- Measures to manage and mitigate space debris shall be tracked, documented, and validated.
- A Space Debris Management Plan shall define approach, methods, procedure, resources, and organization to coordinate and manage debris mitigation activities.

Disposal of Satellites in Geostationary Orbit

- This International Standard specifies requirements for
  - planning for disposal of satellites operating at geosynchronous altitude to ensure that final disposal is sufficiently characterized and that adequate propellant will be reserved for the maneuver,
  - selecting final disposal orbits where the satellite will not re-enter the operational region within the next 100 years,
  - executing the disposal maneuver successfully, and
  - depleting all energy sources on-board the vehicle before the end of its life to minimize the possibility of an event that can produce debris.

Estimating mass of remaining usable propellant

- Mass of remaining usable propellant shall be monitored through life
- Approaches to propellant gauging shall be described in detail, including measurement uncertainties.
- Allowance shall be made for sufficient propellant to execute end of life maneuver
- When usable propellant is within margin for end of life, the mission shall be terminated.

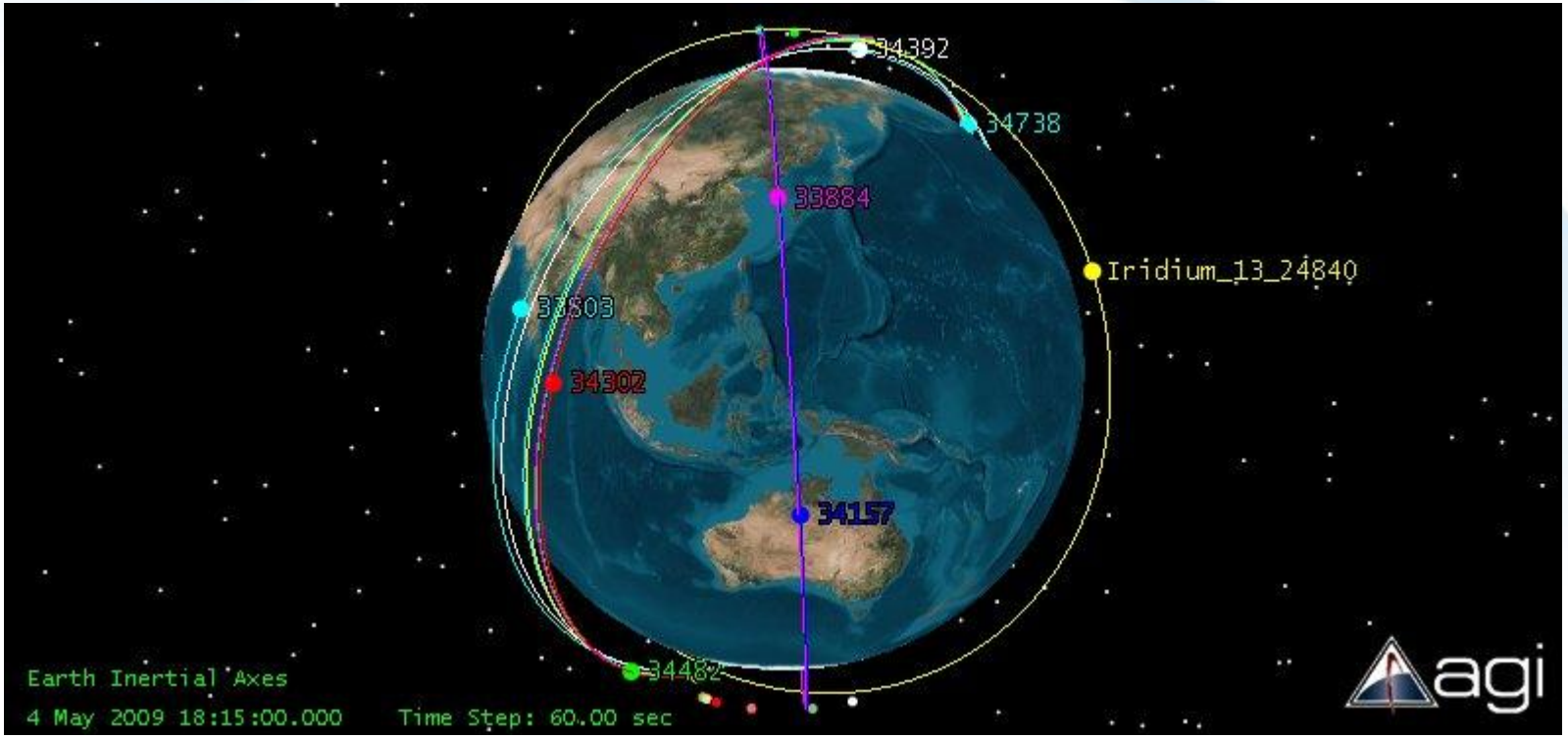
Standards development and implementation issues

- Competing standards bodies and conflicting desires
  - National and industrial pressures
- Insufficient technical expertise
  - Many member bodies are affected by outcomes but only a few have required expertise to influence outcomes
- Resistance from industry and government
  - Debris standards increase manufacturing and operations costs.
  - Debris standards impose additional constraints
- Resource demands for developing standards

Conclusion

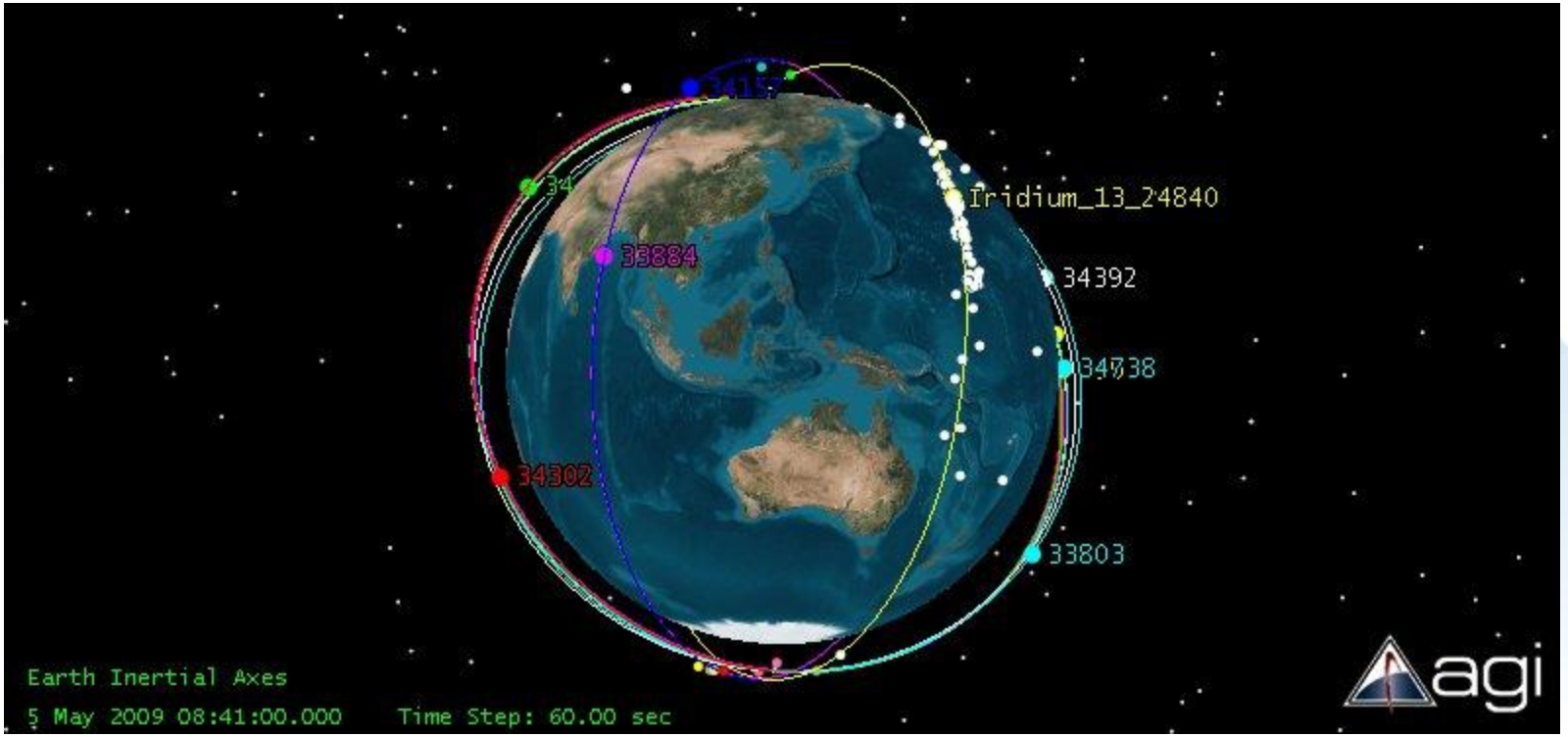
- **Debris mitigation codes of conduct, guidelines, and similar instruments are ineffective.**
- **Guidelines should not be static**
  - **Guidelines may be based on desire rather than feasibility**
- **Industrial standards are the environment for space debris mitigation.**
  - **Debris mitigation requirements throughout space system life cycle are the most effective and verifiable approach**
  - **Industry must be involved from inception, not just in final review.**
- **Many issues must be overcome to develop a sufficient set of standards.**

Iridium 13 Conjunctions with 10 Feb 09 Debris



5-10 May 2009

First Conjunction + 27 min



A CLOSE APPROACH DOES NOT ITSELF IMPLY A COLLISION

FEW COLLISIONS HAVE CATASTROPHIC CONSEQUENCES

Iridium 13 Vulnerability This Week