Inter-Agency Space Debris Coordination Committee

Report of the IADC Activities on Space Debris Mitigation Guidelines

Presented to:

40th Session of the
Scientific and Technical Subcommittee
United Nations Committee on the Peaceful Uses of Outer Space

Inter-Agency Space Debris Coordination Committee

- Comprises:
  - ASI, BNSC, CNES, CNSA, DLR, ESA, ISRO, *Japan,* NASA,NSAU, Rosaviakosmos
- Consists of:
  - Steering Group
  - Working Group 1: Measurements
  - Working Group 2: Modelling
  - Working Group 3: Protection
  - Working Group 4: Mitigation
- Undertook to develop Mitigation Guidelines

Background (1)

- Today man-made orbital debris poses a risk to both manned and un-manned spacecraft
- The debris population in orbit is growing
- Probability of damaging collisions is increasing
- The implementation of mitigation measures is needed to preserve the near-Earth space environment for future generations

Background (2)

- A number of space-faring organisations have established debris mitigation standards and handbooks
- Contents are slightly different but fundamental principles are the same:
  - Prevent on-orbit break-ups
  - Remove non-operational objects from populated regions
  - Limit objects released during normal operations

Scope

- Guidelines describe existing practices that have been evaluated for limiting generation of space debris
- Measures cover impact of missions on environment with focus on:
  - Limitation of debris released during normal operations
  - Minimisation of the potential for on-orbit break-ups
  - Post-mission disposal
  - Prevention of on-orbit collisions

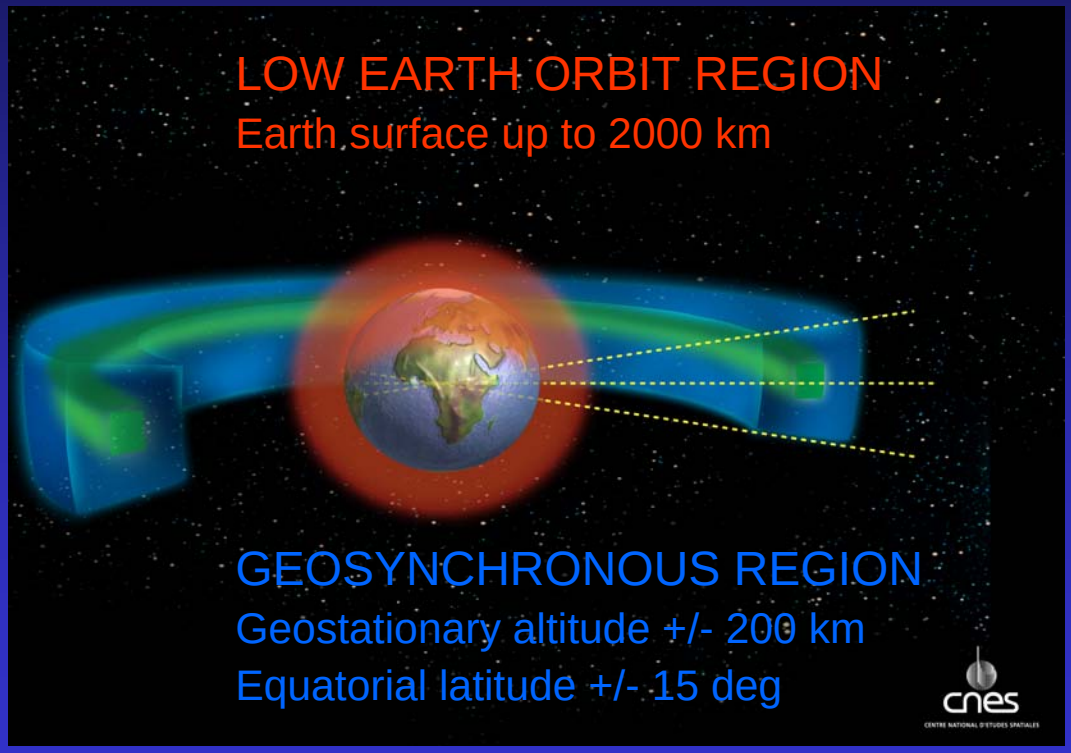
Application

Applicable to planned Earth orbiting spacecraft, and existing systems where possible, addressing:

- Mission Planning
- Design
- Operation (launch, mission, disposal)

Protected Regions

- Activities in space should recognise the unique nature of 2 regions in space:



Mitigation Planning

- Management plan addressing mitigation activities
- Plan for assessment and mitigation of debris risks
- Measures minimising the hazards related to malfunctions that could generate debris
- Plan for system disposal at end of life
- Justification of choice where several possible selections exist
- Compliance matrix addressing recommendations of the Guidelines

Limit debris released during normal operations

- Space systems should be designed not to release debris during normal operations
- Where this is not feasible, any release of debris should be limited in number, area, and orbital lifetime
- Any release of objects in orbit should not be planned unless adequate assessment can verify effect on orbital environment and population
- Potential hazard of both intact and severed tethers should be analysed

Minimise potential for post-mission break-ups

- Residual propellants and other fluids should be depleted
- Batteries should be designed to prevent break-ups and at end of operations charging lines should be de-activated
- High pressure vessels should be vented to ensure no break-ups can occur
- Self-destruct systems should be designed not to cause unintentional destruction
- Power to flywheels and momentum wheels should be terminated during disposal phase
- Other forms of stored energy should be assessed and adequate mitigation measures applied

Minimise potential for break-ups during operational phases

- Using failure analyses, programs should demonstrate that there is no failure mode leading to accidental break-ups or, if cannot be excluded, probability minimised
- During operational phases, system should be periodically monitored to detect malfunctions which could lead to break-up or loss of control. If recovery measures cannot be conducted, disposal and passivation measures should be applied

Avoidance of intentional destruction & harmful activities

- Intentional destruction of a space system and other harmful activities that may significantly increase collision risks should be avoided
- Intentional break-ups should be conducted at sufficiently low altitudes so that orbital fragments are short-lived

Post mission disposal for geosynchronous region

- Space systems that have terminated their mission should be manoeuvred far enough away from geostationary orbit to avoid interference with GEO systems
- Recommended minimum increase in perigee altitude is
  - 235 km + (1000 Cr A/m)
    - 235 = 200 km (GEO protected region) + 35 km (gravitational perturbations)
    - Cr = solar radiation pressure coefficient
    - A/m = aspect area (m^2) to dry mass (kg) ratio

Post mission disposal for objects within LEO region

- Systems terminating operational phases in orbits passing through low Earth orbit region should be de-orbited or, where appropriate, manoeuvred to orbit with reduced lifetime
- Systems should be left in an orbit where drag will limit lifetime after completion of operations
- IADC has performed study of effect of post-mission orbital lifetime on collision rate in LEO. 25 years found to be reasonable and appropriate limit

Prevention of on-orbit collisions

- Project should estimate and limit probability of accidental collision with known objects
- If reliable orbit data is available, avoidance of collisions and co-ordination of launch windows may be considered if non-negligible risk
- Spacecraft design should limit probability of collision with small debris which could cause loss of control, preventing post-mission disposal

Summary

- IADC guidelines based on common principles, derived from existing documents and agreed by consensus, passed to UNCOPUOS 18 November 2002
- Organisations are encouraged to use Guidelines to help establish mission requirements for planned space systems
- Operators of existing systems are encouraged to apply Guidelines to greatest extent possible
- IADC Guidelines may be updated as new information becomes available