

Space Debris Mitigation – Coordination and Implementation efforts in India



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SPACE CAPABILITIES OF INDIA

- NATIONAL SPACE AGENCY, ISRO, IS ORGANIZED UNDER DEPARTMENT OF SPACE OF GOVERNMENT OF INDIA
- DESIGN, DEVELOPMENT AND OPERATION OF SPACE SYSTEMS
 - SATELLITES – LEO, GEO AND LUNAR
 - LAUNCH VEHICLES - PSLV & GSLV
 - HEAVY LIFT GSLV MK III UNDER DEVELOPMENT
- CONDUCTED >50 SATELLITE MISSIONS AND >25 LAUNCH MISSIONS SINCE INCEPTION
- LAUNCHED 16 FOREIGN SATELLITES THROUGH PSLV
- ISRO IS ALSO ENGAGED IN A WIDE RANGE OF SPACE APPLICATIONS RELEVANT SOCIO ECONOMIC DEVELOPMENT

PSLV

6S9 + S139+ L40+ S7+ L2

VEHICLE CHARACTERISTICS

Vehicle Height : 44.4 m

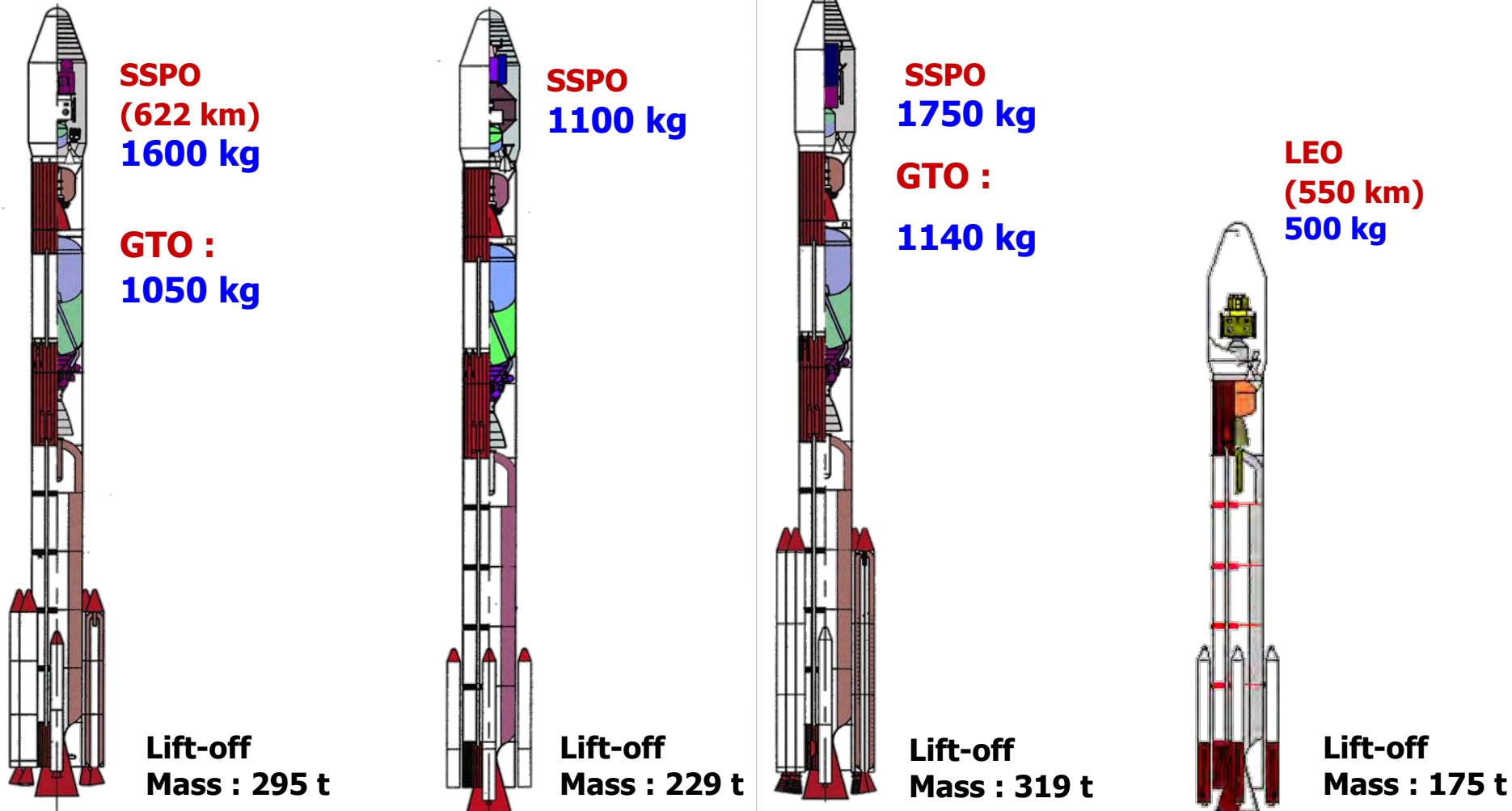
P/L Fairing Dia : 3.2 m

LIFT OFF MASS : 295 t

SSO P/L(800 km) : 1.5 t



PSLV variants



PSLV

PSLV CA

PSLV XL

PSLV 3S

GSLV

- 4 Successful flights

4L40 + S139+ L37.5 + CS

VEHICLE CHARACTERISTICS

Vehicle Height : 49.1 m

P/L Fairing Dia : 3.4 m

LIFT OFF MASS : 414 t

GTO PAYLOAD : 2.2 t – 2.4 t



GSLV- Mk III

GSLV-Mk III can launch 4 ton class satellite in Geo-synchronous Transfer Orbit (GTO)

2 S200 + L110 + C25

VEHICLE CHARACTERISTICS

CORE STAGE Dia : 4 m

STRAP-ON DIA : 3.2m

FAIRING Dia : 5 m

LIFT OFF MASS : 629 t



.....**Capability to place 10 t in LEO**.....

ISRO's FUTURE MISSIONS

EARTH OBSERVATIONS

SATCOM & NAVIGATION

SCIENCE & ENVIRONMENT

CARTO-2B OCEANSAT 2	GSAT- 4 & 5	ASTROSAT-1 SRE-2
RESOURCE SAT 2 MEGHA -TROPIQUES RISAT-1 INSAT-3D	GSAT- 6 & 9 IRNSS-1& 2 GSAT 8	CHANDRAYA AN-2 I-STAG
TES HYS ALTICA-ARGOS GEO-HR	GSAT- 7 GSAT-10 IRNSS- 3 & 4	
DMSAR-1 RESOURCESAT-3 CARTO-3	GSAT-11-13 IRNSS- 5 & 6	ADITYA -1 SENSE P&E ITM-1
RISAT-3 OCEANSAT-3	GSAT-14 & 15 IRNSS-7	

DEBRIS MITIGATION AND INDIA'S EFFORTS

- ISRO/DEPARTMENT OF SPACE RESPONSIBLE FOR PARTICIPATION IN UN COPUOS IN COORDINATION WITH MINISTRY OF EXTERNAL AFFAIRS
- INDIA ACTIVELY SUPPORTED EFFORTS OF UN COPUOS TO DEVELOP AND ADOPT SPACE DEBRIS MITIGATION GUIDELINES
- ISRO IS A MEMBER OF IADC SINCE 1996 AND SUPPORTING ITS EFFORTS.
- ISRO CO-OPERATES WITH MORE THAN 20 COUNTRIES / SPACE AGENCIES AND HAS BEEN PROMOTING INTERNATIONAL COOPERATION IN MAINTAINING SPACE ENVIRONMENT.

SPACE DEBRIS MITIGATION GUIDELINES IMPLEMENTED BY ISRO

- **PASSIVATION OF FINAL STAGES OF INDIA'S LAUNCH VEHICLES..PSLV and GSLVs IMPLEMENT THIS**
- **RE-ORBITING OF GSO SATELLITES / DE ORBIT LEO SATs
(INSAT 2B, 2C and 2DT re-orbited)**
- **MINIMISING MISSION RELATED DEBRIS IMPLEMENTED BY DESIGN**
- **DEVELOPMENT OF MODELS FOR ON - ORBIT FRAGMENTATION, WITH THE CONCEPT OF EQUIVALENT BREAK UP**
- **DEVELOPMENT OF MODELS TO ESTIMATE CLOSE APPROACH BETWEEN SPACE DEBRIS AND ISRO'S SATELLITES AND LAUNCH VEHICLES / COLLISION AVOIDANCE MEASURES**
- **PARTICIPATION IN THE INTERNATIONAL EXERCISES OF ESTIMATION OF REENTRY OF THE DE-ORBITING OBJECTS.**

ISRO and Debris Mitigation guidelines

Organisational units involved in implementation

- **ISRO Head Quarters**

- International Cooperation office
- Launch Vehicle Programme office
- Satcom & EOS programme offices
- ISRO Reliability & Safety office

**POLICY ANALYSIS AND
IMPLEMENTATION
SUPPORT**

**OVERSIGHT: SCIENTIFIC
SECRETARY, ISRO**

- IADC coordinator

- UN COPUOS Delegates

- **ISRO Satellite Centre** →

SATELLITE MISSION DIRECTOR

- **Vikram Sarabhai Space Centre**

LAUNCH MISSION DIRECTOR

- **Master Control Facility** →

ORBIT MANOEUVRES OF GEO SATs

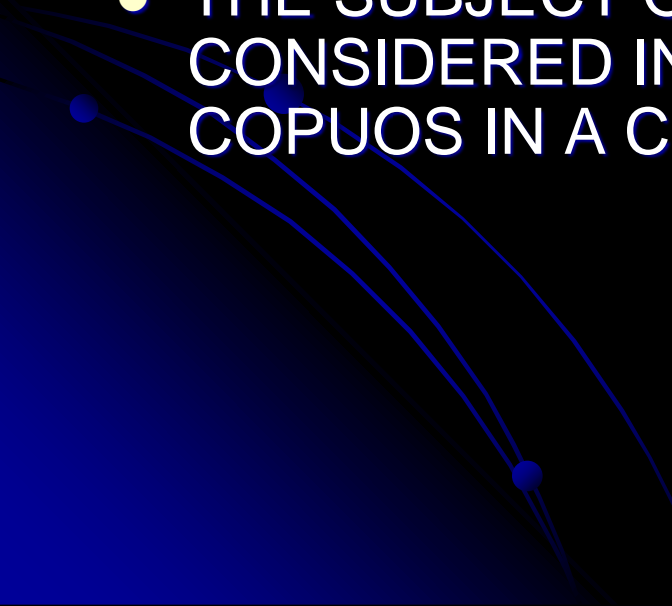
- **ISRO Telemetry, Command and Tracking Unit** →

ORBIT MANOEUVRES OF NON GEO SATs


INDIA'S POSITIONS AT THE UNITED NATIONS IN RELATION TO SPACE DEBRIS

- EMPHASIS ON AGENDA OF SPACE DEBRIS AND EFFORTS TO KEEP SPACE ENVIRONMENT CLEAN.
- GOAL OF PRESERVING OUTERSPACE TO ENABLE ITS UTILISATION BY PRESENT AND FUTURE GENERATIONS
- ACCESSIBILITY OF SPACE DEBRIS DATA BASE TO ALL THE MEMBER STATES OF THE UN
- MITIGATION MEASURES TO BE IMPLEMENTED AS PER RECOMMENDATIONS OF UN COPUOS

INDIA'S POSITIONS AT THE UNITED NATIONS IN RELATION TO SPACE DEBRIS

- STATES RESPONSIBLE FOR CREATION OF CURRENT SITUATION AND THOSE WHO HAVE CAPABILITY TO TAKE MITIGATION ACTION SHOULD TAKE LEAD ROLES.
 - THE SUBJECT OF SPACE DEBRIS SHOULD BE CONSIDERED IN THE LEGAL SUB-COMMITTEE OF COPUOS IN A COMPREHENSIVE MANNER.
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AREAS FOR FURTHER DISCUSSION AND CONSENSUS

- ACCESS TO SPACE DEBRIS DATABASES
 - RESPONSIBILITY AND LIABILITY IN CASES OF ACCIDENTS WHERE OWNERSHIP (I) CAN BE AND (II) CANNOT BE ESTABLISHED,
 - THE ONUS OF PROVING THE FAULT
 - INTERNATIONAL SYSTEM FOR MONITORING
 - INTERNATIONAL LEGAL NORMS
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UN COPUOS Guidelines Implementation - Issues

TECHNICAL ISSUES :

- Around 50% of the catalogued objects is break-ups or fragmentations of spacecrafts and rocket bodies. Hence, the primary technical focus should be to carry on more research into passivation techniques, long term structural behavior of the materials used in the satellites and the rocket bodies.
- The results of this R&D should be made accessible to manufacturers dealing with launch vehicles and satellites.
- The system engineering and technology of passivation should be simplified and made reliable (not to pose any unacceptable risk to the main mission).

UN COPUOS Guidelines Implementation

TECHNICAL ISSUES (Contd.) :

- Inoperable satellites account for another 25% of Debris. Hence the technical research to remove them from LEO and GEO protected zones should be intensified, and to be made available to all operators.
- The R&D on configuration and feasibility of an active Debris disposal system to remove big inoperable satellites from special protected zones to be pursued.

TECHNICAL ISSUES (Contd.)

- The reorbiting of GSO satellites at the end of the Mission should be carried out to result in very low eccentricity- because, higher eccentricity will make the satellite cross GSO circle, which is dangerous for operational satellites. This requires special training to the satellite operators for disposal operations.
- The final stage of the launch vehicles, which have GSO orbiting capabilities, should be operated such that they do not cross GSO every day, and their apogee should be well below GSO.

UN COPUOS Guidelines Implementation Strategies (Contd.)

ORGANISATIONAL ISSUES :

- Debris mitigation measures have to be implemented by the Launching States/International Launch Service Operators/ Satellite Operators. Hence, the Member States of UN should have internal **national mechanisms** to implement the UN Space Debris Mitigation Guidelines.
- International cooperation is essential in this area due to common interest for limited debris Space, and also due to different levels of expertise among different stake holders. A viable **international structure** with adequate technical expertise, databases and financial resources to be created to act as catalyst and **support for implementation** of the Guidelines.
- A **corpus fund** can be created to compensate satellite operators for the loss of revenue due to shortened operational life for reorbiting the GSO satellites.

UN COPUOS Guidelines Implementation Strategies (Contd.)

ORGANISATIONAL ISSUES (Contd.) :

- The Member States adhering and implementing UN Space Debris Mitigation Guidelines can be encouraged by according **incentives** in :
 - Allotment of orbital slots by ITU
 - Discount in the Insurance premium for satellite coverage
 - Discount in the Launch prices
- UN should actively engage all concerned towards the above objectives.
- The Space Debris **Databases** should be **accessible** to all the interested and concerned parties for the purpose of implementation of Debris Mitigation Guidelines.

UN COPUOS Guidelines Implementation Strategies ..

LEGAL ISSUES :

The driving factors in achieving consensus for the UN Space Debris Mitigation Guidelines were :

- They were evolved based on technical study and rationale
- Their implementation on voluntary basis
- They are to be implemented through National Mechanisms

- The above fundamental agreement must be respected to encourage all Member-States to implement the Guidelines.
- Implementation of Space Debris Mitigation Guidelines should be considered as “**Common but Differentiated responsibility**” – which means that states responsible for the present Debris scenario and the states capable of Debris Mitigation should take more responsibility within the common responsibility of all.

UN COPUOS Guidelines Implementation Strategies (Contd.)

LEGAL ISSUES (Contd.) :

- An **International Treaty** on Space Debris in future should be comprehensive and should deal with :
 - Prevention of growth of Space Debris
 - Establishing an international organisation for technical support to the implementation of Mitigation measures.
 - Establishment of a corpus fund to be used to encourage adherence to Guidelines.
 - Liability regime in case of an accident involving operational satellites and Debris.
 - Liability regime for damage on the earth due to reentry of Space Debris.

Thank you

