Indian Space Situational Assessment for the year 2022 – Highlights

April 3, 2023

Shri S. Somanath, Secretary DOS/Chairman ISRO, released the Indian Space Situational Assessment Report (ISSAR) for 2022 in March 2023. The report is compiled by ISRO System for Safe & Sustainable Operations Management (IS4OM)

Introduction

Spaceassets are vital for the social and economic development of a nation. They play a crucial role in national security and defense. Rapid technological advancement and diversification of space activities have led to a growing number of space objects. The current space object population consists of more than 7000 operational satellites orbiting the Earth at different altitudes with millions of pieces of space debris. The space environmental risks to space assets arise due to space debris. Due to the enormousspeed, a collision with even a centimeter-sized object can cause a space asset's catastrophic failure, leading to mission closure. Therefore, continual awareness of the space environment and

its future evolution, namely Space Situational Awareness (SSA), is a prerequisite for safe and sustainable operations in space. As a responsible space-faring nation, India follows the guidelines recommended by the UN and IADC in its space activities. It complies with them to the best possible and practicable extent. India's national space agency, ISRO, monitors the ever-evolving, highly dynamic space environment to protect Indian space assets and annually assesses the prevailing space situation for reference and planning. The Indian Space Situational Assessment Report (ISSAR) for 2022 is compiled by ISRO System for Safe & Sustainable Operations Management (IS4OM). Highlights of the report are as follows.

Highlights of the space situational assessment for the year 2022:

Global Scenario

In 2022, the space object population grew,indicating easy accessibility to space and increasingdiverse applications of space technology. In 2022, more space objects were placed in orbit per launch compared to the previous year. Total of 2533 objects from 179 launches in 2022 against 1860 objects from 135 launches in 2021. A 32% increase in successful launches anda 36% increase in the number of objects inserted in orbit were witnessed. Four major on-orbit break-up events added over 360 fragmented objects to the space debris population.

Indian Scenario

Till 2022, a total of 124 Indian satellites, including those from private operators/academic institutions,have beenlaunched. As of January 1, 2023, the government owns 23 and 29 operational satellites in LEO and GEO, respectively. Chandrayaan-2 Orbiter is active in lunar orbit. During the year, 13 satellites re-entered the atmosphere.The rocket body (uppermost stage of a launch vehicle) of the PSLV-C8/Advance Avionics Module (launched on April 23, 2007) re-entered the Earth on July19, 2022. At the end of 2022, of 69 rocket bodies from Indian launches, 45 are still orbiting. Sixty-one fragments of the PS4stageof PSLV-C3 (launched on October 22, 2001, fragmented in space on December 19, 2001) are orbiting in space (spacetrack.org).

There were four successful launches by ISRO in 2022 (Table-1). A total of eight Indian satellites and four rocket bodies were placed in orbit. Indian communication satellite CMS-02 was launched from French Guiana by an Ariane launch vehicle. SSLV-D1 could not place any object in orbit.

Table-1: List of successful launches by India and the payloads put into orbit

Launch vehicle	**Payloads**
PSLV-C52	EOS-04, INS-2TD, INSPIREsat-1
PSLV-C53	DS-EO, Scoob-1, NeuSAR
PSLV-C54	EOS-06, INS-2B, Thybolt-1, Thybolt-2 4 Astrocast satellites, Anand
LVM3-M2	36 OneWebGen-1 satellites
Total	51

Close approach risk mitigation for Indian space assets in 2022

Space Object Proximity Analysis (SOPA) for Satellites

ISRO regularly analyses to predict close approaches of other space objects to Indian space assets. In 2022,in-house SOPA generated about 14000 alerts for the close approaches within 1 km.Additionally, about 13000 close approach alerts were received from US Space Command USSPACECOM. The latter were re-assessed using more accurate orbital data of the Indian operational satellites. Critical close approaches require a Collision Avoidance Maneuver (CAM) to safeguard the operational spacecraft.A total of 22 CAMs were executed in 2022, including one for the lunar orbit (Table-2). Figure 1 shows the CAMs executed over the years. The plot indicates increasing congestion in outer space.

Table-2: Collision Avoidance Maneuver in 2022

Orbital Regime of Spacecraft	No. of CAMs
LEO	14
GEO	7
Planetary (Chandryaaan-2) (To avoid a close approach with the Lunar Reconnaissance Orbiter of NASA in July 2022)	1

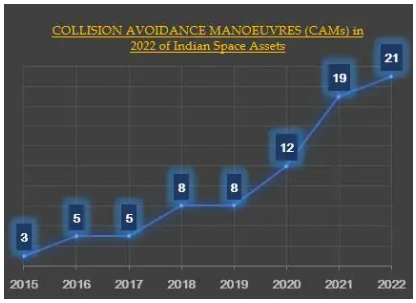

Figure 1. Number of CAMS executed over the years

Regular Orbit Maneuvers (OM)are executed for ISRO satellites to maintain themwithin the specified orbits. SOPA outcomes were utilized to avoid any close approach of the satellite undergoing regular OM with neighboring space objects immediately after the maneuver.

Table-3: Regular Orbit Maneuvers (OM)executed for ISRO satellitesin 2022, excluding CAMs

Orbital Regime	No. of OMs (excluding CAMs)
LEO	262
GEO	460
Planetary (Chandryaaan-2)	19

Collision Avoidance (COLA) Analyses for Launch Vehicles

COLA analyses for lift-off clearance of launch vehicles were carried out as part of the mandatory Launch Clearance Protocol of ISRO launch vehicles. The nominal lift-off of PSLV-C53was deferred by 2 minutes based on the COLA analysis to avoid potentialclose conjunctions within 5 km with COSMOS 2251 debris (NORAD

id 35891), ICEYE-X6 satellite (NORAD id 46497) and a few Starlink satellites 3787, 2701, 2090, during the ascent phase of the launch vehicle and the initial orbital phase of the satellites. The requisite coordination with the operators of the functional satellites was ensured for spaceflight safety. As no close-approach risks were detected, the nominal lift-off timings were cleared for other launches (PSLVC52, PSLV-C54 & LVM3-M2).

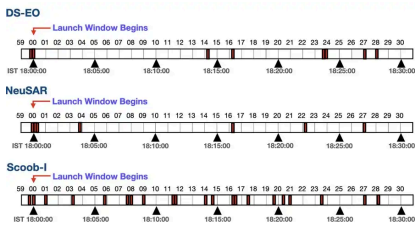

Figure 2. "Black-out" zones within the PSLV-C53 launch window, over which the lift-off is prohibited to avoid close approach risk with other space objects.

Spacecraft Decommissioning and Post Mission Disposal

INSAT-4B (launched on March 11, 2007) was decommissioned on January 24, 2022, after being raised to a super synchronous orbit, a graveyard, anda disposal orbit band. Disposal orbit achieved complies with the IADC guidelines on post-mission disposal of GEO objects (More details).

RISAT-2 (launched on April 20, 2009) was operational till September 2022 at an altitude of 350 km. The spacecraft re-entered Earth's atmosphere on October 30, 2022 (More details).

The planned de-orbiting of a spacecraft is a major highlight of 2022. Meghatropiques-1 satellite (MT1) (launched on October 12, 2011)was de-orbited with a series of maneuversduring August-December 2022. In August, the satellite was operational in a 20° inclined orbit at 867 km altitude, where its post-mission lifetime would have been more than 100 years. The orbital lifetime was reduced to less than 25 years by the September end and to less than a few months by the end of December. The satellite underwent a controlled re-entry over the South Pacific Ocean onMarch 7, 2023 (More details).

Mars Orbiter Mission (MOM) (launched on November 5, 2023) was operational for about

eight years. The spacecraft lost communication with the ground station after experiencing a long eclipse in April 2022. As all the attempts to re-establish communication with the spacecraft were unsuccessful, MOM was declared non-operational (More details).

Way forward

The year 2022 witnessed the maximum number of on-orbit payload deployments reflecting the growing interest in space activities by emergent entities, particularly private sectors. The number of close approach alerts received, and the number of CAMs performed by ISRO also increased. This trend is expected to continue. The associated penalties for CAM, such as fuel expenditure, disruption of payload operations, operational overheads, and frequent coordination with external operators, are also anticipated to increase. As of today,a universally accepted Space Traffic Management (STM) framework is nonexistent. Hence, resolving multiple conjunctions between operational satellites is expected to add operational complexities in the future.

As a part of ISRO's holistic approach towards safe and sustainable utilization of outer space for national development, ISRO System for Safe & Sustainable Operations Management (IS4OM),dedicated to the nation by the Honourable Minister of State, Dr. Jitendra Singh in 2022, aims to safeguard ISRO's space assets and to improve compliance with internationally recognized guidelines on the long-term sustainability of outer space activities. IS4OM is mandated to carry out Space Situational Awareness and Space Traffic Management activities covering observation and monitoring of space objects and space environment, processing the observations for orbit determination, object characterization and cataloging, modeling the evolution of space environment, potential threat detection, risk assessment and mitigation, data exchange, and collaboration.

Participation of private industries and academia is expected soon tounlock India's full potential in the Space sector. All space-faring entities are aware of the potentially detrimental effects of space

debris and adhere to space debris mitigation guidelines and best practices. It is essential to augment and expand the network of observational facilities for heightened awareness of the space situation. Establishing a space surveillance and tracking network with RADARS and Optical Telescopes is currently undertakenby the project Network for Space Objects Tracking and Analysis (NETRA) by ISRO. Complete coverage of the space objects distributed over various orbital regimes requires a wide network of observational facilities with a geographically diverse distribution. As space-based activities have potential global implications, international collaboration ensures preserving the near-Earth space environment for continued exploration and utilization by future generations of humankind.

Address

ISRO Headquarters, Antariksh Bhavan, New BEL Road
Bengaluru-560 094

Phone: +91 80 22172294 / 96
Email: isropr[at]isro[dot]gov[dot]in

- Parliament Questions
- PIB
- e-Saral Hindi Vakyakosh
- Related links
- Check Your 7th CPC Pension Revision Status
- Pensioners' Portal
- Site Map
- Help

Last updated on : Sat Apr 29 2023 12:11:04 GMT+0530 (India Standard Time)

Designed by CITG/MSA VSSC/ISRO