



# ISRO's SpaDeX

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## Why in News?

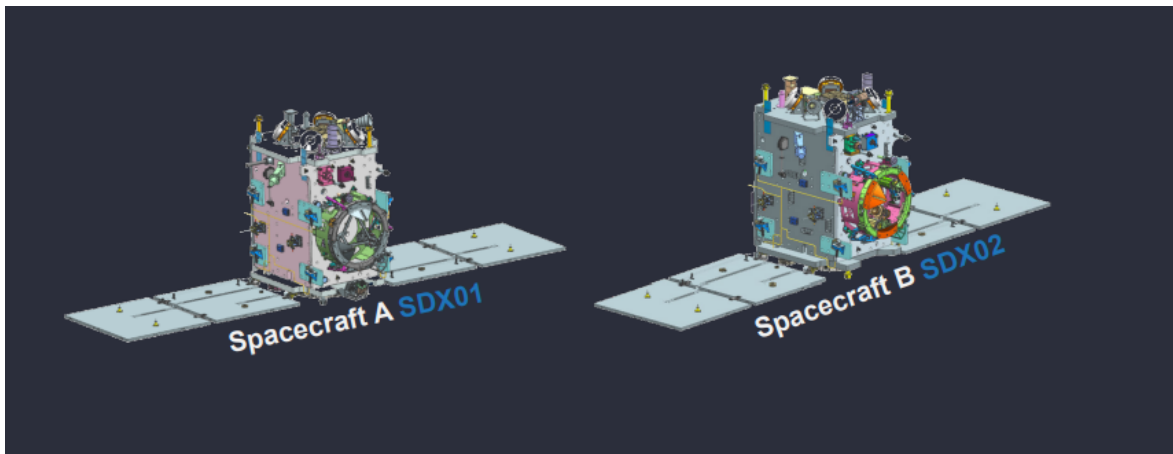
[Indian Space Research Organisation \(ISRO\)](#) is set to achieve a significant milestone with the **launch of the [Space Docking Experiment \(SpaDeX\)](#) mission on 30th December 2024.**

- The mission aims to demonstrate satellite docking capabilities, a crucial technology for future space missions.

## What is SpaDeX?

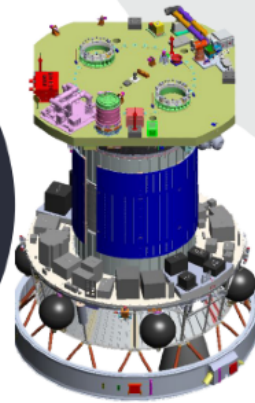
- **About:** SpaDeX (Space Docking Experiment) is a **technology demonstrator mission** developed by the ISRO to showcase **in-space docking technology**.
  - This mission aims to demonstrate the ability to **rendezvous, dock, and undock two small spacecraft**, marking a significant advancement in India's space capabilities.
- **Objective:** The primary goal of SpaDeX is to develop docking technologies for two small spacecraft, **SDX01 (Chaser) and SDX02 (Target)**, in **low Earth orbit**.
  - They will dock autonomously using **advanced sensors and propulsion systems**.
  - Secondary objectives include **testing electric power transfer and demonstrating spacecraft control**.
- **Mission Duration:** Two years
- **Mission Design:** SpaDeX will deploy two satellites, SDX01 and SDX02, into a 470 km orbit using the **[Polar Satellite Launch Vehicle \(PSLV\) rocket](#)**, where they **drift apart and gradually approach each other**, eventually docking at distances from 20 km to 3 meters.
  - The two satellites are equipped with the **Bharatiya Docking System (BDS)**.
    - BDS features identical, low-impact (approach velocity is in the order of 10 mm/s), **androgynous** (docking systems are identical for both spacecraft, Chaser & Target) docking mechanisms, enhancing mission flexibility and precision for future operations like satellite servicing, crew transfers, and India's space station development.
  - SpaDeX will use **PSLV's fourth stage, [POEM \(PSLV Orbital Experimental Module\)-4](#)**, to carry 24 payloads from academic institutions and startups. These experiments will leverage the **microgravity environment** in orbit.
- **Docking Challenge:** The two satellites (Chaser and Target) will orbit at speeds of 28,800 km/h. They will need to carefully reduce their relative velocity to just 0.036 km/h before docking.

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#### ✓ PSLV Orbital Experimental Module-4 (POEM-4)

PS4 stage is configured as a 3-axis stabilized orbital platform for conducting experiments to space qualify systems with novel ideas. The PS4 stage orbital platform electrical power requirements are catered by flexible solar panel in conjunction with 50Ah Li-Ion battery in battery tied configuration. The orbital platform consists of avionics systems to take care of navigation, guidance, control & tele-commands and orbital platform attitude control system to cater to control of the platform to test the payloads.



## Space Docking

- Space docking is the intricate process of **maneuvering two fast-moving spacecraft into the same orbit**, bringing them closer, and joining them to form a single unit.
  - This capability is pivotal for assembling large structures or transferring equipment, crew, or supplies in space.
- For instance, the **International Space Station (ISS)** was built using this technique, with various modules launched separately and docked in space.
  - Continuous docking missions keep the **ISS operational** by delivering supplies, new crew members, and modules while facilitating the return of the older crew to Earth.

## Why is Space Docking Technology Crucial for India?

- **Modular Space Infrastructure:** Docking is a prerequisite for constructing multi-modular space stations. It allows the assembly of structures in space, reducing the size and weight constraints of single-launch missions.
- **Interplanetary and Lunar Missions:** Docking supports orbital refueling, and payload exchange, enhancing mission flexibility for lunar bases and Mars exploration.
  - It is crucial for future missions like **Chandrayaan-4**, space stations, and India's planned **Bharatiya Antariksh Station (BAS)**.
- **Human Spaceflight Program:** Space Docking is critical for **crew transfers and emergency evacuations** during long-duration missions like Gaganyaan and beyond.
- **Global Collaboration and Market Potential:** SpaDeX could position **India as the fourth nation**, after Russia, the US, and China, to master space docking, strengthening its presence in satellite servicing and enabling advanced international collaborations.
- **Satellite Servicing:** Docking allows for repairing, refueling, and upgrading satellites, enhancing their operational life and performance.

## UPSC Civil Services Examination, Previous Year Question (PYQ)

### Prelims

**Q. Consider the following statements: (2016)**

**The Mangalyaan launched by ISRO**

1. is also called the Mars Orbiter Mission
2. made India the second country to have a spacecraft orbit the Mars after USA
3. made India the only country to be successful in making its spacecraft orbit the Mars in its very first attempt

**Which of the statements given above is/are correct?**

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Ans: (c)**

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