GSLV-F18/NVS-03 Mission

Strengthening India’s Indigenous Navigation Capabilities

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NVS-03 Mission: Expanding the Horizon of NavIC

The Indian Space Research Organisation (ISRO) successfully accomplished the **GSLV-F18/NVS-03 mission on 30 October 2026 at 23:51 hours from the Satish Dhawan Space Centre (SDSC), Sriharikota.**



The **GSLV-F18 launch vehicle** injected the **Navigation Satellite NVS-03** into a precise Geosynchronous Transfer Orbit (GTO). Subsequently, first orbit manoeuvre completed on 31 October 2026 at 16:48 hours. Further manoeuvres are planned to place it in its designated geosynchronous orbital slot at 111.75° East.

The satellite is the **third in India's series of five next-generation Navigation satellites** and is designed to strengthen the Navigation with Indian Constellation (NavIC), enhancing India's capabilities in satellite-based navigation.

Did You Know? A spacecraft destined for geosynchronous or geostationary orbit is generally first placed in an elliptical Geosynchronous Transfer Orbit (GTO). This orbit has a low perigee (closest point to Earth) and a high apogee (farthest point from Earth). For a conventional GTO, the apogee is approximately 35,786 km above Earth's surface. Near apogee, the spacecraft fires its onboard propulsion system to raise its perigee and circularise its orbit. Additional manoeuvres may adjust its orbital inclination and position, depending on the target orbit. The propulsion system used for these orbit-raising manoeuvres is commonly called an Apogee Motor. **In the case of NVS-03, the orbit-raising manoeuvre was performed using its Liquid Apogee Motor (LAM), a type of chemical rocket engine.**

Key Highlights of the Mission

- **Successful Launch**: GSLV-F18 **placed NVS-03 into its intended Geosynchronous Transfer Orbit (GTO)**. This marks another milestone in India's efforts to strengthen its satellite navigation infrastructure.
- **20th GSLV Flight**: The mission marks the **20th flight of India's Geosynchronous Satellite Launch Vehicle**. It demonstrates the continued operational use of India's launch vehicle for strategic space missions.
- **Next-Generation Series Satellite**: NVS-03 is the third satellite of second-generation NavIC satellites (NVS-01 to NVS-05). These satellites are designed to strengthen the coverage, accuracy and **reliability of India's regional navigation system**.

Satellite Navigation System

A Satellite Navigation System is a network of satellites that provides positioning, navigation and timing information. These satellites continuously transmit signals containing their location and precise timing information. Receivers, such as smartphones, vehicles and navigation devices, use signals from multiple satellites to determine their precise location, speed and direction. These systems support several applications, including route naviiesation, aircraft and ship tracking, precision agriculture, disaster management and telecommunications. Examples include the **Global Positioning System (GPS)** of the United States, and **Navigation with Indian Constellation** (NavIC) of India.

- **Enhanced Navigation Signals**: NVS-03 carries navigation payloads in the L1, L5 and S frequency bands. The inclusion of the L1 signal alongside the L5 and S signals continues to enhance NavIC's capabilities and compatibility. It supports navigation coverage across India's landmass and a region extending 1,500 km beyond its geopolitical boundary.
- Using multiple frequency bands allows compatible receivers to access signals transmitted at different frequencies. It also provides options for designing receivers suited to different applications and operating conditions.

Navigation Signals and Their Frequency Bands

Navigation signals are radio-frequency signals transmitted by navigation satellites to receivers on Earth. These signals carry precise timing information and satellite-position data. Receivers use this information to calculate their location, speed and time. **Frequency bands** are specific ranges of radio frequencies used to transmit these signals. Satellite navigation systems use designated portions of the radio-frequency spectrum. Different bands allow signals to be transmitted and received at different frequencies.

- **Indigenous Technology:** NVS-03 carries an indigenously developed atomic clock alongside procured atomic clocks. **These clocks provide highly precise time references for navigation signal generation. Accurate timing is essential for determining signal travel times and calculating user positions**.
- **Wider Applications**: **NVS-03 strengthens India's independent Positioning, Navigation and Timing (PNT) capabilities.** These capabilities support applications across transportation, maritime operations, aviation, disaster management, precision agriculture and strategic services. *Read more on Strengthening India's Space Sovereignty*

Geosynchronous Satellite Launch Vehicle (GSLV)

The Geosynchronous Satellite Launch Vehicle (GSLV) is a three-stage launch vehicle developed by the Indian Space Research Organisation (ISRO) to place satellites into Geosynchronous Transfer Orbit (GTO) and Low Earth Orbit (LEO). The feature that makes GSLV unique from other launch vehicles is its final stage, which uses an indigenous Cryogenic Upper Stage. Additionally, the boosters used in GSLV are liquid-powered, popularly known as L-40, and use a hypergolic combination of Nitrogen Tetroxide (N_2O_4) and UH25 (a mixture of 75% Unsymmetrical Dimethylhydrazine (UDMH) and 25% Hydrazine Hydrate) *Read More on GTO.*

The GSLV-F18 stands approximately 50 metres tall, with a lift-off mass of around 420 tonnes. It features a 3.4-metre-diameter metallic payload fairing and successfully carried the approximately 2,250 kg NVS-03 navigation satellite.

Cryogenic Upper Stage: A cryogenic upper stage is the final stage of a launch vehicle that uses these propellants to provide the high efficiency needed to place satellites into their intended orbits. ISRO's indigenous cryogenic upper stage used on GSLV employs liquid hydrogen (LH_2) as fuel and liquid oxygen (LOX) as oxidiser, both stored at extremely low temperatures. It replaced the Russian-supplied stage used in earlier GSLV flights, strengthening India's self-reliance in advanced launch vehicle technology.

Understanding NavIC: India's Indigenous Navigation System

- NavIC is India's regional satellite navigation system, developed by the Indian Space Research Organisation (ISRO).
- It was earlier known as the Indian Regional Navigation Satellite System (IRNSS).
- The system provides Position, Navigation and Timing (PNT) services to users.

- NavIC was originally designed with a seven-satellite constellation supported by a network of ground stations operating round the clock. Its architecture comprises three satellites in geostationary orbit and four in inclined geosynchronous orbit. The NVS series is being deployed to augment the existing constellation and ensure continuity of navigation services.
- NavIC covers the Indian landmass and a region extending approximately 1,500 km beyond India's geopolitical boundary.
- The NVS series adds L1 to the legacy L5 and S signals.

Two Types of Navigation Services

NavIC provides two types of navigation services to cater to civilian and authorised strategic users.

- **Standard Positioning Service (SPS):** An open navigation service available to civilian users. NavIC SPS signals are interoperable with the other global navigation satellite system (GNSS) signals like GPS (USA), Glonass (Russia), Galileo (EU) and BeiDou (China).
- **Restricted Service (RS):** An encrypted navigation service available exclusively to strategic users.

Progress of the Next-Generation Navigation Satellite Series

The five-satellite NVS series is being developed to augment the NavIC constellation and ensure continuity of indigenous navigation services. To date, NVS-01, NVS-02, and NVS-03 have been launched, while NVS-04 and NVS-05 are in the pipeline. ISRO is working to boost the coverage, reliability and availability of NavIC services. *Read more on India's Space Odys sey*

NVS-01 – First Satellite of the Next/Second-Generation Series

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- GSLV-F12, the 15th flight of India’s GSLV, placed NVS-01 into a Geosynchronous Transfer Orbit.
- NVS-01 was launched on 29 May 2023. It is the first satellite of the second-generation NavIC series. It is designed to ensure continuity of legacy NavIC services.
- It carries navigation payloads in the L1, L5 and S bands.
- Its lift-off mass is about 2,232 kg.
- The mission life of NVS-01 is 12 years.
- It carries an indigenously developed Rubidium atomic clock, built by the Space Applications Centre, Ahmedabad.

NVS-02 – Second Satellite of the Series

- NVS-02 was launched on 29 January 2025 aboard GSLV-F15.
- It carries L1, L5 and S band navigation payloads, plus a C-band ranging payload.
- NVS-02 has a lift-off mass of 2,250 kg.
- It uses a mix of indigenous and procured atomic clocks for precise time estimation.
- After launch, orbit-raising could not be carried out because the oxidiser valves did not open. As a result, the satellite could not reach its intended orbital slot.

NVS-04 and NVS-05 – Upcoming Satellites

- NVS-04 and NVS-05 are the fourth and fifth satellites planned in the second-generation NavIC series.
- Like the earlier NVS satellites, they are expected to carry the L1 signal alongside L5 and S. Both are envisaged to offer enhanced navigation capabilities.

One More Step Towards India's Space Sovereignty

The successful development and deployment of next-generation NavIC satellites mark another milestone in India's journey towards Atmanirbhar Bharat in advanced space technology. By strengthening indigenous satellite navigation capabilities, India is enhancing its ability to provide reliable positioning, navigation and timing services independently. These advancements reduce dependence on foreign satellite navigation systems for critical applications. They also strengthen India's technological capacity to design, develop and operate strategic space infrastructure. These efforts reinforce India's space sovereignty, technological self-reliance and growing role in the global space sector.

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