NavIC (Navigation with Indian Constellation)

Prelims: *Current events of national and international importance | Science and Technology*

Why in News?

India's indigenous navigation system NavIC has faced an operational setback after the atomic clock failure in the IRNSS-1F satellite.

- NavIC is India's ***regional satellite navigation system*** to provide accurate positioning, navigation, and timing services.
- It is earlier known as *Indian Regional Navigation Satellite System (IRNSS)* changed as "NavIC" in 2016.
- **Developed by -** The Indian Space Research Organisation (ISRO).
- **Components**
  - **Constellation Structure –** NavIC is designed with a 7-satellite constellation in high Earth orbit (36,000 km).
  - **Orbital Configuration –** 3 Geostationary Orbit (GEO) satellites, 4 Inclined Geosynchronous Orbit (IGSO) satellites to ensure continuous regional coverage over India.
  - **Ground Segment -** The ground network includes Control centres, Precise timing facilities, Range and integrity monitoring stations and Two-way ranging stations
  - These stations operate **24×7** to monitor satellite signals and maintain accuracy.
- **Frequencies–** NavIC operates on dual frequencies L5 band and S band.
- **Coverage –** Primary coverage is Entire India and Extended coverage is 1500 km beyond Indian borders.
- **Offered Services**

Standard Positioning Service (SPS)	Restricted Service (RS)
Open for civilian users	Encrypted high-precision service
Position accuracy ~10–20 metres	Available only for military and authorised users

- **Major Applications –** Defence (missile guidance and military navigation)
- Disaster management (cyclone and tsunami alerts for fishermen)
- Transport (AIS-140 compliant vehicle tracking systems)
- Public services (railway tracking and fleet management)
- Civilian (smartphone navigation and IoT devices)
- **Interoperability -** NavIC signals are interoperable with major Global Navigation Satellite Systems **(GNSS)**
    - **GPS** – USA
    - **GLONASS** – Russia
    - **Galileo** – European Union
    - **BeiDou** – China

Reason for recent setback

- As of now, only 3 satellites are fully operational for navigation **–** IRNSS-1B (2014), IRNSS-1I (2018), NVS-01 (2023) after the atomic clock failure in the IRNSS-1F satellite.
- This is *below the minimum requirement* of 4 satellites, to determine an accurate 3D position (latitude, longitude, and altitude).

References

1. Indian Express | NavIC
2. ISRO | NavIC

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