

Satellite Internet in India

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Satellite Internet Latest News

- Starlink's upcoming launch in India has renewed focus on how satellite internet works, its applications, and regulatory challenges.

Introduction

- Satellite internet is emerging as a transformative solution in global connectivity, especially for remote and underserved areas.
- With Elon Musk's Starlink set to debut in India, the country's internet infrastructure is poised for a significant upgrade.
- Unlike traditional ground-based networks dependent on cables and towers, satellite internet can offer high-speed access in areas where physical infrastructure is unviable, ensuring resilience during disasters and operational continuity for both civilian and military applications.

Significance of Satellite Internet

- Ground-based broadband, while efficient in urban hubs, struggles in sparsely populated or disaster-prone regions due to high infrastructure costs and vulnerability to physical damage.
- Satellite internet overcomes these constraints by providing coverage irrespective of terrain, rapidly deploying during emergencies, and servicing mobile or remote operations such as on ships, aircraft, or oil rigs.
- This makes it not just a backup but a potential primary connectivity mode in specific scenarios.

Key Features and Dual-Use Nature

- The arrival of satellite mega-constellations like Starlink marks a new era. These networks, consisting of thousands of satellites, have applications across:
 - **Civilian sectors:** healthcare, agriculture, transportation, education, and disaster response.
 - **Military sectors:** secure communications, battlefield coordination, and navigation in remote conflict zones.
- Global examples highlight its importance. Viasat enabled disaster relief during Hurricane Harvey, while Starlink has been crucial to Ukrainian defence in the Russia-Ukraine conflict.
- In India, the Army has utilised satellite internet in strategic locations like the Siachen Glacier. However, its borderless nature also poses risks, as seen in cases of smuggled terminals being used by insurgent groups.

Working of Satellite Internet

- A satellite internet network comprises:
 - **Space Segment:** Satellites in orbit, carrying communication payloads with a service life of 5-20 years.
 - **Ground Segment:** Terminals and antennas that connect users to the satellites.
- The orbital altitude determines coverage and latency, with **three main categories**:
 - **Geostationary Earth Orbit (GEO)** – 35,786 km altitude; large coverage but high latency; unsuitable for real-time applications. Example: Viasat's Global Xpress.
 - **Medium Earth Orbit (MEO)** – 2,000-35,786 km altitude; lower latency than GEO but still requiring multiple satellites for coverage. Example: O3b constellation.
 - **Low Earth Orbit (LEO)** – below 2,000 km; very low latency and smaller, cheaper satellites, but requiring large mega-constellations for global coverage. Example: Starlink with over 7,000 satellites.

LEO Mega-Constellations and Innovations

- LEO constellations mitigate their limited coverage by using vast numbers of satellites with onboard processing capabilities.
- Optical inter-satellite links allow direct satellite-to-satellite communication, reducing dependency on ground stations and improving efficiency.
- These systems employ steerable antennas to ensure uninterrupted service as satellites move rapidly across the sky, handing off connections seamlessly between satellites.

Applications Across Sectors

- **Communications:** Internet access in remote regions, support for IoT networks.
- **Transportation:** Enhanced navigation, self-driving vehicle support, and real-time logistics.
- **Disaster Management:** Early warnings, emergency coordination, and resilient communication lines.
- **Healthcare:** Telemedicine, diagnostics, and remote monitoring.
- **Agriculture:** Precision farming and crop analytics.
- **Defence:** Secure communications, surveillance, and operational readiness in remote zones.
- **Environmental Monitoring & Energy:** Tracking natural resources, supporting renewable energy operations.
- Future innovations like direct-to-smartphone satellite connectivity could eliminate the need for dedicated terminals, integrating satellite capabilities directly into consumer devices.

Challenges and Strategic Importance

- While costs remain higher than terrestrial broadband (approx. \$500 for hardware and \$50/month for service), the benefits in remote connectivity and strategic resilience justify the investment.
- However, its dual-use nature raises regulatory and security concerns, making governance critical.
- For India, satellite internet offers the opportunity to:
 - Bridge the digital divide.
 - Strengthen disaster resilience.
 - Enhance national security capabilities.
 - Play a role in shaping the international governance of satellite networks.

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