# INDIA SPACE CONGRESS 2025

# CONFERENCE REPORT

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SIA INDIA
An association for space industry

India Space Congress

# Message from the President

India's space journey has entered a defining phase – marked by ambition, strategic foresight, and global responsibility. The India Space Congress 2025 was not just an event; it was a reaffirmation of our shared determination to build a self-reliant, innovation-led, and globally connected space ecosystem.

This year's edition held deep significance. It was inaugurated at a moment when two historic milestones converged: the initiation of the SPADEx docking mission earlier this year during DEFSAT, and the launch of Group Captain Shubhanshu Shukla aboard Axiom Mission-4, which we witnessed live on the opening day of the ISC 2025. Together, these events showcased India's rapid ascent as a spacefaring nation with both strategic capability and international collaboration at its core.

As someone who began their journey as a scientist with a dream of contributing to India's space programme, it is deeply humbling to witness how far we have come. The Congress was not simply a congregation of delegates; it was a gathering of changemakers, united by a shared sense of purpose. The future we envision, one defined by strategic autonomy, sustainable growth, and global stewardship, is not abstract. It is already taking shape through the actions, alliances, and ambitions we foster here.

Let us translate the momentum generated here into sustained programmes, investible projects, and globally trusted frameworks, so that by 2047 India will stand not merely as a capable spacefarer, but as an indispensable, principled partner in the stewardship of the space commons.

**Thank you for being part of this journey.**

**Dr Subba Rao Pavuluri**
President, SIA-India & CMD
Ananth Technologies Ltd

# ISC 2025 IN NUMBERS

**1000+**
Delegates

**400+**
Organisation Participated

**200**
Speakers

**19**
Government Agencies

**35+**
Countries

**5 MoU Signed**

**8**
Country Delegation

**4 Report Release**

**35+**
Thematic Sessions

**4**
Dedicated Country Sessions

**20**
Exhibitors

**100+**
Online and Print media coverage

# GLOBAL REPRESENTATION

# MEDIA COVERAGE

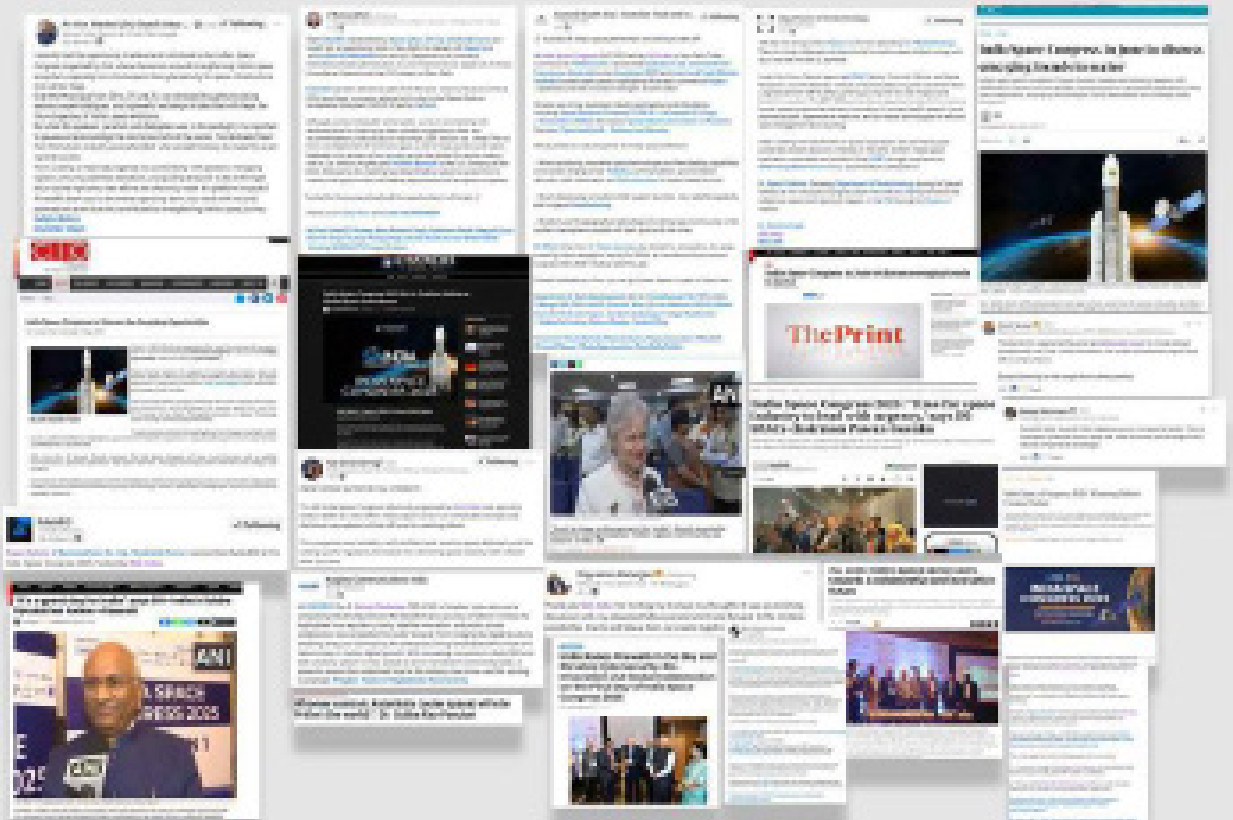
Over 100+ Online Print and TV media

Attended by 50+ top media houses

12+ international news portals

40+ regional publications

1 million+ media impressions across formats



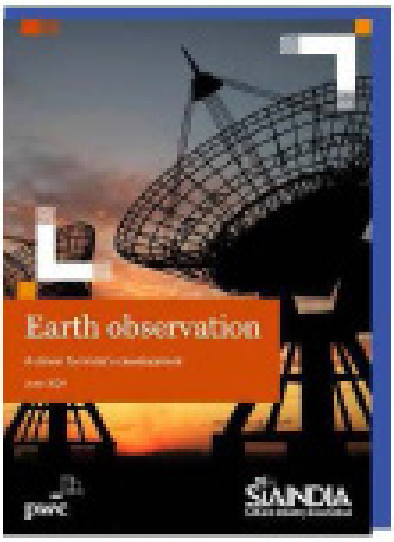
# Support from Esteemed Govt. Partners


We are immensely grateful for the support from a wide array of departments, ministries, institutions,and organizations. Their collective contributions and backing were crucial to the success of the India Space Congress 2025, demonstrating a remarkable commitment to fostering innovationand collaboration within the space sector.

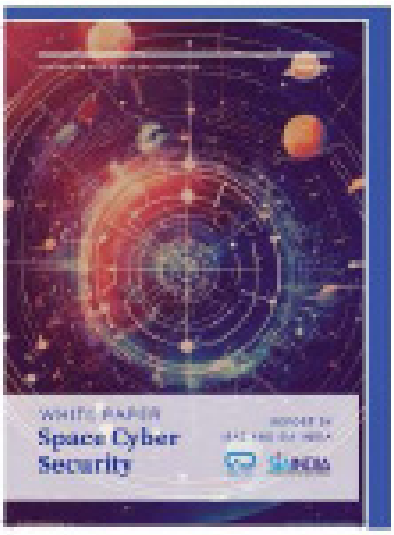
# RELEASE OF REPORTS

To access complete report
https://www.sia-india.com/category/reports-publications/

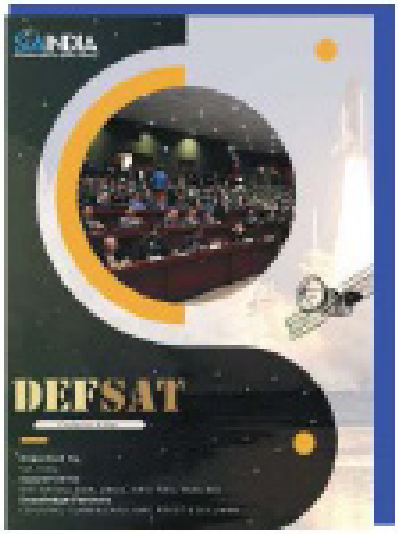

Whitepaper
Bridging the Digital Divide in India via Satelliteby SIA-India



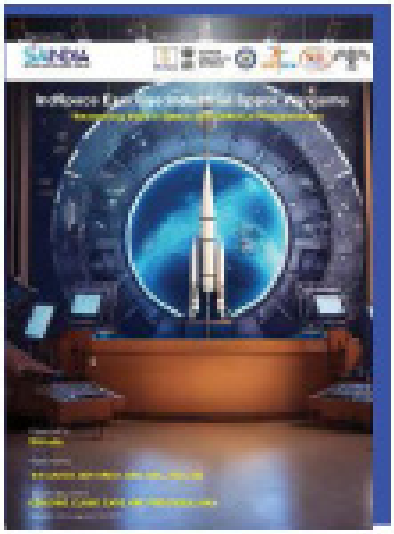

Whitepaper
Earth Observation
by SIA-India and PwC




Whitepaper
Space Cyber Security
by SIA-India and ISAC




Conference report
DefSat 2024




Report
IndSpace Exercise: Industrial
Space War Game

# Panel 01: Satcom Enabling Smart Connectivity Across Industries

**Chair:** Dr. PK Jain, Director, IN-SPACe
**Moderator:** Ms. Sukhraj Kaur, Analyst, Analysys Mason

**Panellists:**

- Mr. Adi Rahman Adiwoso, President Director, PT Pasifik Satelit Nusantara (PSN)
- Mr. Thomas Antony, Director – Sales, APT Satellite Company Ltd.


Satellite communication is no longer confined to heritage applications like TV broadcasting or remote telephony. It's evolving into a vital infrastructure layer supporting modern digital economies, particularly where terrestrial networks falter. The global and domestic experts in the panel outlined how 3GPP Releases 17–19 are enabling full integration between satellite and terrestrial mobile networks, opening new IoT opportunities that work seamlessly with existing 5G/6G devices. How satcom is unlocking smart connectivity across diverse sectors, from agriculture and mining to finance and governance, and where India must position itself to lead both technologically and geopolitically.

Costs are falling due to high throughput satellites (HTS), NGSO constellations, software-defined payloads, and lower satellite mass, reducing cost per bit. GEO satellites still take about three years to build and have a 15-year operational life, with future flexibility dependent on ground-segment innovations such as flat-panel antennas. For India, IN-SPACe, along with DoT, MIB, DoS, and industry, projects demand of about 900 Gbps for IoT, BharatNet village links, cellular backhaul, and VSAT, which could rise to 3–4 Tbps if consumer broadband scales. Government departments can serve as anchor customers. Application drivers include IoT in agriculture, maritime, mining, oil/gas, environmental monitoring, logistics, and fintech; "Fidgetal" smart villages under Digital Bharat Nidhi/Samriddhi Gram integrating health, education, e-governance, and agriculture; and BharatNet 3.0's shift to multi-sector connectivity.

India's digital transformation efforts, like the phases of BharatNet and the proposed

Samriddhi Gram and Fidgetal Villages under Digital Bharat Nidhi, are primed to benefit. Crucially, they go beyond broadband access by embedding cross-sectoral service delivery on a unified digital infrastructure. While efforts are underway through IN-SPACe and DoT to create unified guidelines, the pace must match the growth in demand.

Spectrum allocation and global regulatory coordination are emerging flashpoints. The upcoming World Radiocommunication Conference 2027 (WRC-27) is expected to be a high-stakes battleground, particularly on direct-to-device (D2D) services. These services, which involve using GSM spectrum for satellite-based mobile connectivity, pose both economic and sovereignty dilemmas. The reallocation of auctioned GSM spectrum raises questions about fair compensation and security risks. At the heart of the debate lies Article 1.5, governing cross-border transmission rights where implicit transmission consent demanded by some countries could dilute national control. India, like many others, sees this as a potential breach of sovereignty.

What emerged was a clear roadmap, India must shift from policy inertia to anticipatory regulation, from sectoral pilots to scaled implementations, and from isolated satcom use cases to integrated connectivity frameworks.

## KEY RECOMMENDATIONS

1. **Recognise Satcom as Foundational for Rural Development:** Integrate satcom into BharatNet 3.0 and Samriddhi Gram for continuity of sectoral services (agri, health, marine, disaster) using a service-integration model.
2. **Operationalise a Multi-Orbit Service Delivery Framework:** Issue harmonised DoT–IN-SPACe guidelines covering D2D, NTN-IoT, enterprise satcom and multi-orbit handover, with clear norms for landing rights, lawful interception, security and licensing to enable predictable deployment.
3. **Consolidate a Unified Satcom Regulatory Architecture:** Create a single, integrated policy framework for satellite IoT, D2D and multi-orbit use, ensuring 3GPP-aligned satellite–terrestrial interoperability, device-level compliance and clarity for OEMs, constellations and Indian integrators.
4. **Institutional Demand Mapping (Annual, IN-SPACe Led):** Undertake structured, annual demand estimation with DoT, DoS and sector ministries to guide capacity authorisations, ground-segment expansion and safety-critical nodes (coastal, border, disaster, aviation, maritime)

5. **Coordinate India's WRC-27 Position on D2D:** Develop a consistent national stance on explicit consent, landing rights and sovereignty under Article 1.5, ensuring D2D evolution does not bypass national authorisation mechanisms.
6. **Support Ground-Segment Modernisation:** Prioritise domestic testing access, qualification standards and interoperability for terminals, gateways and flat-panel platforms without referencing cost targets or numeric reductions.
7. **Advance Satcom Export Readiness Without Regional Posturing:** Facilitate joint manufacturing, testing corridors and bilateral interoperability standards where feasible, without positioning India as a regional satcom hub or preferred provider, in line with FinMin neutrality guidance.

# Panel 02: The Future of Multi-Orbit SATCOM

**Chair:** Mr. Arun Agarwal, DDG, Satellite, Dept of Telecom
**Keynote Address:** Mr Harsh Verma, VP – Sales Asia, SES
**Moderator:** Mr Alexander Jeuck, Sr Advisor, Novaspace

**Panellists:**

- Mr Christopher Macintosh, CEO, Methera Global
- Mr. Adi Rahman Adiwoso, President Director, PT Pasifik Satelit Nusantara (PSN)


Currently, India operated 37 GEO satellites for telecom and broadcasting services, with LEO and MEO services already authorized by INSPACe, await commercial rollout pending final spectrum assignment by DoT.. Discussions highlighted the role of sovereign multi-orbit strategies for national data control, as well as the rise of small GEO platforms enabling country-specific coverage. While LEO offers low latency and rapid deployment, MEO provides a balance of performance and sovereignty compliance, and GEO remains unmatched for wide-area broadcast efficiency. The panel stressed that multi-orbit capability is not just a backup option — it is the **primary operational model** for the next decade.

The session highlighted how to leverage different satellite technologies (GEO, LEO, MEO) to achieve seamless coverage, combining the strengths of each while mitigating their weaknesses. Customer demand is shifting from static quality of service (QoS) to dynamic quality of experience (QoE), requiring AI-driven orchestration layers that make microsecond-level routing decisions based on application needs. Examples such as Hughes' Hughes Fusion platform — bonding GEO (~50 Mbps), OneWeb LEO (~195 Mbps), and future Telesat LEO (~900 Mbps) to achieve ~1.5 Gbps to a single terminal — illustrate the performance leap possible with bonded multi-orbit solutions.The discussion also highlighted the potential for acquisitions, partnerships, and organisations focusing on their core business. The development of satellite routers and the evolution of spectrum utilisation, particularly in GEO, were also discussed, emphasising the growing interest in multi-orbit strategies for sovereign nations. Spectrum use is evolving, with declining demand for C-band, migration from Ku to Ka-band, and growing exploration of Q/V bands. Multi-orbit

routers, single-antenna dual/multi-band terminals, and software-defined ground infrastructure are emerging as key enablers.

Regulatory alignment, partnerships between established operators and new entrants, and modular satellite designs will be essential to reduce time-to-market and keep pace with 3–5-year technology refresh cycles. The long-term vision is to enable network agnosticism, allowing users to connect to any network (LEO, MEO, GEO) as long as performance, stability, and cost-effectiveness are maintained.

## KEY RECOMMENDATIONS

1. **Finalise Spectrum Allocation for NGSO Services:** DoT should expedite the spectrum assignment process for NGSO (LEO/MEO) systems to move from testing to commercial service deployment. Regulatory certainty is critical for accelerating investment and service readiness.
2. **Promote AI-Driven Network Orchestration:** AI-driven orchestration platforms should be integrated across service providers to allow application-aware traffic routing, better latency management, and seamless user experience. Establish government-led trials with operators to validate real-time orbit-switching and latency management before commercial rollout.
3. **Prioritise Sovereign Multi-Orbit Strategies:** Support terminal platforms capable of GEO–MEO–LEO handover for aviation, maritime, and remote enterprise use, with clear norms on landing rights, lawful interception, and data jurisdiction, ensuring security and operability without committing India to new constellation build-outs.
4. **Enable Interoperability, standards and Integration Across Orbits:** Enable 3GPP-aligned interoperability across GEO, MEO, and LEO systems; task TEC/ BIS with standards for device and network handover so multi-orbit services operate seamlessly without orbit-specific lock-in.
5. **Support Vertical Integration and Modular Innovation:** Promote modular designs and shared test/qualification access for terminals, gateways, and payload subsystems through industry partnerships, focusing on **faster upgrade cycles and reduced time-to-market,** without invoking PLI or volume-based incentives.

6. Encourage Commercial Models That Optimise ROI per Hertz: Focus on building monetisable service models, especially for VSAT operators by supporting flexible capacity allocation, customised plans, and dynamic traffic management. Allow flexible capacity trading/leasing between operators to optimise spectrum ROI.

7. **Prepare for Rapid Tech Evolution and Shorter Refresh Cycles** Satellite manufacturers and service providers must be equipped to handle 3–5-year disruption cycles, requiring backward-compatible ground infrastructure and flexible constellations.

# Panel 03: India's Launch Ecosystem: Catalysing Capacity, Competition, and Global Reach

**Chair & Moderator** : Mr. N Sudheer Kumar, Former Director CBPO, ISRO

**Panellists:**

- Mr Srinath Ravichandran, CEO, Agnikul
- Mr. Sireesh Pallikonda, VP Business Develop Skyroot Aerospace
- Mr. Thomas Antony, Director – Sales, APT Satellite Company Ltd.


India's launch landscape has shifted from a state-exclusive programme to a multi-provider ecosystem where private launchers complement ISRO's proven capabilities (SLV → PSLV → GSLV → LVM3). With small-sat missions, responsive launch timelines, and 3D-printed propulsion now available from industry, India is positioned to compete in the rapidly expanding global small-launch segment where reliability, turnaround time, and orbital flexibility outweigh mass rideshare pricing.

Skyroot is targeting rapid-cycle modular launchers for dedicated access between USD 7,000–40,000/kg, while Agnikul has demonstrated a single-piece 3D-printed semi-cryogenic engine and India's first private launchpad with mobile launch capability, reducing manufacturing and integration timelines from months to days. These capabilities align with the emerging global requirement for **on-demand, schedule-controlled, orbit-specific** launches rather than low-cost bulk slots.

India's geographic location, enabling sun-synchronous and equatorial launch windows, strengthens competitive positioning, provided policy continuity and national anchor demand signal remain predictable.

## KEY RECOMMENDATIONS

1. **Selective Government Anchor Use:** Allocate limited national payloads to domestic launchers to build flight heritage and credibility without committing to volume guarantees.

2. **Responsive Launch & Modularity:** Support mobile pads, rapid-integration vehicles and modular stages to enable on-demand missions for EO refresh, defence tasks and time-critical deployments.

3. **Fast-Track Clearances for Export & Launch: Enable coordinated, time-bound licensing and export clearances across IN-SPACe, DoS and MEA to reduce bid-to-launch timelines for commercial contracts.**

4. **Cost-Based Access to National Test & Range Assets: Provide transparent, cost-recovery access to ISRO test, integration and range infrastructure to avoid duplication and meet commercial cadence needs.**

5. **Unified Global Positioning: "Launch from India": Use IN-SPACe to lead market outreach, reliability disclosure, and partner-nation engagement to strengthen Indian launch presence in ASEAN, Africa and other friendly regions.**

6. **Standards, Safety & Qualification for Market Acceptance: Establish clear inspection, qualification and mission assurance norms to support export acceptance and reduce customer-side risk barriers.**

# Panel 04: Payload Pioneers: Showcasing India's Diverse Payload Manufacturing Ecosystem

**Chair:** Mr Ashish Mishra, Group Director, SAC
**Moderator:** Dr. Chaitanya Giri, Space and Emerging Tech Fellow ORF

**Panellists:**

- Mr Arup Banerjee, Founder and CEO, Spectragaze
- Mr Promod Kumar, SVP Engineering and Payloads, XDLinx Labs
- Mr Suyash Singh, Co-founder and CEO, Galaxeye
- Mr Ankit Bhateja, Founder and Director, Xovian Space
- Lt Col V Ramanathan VP - Strategic Liasion, KaleidEO


India's payload sector is transitioning from ISRO-led sensor heritage (≈100 EO sensors developed to date) to a multi-actor private payload ecosystem across EO, SAR, hyperspectral, RF, and multi-sensor configurations. Startups are engineering hybrid payloads (optical + SAR + thermal) to address India's persistent operational constraints such as cloud cover >70% during monsoon months, maritime haze, and high revisit needs.

A recurring structural barrier identified: over 65–75% of high-reliability payload parts — detectors, rad-hard processors, RF front-ends, MMICs, ROICs — remain imported, with zero-duty exemptions frequently delayed at customs due to classification ambiguity. Payload development cycles are often extended 4–6 months because of import-release lag, despite mission-critical timelines.

While ISRO retains detector leadership (30+ years), private attempts in onboard SDRs, SAR front-ends, and compact antennas are maturing but fragmented. The shift from payload manufacturing to full-stack insight systems was decisive: panelists warned that India may not suffer from "lack of sensors" but "lack of usable intelligence," unless compression, onboard processing, and fast ground analytics pipelines are executed as part of payload design.

# KEY RECOMMENDATIONS

1. **Accelerate Indigenous Detector & RF Manufacturing:** Prioritise domestic development of detectors, RF front ends, rad-hard compute and SAR electronics to reduce current **≈70% import dependence** and exposure to export controls.
2. **Uniform, Time-Bound Customs Treatment:** Implement a dedicated customs classification for space-grade hardware and enforce uniform zero-duty exemption handling to prevent 4–6 month delays in payload delivery cycles.
3. **Structured, Cost-Based Access to ISRO Qualification Assets:** Schedule and publish predictable utilisation windows for TVAC, EMI/EMC, antenna ranges and calibration labs on a fee-recovery basis to avoid duplication and accelerate commercial cadence.
4. **Design for Global South, Not Western Climates:** Prioritise payloads tuned for persistent **tropics + cloud + moisture + monsoon regimes,** enabling differentiated markets rather than replicating temperate-environment sensor architectures.
5. **Full-Stack Payload-to-Insight Integration:** Support ecosystems where payload builders also partner downstream for compression, onboard processing, latency reduction, automated analytics, bridging the current sensing–to–decision gap.
6. **Strategic Import Bridging:** Maintain controlled import dependence only until domestic detector and SAR fabs stabilise, with clear sunset horizons, preventing long-term lock-in.

# Panel 05: India and Italy's Expanding Space Synergy

**Panellists:**

- Ms Antonietta Baccanari, Italian Trade Commissioner, Embassy of Italy, New Delhi
- Mr Roberto Simonetti Spallotta, Chief Representative Officer, ELT Group
- Mr Roberto Pierdominici, MD, Leonardo Aerospace Defence and Security Pvt Ltd
- Mr Sergio Ledda, Scientific Attaché, Italian Embassy in New Delhi
- Mr Jai dalani, MD USA, Leaf Space


India–Italy space cooperation, built on 25+ years of collaboration, has entered a strategic expansion phase under the India–Italy Joint Strategic Action Plan 2025–2029, which formally elevates space, EO, security-grade payloads, lunar instrumentation, and hosted-payload cooperation. Italy brings a deep industrial and institutional base (Leonardo, ELT, research centres, test facilities), while India provides launch access, rapidly scaling commercial space, and a dynamic downstream/ground network.

Mutual alignment is clear: Italy's high-precision payload, sensor and test heritage + India's launch cost advantages, ground capacity and market scale. Speakers pointed to immediate opportunities in EO/climate payloads, hosted-payload access, lunar science, and interoperable ground/antenna networks, while highlighting cross-border frictions such as export licensing, classification, payment routing, dual-use compliance, and supplier accreditation.

## KEY RECOMMENDATIONS

1. **Convert Political Mandate into 2–3 Flagships:** Fast-track joint demonstrators (EO climate payload, hosted-payload slot, lunar instrument) with committed leads and schedules under the 2025–2029 plan.
2. **Structured Industry & B2B Roadmap:** Formalise upcoming delegations into targeted testbed tours, JV matchmaking, and outcomes tracking rather than solely courtesy visits.

3. **Standardised Hosted-Payload Framework:** Develop bilateral technical and contractual norms (mechanical fit, electrical interfaces, data, insurance, ITU/coordination) enabling plug-and-operate payload hosting.
4. **Secure Supply-Chain Accreditation:** Co-create a supplier validation process (cyber, export-control, IP, provenance) for dual-use space hardware to derisk co-manufacturing.
5. **Resolve Transaction Friction:** Use trade-promotion channels to stabilise LC/escrow norms, payment timing, insurance formats, reducing contract drop-off and bid withdrawals.
6. **Joint Regulatory Coordination Cell:** Establish a small India–Italy desk to align export/licence decisions, dual-use clauses, component routing and ground-data rules.
7. **Co-Develop Ground & Downstream Services:** Link Italian antenna/test facilities + European analytics with India's launch & operations networks to enable "design Europe – fly India – operate global".
8. **Build Bilateral R&D & Talent Tracks:** Launch joint PhD/postdoc exchanges and thematic CoEs focused on EO analytics, lunar ISRU, instruments, atomic clocks, GW sensing.

# Panel 06: Unlocking Bilateral Growth and Global Impact through WA–India Space Collaboration

**Panellists:**

- Dr. Ian Martinus, Investment and Trade Commissioner- India-Gulf, Invest and Trade Western Australia
- Mr Chris Cubbage, Editor in Chief, My Security Media
- Dr Vinod Kumar, Director Promotion Directorate, IN-SPACe
- Dr Siddharth Pandey , Deputy Projects Manager, Fugro SpAARC
- Mr Sireesh Pallikonda, VP- Business Development & Launch Services
- Mr Venkat Pillay, Co-founder, Latconnect60
- Mr Nathan Davis, Trade and Investment Commissioner, Austrade
- Dr Subba Rao Pavuluri, CMD, Ananth Technologies


The discussion positioned Western Australia (WA) and India as natural Indo-Pacific complements. WA brings southern-hemisphere ground coverage, deep-space antennas, radio astronomy quiet zones, mining/ocean data markets and flight-proven tracking capability. India offers launch access, satellite build scale, downstream analytics and a rapidly expanding commercial ecosystem enabled by IN-SPACe reforms.

Current cooperation already spans launches of Australian satellites from India, hosted payload talks, EO pilots for mining/ocean sectors, and talent exchanges. The shared goal now is to move from dialogue to time-bound anchor missions, interoperable ground/data infrastructure, and co-funded demonstrators that make WA–India a central Indo-Pacific space corridor.

## KEY RECOMMENDATIONS

1. **Execute 2 Anchor Missions:** Deliver two bilateral demonstrators (e.g., WA climate/mining payload + India launch, and a hosted sensor node) within 18–30 months to convert diplomatic goodwill into measurable commercial output.

2. **Integrate Ground & Deep-Space Coverage:** Link WA radio-quiet zones and deep-space antennas with Indian mission operations and NRSC/IN-SPACe networks to create a continuous Indo-Pacific tracking layer for launches, EO downlink and SDA.

3. **Standardise Hosted-Payload Interfaces:** Issue bilateral plug-and-operate norms covering mechanical fit, electrical power, thermal limits, encryption, and data APIs so payloads can be slotted without bespoke contracts or redesign cycles.

4. **Co-Design Market-Tied EO Offerings:** Build EO + ocean + mining data services around confirmed WA users (ports, LNG, mining, wildfire agencies) and Indian downstream analytics firms, replacing “image sales” with validated, high-value use cases.

5. **Co-Fund First-Orbit Demonstrators:** Establish a bilateral micro-pool (no new institution) to co-finance first payload flights, allowing private players to secure post-flight contracts faster and avoid the typical 18–24 month investor hesitation.

6. **Fast-Track Clearances & Payments:** Align export control forms, customs flags, encryption approvals and banking LC processes so payload movement, ground-link licensing and data-sharing timelines are predictable for joint missions.

7. **Joint Space-Domain Awareness Experiments:** Use WA vantage + Indian sensors for debris tracking, conjunction alerts, GNSS interference monitoring and shared orbital ephemeris datasets supporting Indo-Pacific SDA stability.

8. **Build Bilateral R&D & Talent Tracks:** Launch joint PhD/postdoc exchanges and thematic CoEs on EO analytics, deep-space comm, autonomy for lunar systems, and SDA algorithms to secure long-horizon workforce continuity.

# Panel 07: Integration of Space Products and Services with GeM

**Moderator:**

- AVM DV Khot, Director Strategy & Planning, INSPACe

**Panellists:**

- Mr Anagh Dutt, Director Category Management, GeM
- Col Alok Parashar, VP of Products (India) - Antaris Space, Chief Product Officer, Geminus Space
- Maj Gen Sanjeev Grover, Advisor, Elena Geo Systems
- Mr Amit Seymour, Director, Satpalda
- Mr John Saripally, Managing Director, Comsat Systems


As India's space ecosystem rapidly diversifies with startups, OEMs, and system integrators, the Government e-Marketplace (GeM) is emerging as a transformative procurement platform for public sector buyers. Now the world's second-largest public procurement platform after South Korea's Connex, GeM recorded transactions worth USD 65 billion (~₹5.4 lakh crore) in the last fiscal year, up from just ₹420 crore in FY 2016–17. Despite hosting over 25 lakh sellers, 11,000+ product categories, and 325+ services, space-related offerings remain scattered across multiple categories, reducing visibility and buyer engagement.

To address this, GeM has signed MoUs with IN-SPACe to create a dedicated "Space on GeM" page and with SIA-India to integrate geospatial solutions and ensure a level playing field for startups and SMEs. Initial actions include AI-assisted discovery, taxonomy redesign, and targeted government buyer training. The session underscored that with India's accelerating private-sector payload, EO and NTN-satcom capacity, GeM will become a key interface to create demand certainty and transparent procurement pathways for space solutions across ministries.

# KEY RECOMMENDATIONS

1. **Key Segment Buyer Groups Before Cataloguing:** Create distinct GeM sub-tracks for raw satellite data buyers, analytics/API platform users, and insights-only end-users to guide precise taxonomy and template design.
2. **Standardise EO & Space-Data Templates:** Issue model bid formats covering resolution class, revisit, cloud masking, latency and licence terms to simplify procurement of EO data and subscription-based services.
3. **Showcase Indigenous Space Offerings Prominently:** Add an "Indigenous Space Solutions" display layer to improve visibility of Indian payload, GNSS, satcom, EO and analytics firms without imposing preferential quotas.
4. **Embed Structured Technical Disclosures:** Mandate uniform listing fields for calibration accuracy, GNSS specifications, SDR parameters, antenna/RF stack configurations and imagery constraints aligned with IN-SPACe standards.
5. **Use PAC for Novel Space Products:** Allow first-of-its-kind space hardware and analytics systems to onboard via PAC routes where comparator OEMs are unavailable due to technology novelty.
6. **Co-Develop Specifications with IN-SPACe:** Run joint Consultative Committee Meetings (CCM) to define and maintain space product standards, preventing fragmented category creation.
7. **Enable Dynamic Category Refresh:** Permit time-bound category updates to accommodate evolving EO, NTNs, GNSS receivers and analytics models as market maturity increases.
8. **Train Non-Technical Government Buyers:** Deploy targeted space-procurement modules and AI-assisted discovery tools to reduce technical ambiguity in satellite and analytics listings.

# Panel 08: Commercialisation of EO Data: Unlocking New Revenue Streams

**Moderator:**

- Ms Annaya Narain, VP, GW Consulting

**Panellists:**

- Mr Vasudeva Rao Vemana, Head Pre-Sales, Planet Labs
- Mr Deepak Pareekh, Founder, HnyB Tech-Incubations Pvt. Ltd.
- Mr Árisz Kecskés, Head of Business development, 4iG Space and Defence Technologies
- Dr Debjyoti Pal, Senior VP, Galaxeye Space


The session explored the evolving EO ecosystem in India and its growing global relevance. Industry leaders, technology innovators, and policymakers discussed how EO capabilities are moving beyond traditional applications toward commercialization, user-driven solutions, and market expansion. The conversation highlighted the need for intuitive and easily deployable EO solutions tailored to the needs of the users, industry stakeholders, and policymakers. Panelists emphasized that EO's real value lies in insights, not just data, and solutions must be outcome-driven, cost-effective, and scalable. Public-Private Partnerships (PPPs) emerged as a key enabler for developing infrastructure, funding pilot projects, and fostering innovation while mitigating risks.

The session also underlined the importance of no-cost pilot programs to demonstrate value before monetization, helping to build trust and drive adoption among end-users. Additionally, the panel discussed technology integration—including AI, ML, and edge computing—for real-time analytics, as well as the role of policy frameworks in encouraging investment, ensuring data security, and facilitating international collaboration. The session concluded with a call for capacity building and domestic success stories to position India as a leading EO solutions provider for the Global South and international markets.

# KEY RECOMMENDATIONS

1. **Design EO for Outcome, Not Imagery:** Build farmer-centric and department-centric EO services with vernacular UX, low-friction onboarding, and "alerts not dashboards" models to drive adoption beyond technically skilled users.
2. **Deploy PPP EO Constellations with Anchor Use-Cases:** Use selective anchor ministries (agriculture, disaster, coastal) to validate PPP EO missions; replicate the Pixxel–Dhruva–PierSight–SatSure model for sovereign-grade capacity without full state ownership.
3. **Launch Structured No-Cost Demonstrators:** Conduct limited-duration, no-cost pilots with state agri departments and cooperatives (e.g., NAFED/NCCF/IFFCO) to prove utility before monetisation rather than indefinite freemium models.
4. **Shift to Insight-as-a-Service:** Transition from raw-data sale to APIs and recurring insights contracts tied to crop insurance triggers, flood alerts, encroachment maps and compliance reporting, not pixel delivery.
5. **Automate Analytics at Source:** Use edge+AI for low-latency crop, soil-moisture and disaster analytics; enable standardised EO → API → state dashboard delivery without manual post-processing cycles.
6. **Codify EO Procurement Formats:** Issue standard templates for EO licensing, cloud masking thresholds, revisit norms and derived-product pricing so ministries procure "flood model X / crop-health index Y" instead of ambiguous imagery.
7. **Build Bilateral EO Scaling Tracks:** Use India use-cases (crop-loss triggers, monsoon vulnerability, coastal erosion) as reference deployments for Global South markets under co-delivery frameworks.
8. **Expand EO Skills in Line Ministries:** Create targeted EO modules for extension officers, municipal planning, disaster rooms and agriculture insurance agencies so insights are operationally absorbed, not archived.
9. **Prioritise Risk & Food-Security Applications:** Channel EO commercialisation first to government-backed risk functions—crop risk scoring, reservoir forecasting, drought alerts—where demand is institutional and recurring.

# Panel 09: Fireside Chat with CEO ANRF

- **Dr. Shivkumar Kalyanaram**, CEO, Anusandhan National Research Foundation ANRF with **Mr. Anil Prakash**, Director General, SIA-India


Dr. Shivkumar outlined ANRF's mandate as India's statutory apex body for national research prioritisation and innovation coordination. Rather than replicating grant-making councils, ANRF is designed to (i) consolidate research direction across ministries, (ii) enable mission-driven, outcome-tied programmes, and (iii) co-fund academia–industry–startup consortia without becoming a perpetual financier. Its focus is on catalytic public investment that unlocks private R&D flows, particularly in deep-tech sectors such as space, semiconductors, climate analytics, and AI.

He emphasised enabling industry experts as co-PIs, templated co-funding to attract philanthropy and corporate R&D, interoperable IP norms, and outcome-linked disbursement models. ANRF's role is to convert research into measurable, deployable outputs while maintaining room for foundational science.

## KEY RECOMMENDATIONS

1. **Frame Clear Mission Briefs Before Funding Calls:** Publish concise mission notes with target outcomes, stakeholders, TRL expectations, and data-sharing norms to reduce ambiguity during evaluation.
2. **Enable Industry Co-PIs for Mission Grants:** Institutionalise honorary PI/co-PI roles for industry experts with lean compliance, ensuring consortia include academia, at least one MSME/startup, and a research lab.
3. **Deploy Standardised Co-Funding Templates:** Use predefined matching-fund formats to draw philanthropic capital, CSR-R&D and corporate labs into missions without prolonged negotiations.

4. **Launch Startup-Scale Track Within Missions:** Support TRL 3–6 prototypes with rapid-cycle challenge grants and clear pathways to departmental pilots once validation is achieved.
5. **Define Mission KPIs Upfront:** Track validated prototypes, patents filed, follow-on industry investment, and public-sector deployment rather than counting only academic outputs.
6. **Standardise IP & Data-Use Frameworks:** Issue interoperable IP rules covering licensing, sovereign use, open data release, and revenue-sharing to avoid case-by-case negotiation.
7. **Prioritise Cross-Ministerial Problem Statements:** Focus missions on challenges spanning multiple ministries (e.g., EO + agriculture risk + climate), reducing duplication across departments.
8. **Use Government as Demand Anchor Selectively:** Align successful mission outputs with limited deployment windows in line ministries as first customers, without guaranteed productisation commitments.
9. **Maintain Risk-Tolerance with Accountability:** Ring-fence a small portion of mission calls for high-risk/high-yield innovation with structured “lessons-learned” reporting rather than punitive evaluation.

# Keynote Address: Protecting and Improving the Critical Space Infrastructure

- **Speaker:** Christopher Macintosh, CEO, Methera Global


The talk focused on improving and protecting critical space infrastructure as satellites proliferate and Earth becomes ever more reliant on space services (PNT, communications, EO, weather, defense). The speaker argued the threat picture has shifted: satellites are now maneuverable and fuelled, debris is multiplying, and adversaries may seek to deny space services all of which raises the urgency for continuous custody, faster detection, and resilient communications.

To address this, the speaker described a layered technical approach built around a Medium-Earth Orbit (MEO) backbone a mesh of MEO satellites with optical inter-satellite links, edge AI/processing and Gen-2 storage to deliver persistent Space Domain Awareness (SDA), on-demand data-relay and dynamic broadband, plus hosted payload capacity. Key advantages of this architecture are reduced solar-exclusion blind spots, 24/7 custody of GEO/LEO assets, in-space processing to lower latency, and redundant routing that keeps missions operating through Earth-side outages or attacks. The speaker emphasised practical engineering (optical ISLs, hosted payload standards), security (encryption, protected links) and the business model of enabling other constellations to join the relay/network.

## KEY RECOMMENDATIONS

1. **Deploy MEO SDA Backbone:** Establish a medium-orbit mesh with optical ISLs to deliver persistent custody of LEO/GEO objects, enable crosslink relay, and reduce solar-exclusion blind spots.
2. **Adopt In-Orbit Edge Processing:** Prioritise onboard analytics (collision alerts, anomaly triage, cryptographic verification) to reduce downlink burden and improve reaction times during contested events.

3. **Multi-Path Relay Resilience:** Integrate multi-route routing (LEO → MEO → ground + crosslinks) to maintain continuity when ground stations, fibers, or regional gateways are compromised.
4. **Host-Payload Standards:** Issue common mechanical + data + security payload-hosting norms so third-party sensors can integrate without bespoke interfaces.
5. **Secure Optical ISLs :** Standardise optical ISL security modules with authenticated encryption and anti-spoofing protections for space-to-space and space-to-ground relay.
6. **Operator Integration Incentives:** Provide non-fiscal incentives (priority access, assured relay slots, sovereign service credits) for future GEO/LEO spacecraft to be "relay-ready."
7. **National Resilience Integration:** Treat SDA + relay capacity as critical infrastructure within contingency playbooks (satcom outage, conflict, orbital debris events, undersea-cable failure).
8. **Traffic Norms & Data Coordination:** Advance shared SDA data protocols with controlled access—not blanket sharing—to reduce misinterpretation and collision risk.
9. **Demonstration Missions First:** Sequence near-term hosted payload and SDA relay pilots to validate real-time custody, anomaly routing, and cross-operator plug-in services before scale-up.

# Pannel 10: Young Entrepreneurs Redefining Space

**Moderator:**

- Ms. Tanushri Joshi, Independent Space Lawyer and Business Consulting

**Panellists:**

- Mr Divyanshu Poddar, CEO, Rocketeers
- Mr Lokesh Kabdal, Co-founder & CEO, AeroDome Technologies.
- Mr Chiranjeevi Phanindra, Former Scientist ISRO and Founder, Cosmoserve Space
- Mr Suhas Gopinath, CEO, Globals Inc
- Mr Saurabh Kapil, Co-Founder & CEO, Biosky Space


The session brought together a dynamic panel of young founders who are shaping India's emerging space ecosystem through innovation, resilience, and bold vision. Speakers shared their journeys—from transitioning out of ISRO to building ventures in navigation, cybersecurity, and rocketry—highlighting how India's private space sector is maturing beyond traditional institutions. They emphasized the need to validate real-world problems early, strengthen industry–academia collaboration, and build globally competitive solutions from India. The discussion also addressed challenges faced by young entrepreneurs, including credibility barriers and the need to establish trust through demonstrable success. A recurring message was to "build from India for the world," underscoring confidence in the nation's capability to lead globally in the coming decade. The session concluded with calls for greater ecosystem support, inclusion of diverse founders, and integration of cybersecurity and indigenous technologies into future space infrastructure.

## KEY RECOMMENDATIONS

1. **Encourage Problem-Driven Innovation:** Promote early validation of real-world use cases and paying users to ensure that start-ups address tangible market needs rather than pursuing trend-based technologies.

2. **Strengthen Industry–Academia Collaboration:** Facilitate partnerships between start-ups, universities, and R&D institutions to accelerate deep-tech innovation and commercialization in areas like navigation, debris mitigation, and cybersecurity.

3. **Diversify the Entrepreneurial Base:** Move beyond the perception that only ex-ISRO scientists can establish space ventures. Encourage participation from multidisciplinary founders with expertise in technology, data, and systems engineering.

4. **Integrate Cybersecurity into Space Infrastructure:** Mandate cyber resilience and data protection frameworks across satellite systems, ground networks, and mission operations to safeguard national and commercial assets.

5. **Foster a Supportive Ecosystem for Young Innovators:** Strengthen mentorship, funding, and policy support for young entrepreneurs while dismantling credibility barriers and enabling trust through prototype demonstrations and pilot projects.

# Pannel 11: SATCOM & 5G/6G Integration: Enabling Telco-Satellite Partnerships

**Moderator:**

- Ms Grace Khanuja, Management & Strategy Consultant, Novaspace

**Panellists:**

- Mr Vikram Tiwathia, DDG, COAI
- Mr Manoj Gurnani, Chief Technology Officer & Head of Strategy, Nokia India
- Mr Vishal Mathur, Vishal Mathur Consultants LLP
- Mr Vinod Kaul, RVP - Asia (South /South East) Gilat Satellite Networks


This panel, “SATCOM & 5G/6G Integration: Enabling Telco-Satellite Partnerships,” at the Indian Space Congress Conference 2025, explored the critical convergence of satellite communication with 5G and future 6G networks in India. The discussion highlighted connectivity as essential infrastructure, especially for achieving digital equity in unserved and underserved regions. Key themes included leveraging satellites for ubiquitous coverage where terrestrial networks are economically and technically unviable, enhancing service reliability through satellite backup, and improving scalability by offloading traffic during peak hours

Significant challenges were identified such as security concerns regarding global satellite services, the need for investment incentives, device affordability for mass adoption, equitable opportunities for VSAT service providers, and efficient spectrum management. Technical integration also poses hurdles due to historical fragmentation between satellite and telecom standards, emphasizing the necessity for 3GPP Non-Terrestrial Network (NTN) standardization and multi-orbit network capabilities. The economic viability of satellite services in a price-sensitive market like India, given low data costs, was also a central point. The panel concluded that future competitive dynamics will favor collaboration, cooperation, and harmonization, leading to a seamlessly integrated terrestrial and non-terrestrial network in the 6G era.

# KEY RECOMMENDATIONS

1. **Recognise SATCOM as a Core Pillar of the 5G/6G Ecosystem:** Treat satellite communications as complementary not competitive to terrestrial networks for universal, reliable, and resilient connectivity across rural and remote regions.

2. **Establish a facilitating Licensing Framework:** Enable seamless integration between telcos and satellite operators through a regulatory structure that supports hybrid broadband, backhaul, and direct-to-device (D2D) services.

3. **Security & Legal Framework:** Develop clear policies for legal interception (LI) and the use of satellite phones in India to address security concerns.

4. **Accelerate Spectrum and Gateway Approvals:** Streamline approvals for spectrum allocation, landing rights, and gateway licensing to align with the rapid deployment cycles of modern satellite constellations.

5. **Adopt Global 3GPP and ITU Standards for Non-Terrestrial Networks (NTN):** Actively implement and promote 3GPP Release 17, 18, and 19 standards to ensure interoperability and a unified global ecosystem across terrestrial and satellite networks.

6. **Create Targeted Investment and Incentive Mechanism:** Introduce government-backed incentives, viability gap funding, and concessional financing models to attract private investment in satellite infrastructure for unserved and underserved areas.

7. **Enable a Level Playing Field for VSAT and Satellite Operators:** Allow existing VSAT and satellite service providers to compete equitably with telcos in offering broadband and Wi-Fi backhaul services across India.

8. **Multi-Orbit Capabilities:** Invest in and develop networks that seamlessly integrate GEO, MEO, and LEO satellite systems for redundancy, low latency, and efficiency across different service use cases.

9. **Device Affordability and Local Manufacturing:** Develop a domestic ecosystem of chipmakers, device manufacturers, and integrators to bring down the cost of satellite-enabled user equipment and terminals.

10. **Demand Aggregation:** Encourage collaboration between telcos and satellite operators to aggregate demand, making investments more attractive for serving rural and remote areas.

11. **Drive Ecosystem Collaboration and Interoperability:** Promote close cooperation across device, access, and backhaul layers to enable affordable, interoperable, and sustainable connectivity solutions.

12. **Enhance International Alignment and Standards Recognition:** Work with global regulators (ITU, FCC, Ofcom, IN-SPACe, ESA) to establish mutual recognition of standards, ensuring harmonisation, interoperability, and market access for Indian operators.

# Pannel 12: Disaster Resilience and Recovery through Space Capabilities

**Chair:**

- Mr. Safi Ahsan Rizvi, IPS, Advisor (Mitigation), NDMA

**Moderator:**

- Mr. Sanjay Kundu, Former DGP Himachal Pradesh

**Panellists:**

- Dr. S.P. Aggarwal, Director, NESAC
- Mr. Christopher McIntosh, CEO, Methera Global
- Mr. Paul Krzystoszek, Solutions Director – Government, Defence & Space (APAC), Intelsat
- Dr. Rajashekhar M, Scientist–SG / Chief Meteorologist, ISRO
- Mr. Rajashekhar N, DIG, BPR&D


The session highlighted how **EO, SATCOM and SATNAV** now form the backbone of India's disaster management cycle—from hazard mapping and early warnings to real-time response and recovery planning. Experts stressed that with intensifying climate events (floods, landslides, GLOFs, cyclones), India requires **continuous, integrated, multi-sensor situational awareness.**

EO satellites (including Cartosat-class high-resolution imagery) provide rapid flood mapping, landslide inventorying, and damage assessments. SATCOM ensures mission-critical connectivity when terrestrial systems fail vital for command, control, and coordination. SATNAV supports precise geolocation for rescue, drone deployment, and logistics.

Key gaps include inconsistent access to space-derived information at district levels, limited interferometric use for slope deformation, slow inter-agency data flow, and insufficient trained personnel. The panel emphasised the need for **impactful information delivery**, not just data availability. Emerging trends IoT-enabled sensor grids, AI/ML-based early warnings, InSAR deformation monitoring, drone–satellite fusion, and edge processing can significantly improve predictiveness and response time. The discussion underscored the importance of **pre-disaster mitigation**, public–private collaboration, and institutional mechanisms to ensure that critical insights reach administrators and first responders on time.

# KEY RECOMMENDATIONS

1. **National Multi-Sensor Disaster Intelligence Framework:** Integrate EO, SATCOM, SATNAV, drones, and IoT sensors into a unified NDMA-led operational stream, ensuring district-level authorities receive actionable, impact-ready insights not raw data.
2. **Mainstream Interferometry (InSAR) for Pre-Disaster Mitigation:** Deploy nationwide InSAR monitoring for slope deformation, land subsidence, and GLOF risks; establish state-level dashboards with auto-generated alerts for administrators.
3. **Guarantee Resilient SATCOM for Crisis Connectivity:** Pre-position SATCOM terminals for police, SDRF/NDRF, and district administrations to ensure communications continuity during terrestrial outages.
4. **Adopt Near Real-Time Analytics Using AI/Edge Processing:** Promote satellite-edge analytics for faster flood mapping, anomaly detection, and prioritisation, reducing reliance on large downlinks and speeding up decision cycles.
5. **Strengthen Inter-Agency Coordination and Training:** Institutionalise periodic joint training for civil administration, SDRF/NDRF, police, and line departments on interpreting EO/SATCOM/SATNAV outputs.
6. **Pilot Public–Private Demonstrators for High-Value Use Cases:** Co-develop demonstrators with industry for cloudburst monitoring, landslide risk scoring, rapid-damage analytics, and SATCOM-enabled emergency kits.
7. **Ensure Seamless Information Flow to the Last Mile:** Standardise SOPs to push early warnings directly to district magistrates, field officers, and community responders via multi-channel dissemination (satcom alerts, IVRS, mobile, radio).
8. **Institutionalise Pre-Disaster Funding and Preventive Action:** Allocate dedicated budgets for proactive mitigation (InSAR monitoring, infrastructure risk audits, early-warning upgrades) rather than focusing primarily on post-disaster compensation.

# Panel 12: Quantum Space: Secure, Precise, and Powerful

**Chair & Moderator :**

- Dr. N Ranjana, Outstanding Scientist and Director DFTM, DRDO

**Panellists:**

- Dr Anindita Banerjee, Senior Quantum Technologist , CDAC
- Ms Richa Hukumchand, Founder & CEO, Pramatra Space
- Mr Kannan K, Co-founder and CEO, AugSense Labs
- Dr Vishal Saraswat, Head Research and Innovation, Bosch Cybersecurity University (MS/ECL3)


The session explored **India's emerging quantum–space stack,** spanning quantum communication, post-quantum cryptography (PQC), quantum sensing, photonics, and secure systems engineering. Experts highlighted that **quantum communication** will be the earliest deployable capability—critical for national security as global systems transition to PQC by **2030–2035.**

India must prepare for a dual pathway of **PQC + QKD**, backed by indigenous algorithms, validation frameworks, and secure hardware. Quantum sensors were recognised as powerful dual-use tools for defence (underground detection, navigation), disaster management (landslides/GLOFs), and resource exploration.

Key bottlenecks include: slow project sanctioning for startups, fragmented R&D, limited chip-level testing infrastructure, talent shortages, and the "valley of death" between laboratory demonstrations and deployable systems. Photonics emerged as a strategic enabler for scalable quantum communication and sensing.

The discussion called for **cohesive public–private–academic collaboration,** agile funding, integrated testbeds, and open-access infrastructure to accelerate India's quantum readiness.

# KEY RECOMMENDATIONS

1. **Prioritise Quantum Communication for Near-Term Security Needs:** Accelerate QKD testbeds, trusted-node networks, space–ground trials, and PQC transition plans, recognising quantum communication as India's first deployable quantum capability.

2. **Develop Indigenous PQC Algorithms with Independent Validation:** Move beyond incremental variants and build sovereign PQC suites that undergo rigorous cryptanalytic testing; integrate PQC into national HPC systems and accelerator cards for secure, low-latency operation.

3. **Invest in Photonics Design & Manufacturing as a Strategic Industry:** Build domestic capability in photonic chips, modulators, and detectors that underpin QKD, quantum sensors, and high-speed PQC hardware—reducing import dependence

4. **Create a National Quantum Testbed Network with Open Access:** Establish shared photonics, cryogenic, and quantum-sensing labs accessible to startups, universities, and research groups to accelerate prototyping and validation.

5. **Introduce Agile Funding Mechanisms for Startups:** Adopt SBIR/STER-like fast-track funding, milestone-based grants, and iDEX-style challenge calls with guaranteed procurement pathways to overcome the "valley of death."

6. **Strengthen Industry Validation Pathways:** Mandate pilot deployments with government and strategic-sector users (defence, energy, mining, disaster organisations) so that startups gain technical validation and market traction.

7. **Advance Dual-Use Quantum Sensing Applications:** Support demonstrators in underground mapping, landmine detection, navigation without GPS, resource exploration, and medical sensing aligned with national security and civilian needs.

8. **Coordinate National Efforts through a Hub–and–Spoke Quantum Mission:** Consolidate fragmented R&D across DRDO, ISRO, CDAC, academia, and startups under an integrated mission mode, ensuring clarity of roles from TRL 1–6 (academia) to TRL 7+ (industry-led).

# Panel 13: Innovation Unites India and NSW (Australia)

**Moderator :**

- Malini Dutt, Trade & Investment Commissioner, NSW Government

**Panellists:**

- Nathan Davis, Trade Commissioner, Australian Trade Commission, India
- Rajat Kulshrestha, Co-Founder & Chief Executive Officer, Space Machines Company
- Dr. Vinod Kumar, Director, Promotion Directorate, IN-SPACe,
- Rakesh Bhan, Vice President & Head of Space Group, Tata Advanced Systems Limited
- Nanduru Sarath Chandra, DGM – Marketing, Contracts & Consortium Management, Aerospace Systems, L&T PES


This session underscored the growing India–NSW partnership across the space ecosystem, framed around shared Indo-Pacific priorities and complementary national strengths. NSW brings strong early-stage R&D, precision engineering, and a mature innovation environment, while India offers scale, manufacturing depth, spaceflight heritage, and a rapidly expanding commercial market.

The speakers emphasised the need for structured industry connection points, smoother regulatory pathways, and targeted collaboration models between Australian and Indian startups, corporations, and research institutions. Workforce development emerged as a critical enabler, alongside greater cross-utilisation of facilities—India's TRL 5–9 manufacturing and integration capabilities and Australia's southern-hemisphere ground infrastructure, testbeds, and R&D ecosystems. The panel also pointed to downstream opportunities in mining, energy, GIS, and analytics, and highlighted the Quad as a potential mechanism to reduce barriers for peaceful space technologies.

# KEY RECOMMENDATIONS

1. **Establish Bilateral Industry Access Points:** Create clear "front doors" for SMEs and startups through dedicated liaison desks or digital platforms in NSW and India to accelerate B2B matchmaking, regulatory navigation, and joint project formation.
2. **Build a Complementary TRL-to-Production Pipeline:** Leverage Australia's early-TRL R&D strengths and India's TRL 5–9 mass manufacturing and integration capability to create a seamless R&D–to–deployment pathway for missions, components, and space systems.
3. **Expand Joint Workforce & Education Programmes:** Launch bilateral training tracks, immersion programmes, internships, and industry-led vocational courses to build a job-ready talent pool across spacecraft engineering, integration, analytics, and operations.
4. **Use Quad Platforms to Reduce Trade Barriers:** Pursue a Quad-aligned "peaceful space technology corridor" that standardises licensing, reduces export bottlenecks, and simplifies cross-border movement of space hardware and data.
5. **Increase R&D Participation by Large Corporates:** Encourage Indian and Australian primes to invest in joint R&D with startups—drawing on models such as the ARC Training Centre—to accelerate innovation and de-risk commercial adoption.
6. **Enable Aerospace-to-Space Capability Transition:** Support aerospace firms in both countries to diversify into space manufacturing, subsystems, and testing by aligning standards, certification pathways, and co-development opportunities.
7. **Collaborate on Downstream Applications for Key Sectors:** Develop bilateral products in GIS, EO analytics, mining-tech, agriculture, maritime monitoring, and green data centres, where India's data-processing scale complements Australia's sectoral demand.
8. **Jointly Utilise Australia's Geographic Advantage:** Co-own or co-operate southern-hemisphere ground stations, EO calibration sites, and mission-support assets in NSW, paired with Indian launch and operations capability for integrated mission architectures.

# Panel 14: Direct-to-Device (D2D) and Machine-to-Machine (M2M) Satcom

**Moderator :**

- Dr Vijay Madan, Advisor and Mentor, TSDSI

**Panellists:**

- Mr Manmeet Singh, Sr. Director, Qualcomm
- Mr. Satrio Adiwicaksono, Director of Technology, PT Pasifik Satelit Nusantara (PSN)
- Mr Viabhav Magow, Vice President, International Division, Hughes Communication Pvt. Ltd.


The session examined how 3GPP-enabled D2D and M2M satellite communication is reshaping connectivity by merging satellite and terrestrial networks into a unified, interoperable system. With 3GPP Releases 17–19 defining NTN-NB-IoT, NR-NTN, and D2D specifications, satellite connectivity is transitioning from specialised hardware to mainstream consumer devices and IoT modules.

Panelists discussed the technical and commercial trade-offs between satellite-centric and device-centric architectures, especially around power, antenna gains, latency, and spectrum use. Monetization remains uncertain for operators due to CAPEX burdens and unclear business models for non-emergency use cases. Regulatory complexity—dynamic spectrum access, coexistence with mobile services, and global LEO footprints—was highlighted as a major barrier. Security, authentication, and seamless handover between satellite and terrestrial networks were emphasised as essential for user trust and adoption.

The discussion concluded that early markets will be logistics, maritime, agriculture, and emergency response, with mass adoption following once chipset costs decline and regulatory clarity improves. Ultimately, ubiquitous hybrid connectivity—where users and devices switch autonomously between terrestrial and satellite networks—was identified as the long-term target.

# KEY RECOMMENDATIONS

1. **Accelerate 3GPP-Aligned D2D/M2M Adoption:** Adopt 3GPP Release 17–19 NTN standards to enable interoperability, reduce device costs, and align India's ecosystem with global chipset and handset roadmaps.
2. **Prioritise High-Value Early Markets:** Focus initial deployments on logistics, disaster response, remote agriculture, maritime, and defence—segments where D2D/M2M delivers clear ROI despite higher early-stage costs.
3. **Develop a Unified Hybrid Connectivity Framework:** Enable seamless satellite–terrestrial handovers with common authentication, roaming, and security protocols to ensure users experience a single, continuous network.
4. **Establish Clear Spectrum & Regulatory Pathways:** Create guidelines for NTN spectrum sharing, global LEO footprints, and coexistence with terrestrial networks, coordinated through DoT, IN-SPACe, and WPC.
5. **Reduce Cost Barriers via Scale & Standardisation:** Support mass-market chipset ecosystems and encourage standard reference designs for antennas, terminals, and firmware to drive down CAPEX and device costs.
6. **Enable PP Partnerships for Rural & Social Use Cases:** Use PPP models to deploy D2D/M2M solutions for agriculture, disaster resilience, and public safety, where commercial models alone may not sustain early rollout.
7. **Build NTN Security & Resilience Standards:** Develop national guidelines for NTN encryption, gateway security, identity management, and lawful interception to ensure trust across critical and civilian applications.
8. **Leverage Existing IoT Frameworks as Transitional Pathways:** Promote LoRaWAN with satellite backhaul (S/L-band) as an immediate, low-cost route for rural IoT while planning for NB-IoT NTN once chipset prices fall.]
9. **Promote IP, Testing, and Certification Readiness:** Create a certification framework for D2D/M2M devices to avoid fragmentation, reduce interoperability issues, and protect against IPR disputes in emerging waveforms.
10. **Drive Towards Ubiquitous National Coverage:** Position D2D/M2M as part of India's last-mile connectivity architecture supporting national inclusion goals, emergency readiness, and resilient communication networks.

# Panel 15: EO and Digital Twins for Critical Infrastructure: Energy, Utilities and Smart Cities

**Moderator :**

- Captain Vishal Kawar (Retd), MD, PwC

**Panellists:**

- Mr Shailesh Gaur, Expert Digital Transformation
- Dr Shivangi Somvanshi,, Centre Head, CAG, CRDF, CEPT University
- Mr Deepak Tawri, CEO, Geminus Space
- Dr Manan Suri, Founder, Cyran AI
- Mr Nikhil Saraf, Lead Engineer, Lepton Softwar.


The panel examined the growing impact of Earth Observation (EO), geospatial analytics, and Digital Twins in strengthening India's critical infrastructure—urban systems, utilities, and smart cities. With EO already influencing 13+ SDGs, the speakers highlighted how data-driven governance is becoming foundational for climate resilience, urban planning, traffic management, and environmental monitoring.

Digital Twins emerged as a strategic enabler for evidence-based decision-making, capital expenditure optimisation, and "first-time-right" project execution. However, pervasive challenges remain: lack of authoritative and interoperable data, inconsistent standards across states, weak ground-segment automation, and limited accessibility for the private sector. The panel emphasised a shift toward user-centric, open, and integrated data ecosystems supported by AI/ML analytics, dynamic 3D simulation environments, and live urban intelligence systems. With India collecting vast datasets under national missions (AMRUT, Gati Shakti, Swamitva), the need for a unified data backbone and standardised digital-twin frameworks is urgent. Public participation and transparency were identified as critical for improving governance outcomes.

## KEY RECOMMENDATIONS

1. **Standardise EO & Digital Twin Frameworks for Urban Systems:** Create national standards for data ingestion, 3D city models, portal interfaces, and simulation workflows to prevent fragmented state implementations. Issue model agreements and PPP templates for co-developing urban analytics platforms, municipal Digital Twins, and infrastructure-monitoring solutions

2. **Build a Unified, Authoritative Public Data Layer:** Create an integrated national geospatial registry consolidating data from AMRUT, Gati Shakti, Swamitva, municipal systems, and utilities with APIs for controlled public and industry access.

3. **Strengthen Ground Segment Automation & Interoperability:** Develop common interfaces, vendor-neutral protocols, and automation tools for ground-station operations to handle the surge in satellites and real-time EO processing demands.

4. **Operationalise Digital Twins for Priority Urban Challenges:** Use EO-driven Digital Twins for encroachment detection, flood modelling, traffic optimisation, AQI monitoring, heat-island analysis, and municipal finance improvement.

5. **Enable Open Data & Developer Ecosystems:** Release non-PII, machine-readable datasets via open APIs (similar to Google Earth Engine) to stimulate downstream applications, SME innovation, and value-added services.

6. **Embed Transparency & Citizen Participation:** Publish city digital-twin dashboards for public visibility to drive accountability, participatory planning, and better governance outcomes.

7. **Accelerate Academia–User Collaboration & Skilling:** Promote direct collaboration between academia and end-users (municipal bodies, utilities, defence, disaster agencies) with faster funding cycles, smaller grant tranches, and mission-focused research.

8. **Support AI/ML, Edge Analytics & Real-Time Processing:** Invest in cloud-native EO platforms, automated change detection, predictive analytics, and edge-computing models to enable near-real-time urban intelligence.

9. **Expand EO Applications for National Resilience:** Prioritise EO-based solutions for flooding, landslides, urban heat, infrastructure risk, and climate adaptation across India's top metro clusters contributing 50% of GDP.

# Panel 16: Insurance and Space Venture

**Moderator :**

- Dr PK Jain, Director, IN-SPACe

**Panellists:**

- Mr. DS Govindrajan, Executive Board Member, SIA-India
- Dr. Ranjana Kaul, partner, Dua Associates
- Mr Nishith Mishra, Member, IISL, and Researcher, Faculty of Law, McGill University
- Mr Keyur Gandhi, Director - Space Regulatory & Policy, Dhruva Space
- Mr Harsh Thakker, Vice President, AAIRB


The panel underscored that as India's private space sector accelerates—with 250+ startups now active—insurance has become a foundational enabler for launch services, satellite operations, and emerging technologies such as OSAM and active debris removal. The conversation highlighted coverage gaps across the value chain (pre-launch → launch → in-orbit → third-party liability) and stressed the difficulty startups face due to high premiums and dependence on foreign reinsurers.

A core concern discussed was the a**bsolute and unlimited third-party liability** imposed by the international liability convention a structural risk that deters new entrants. With OSAM, ADR, and small-satellite constellations expanding, the panel noted that risk is becoming more frequent, more distributed, and more complex, requiring India to modernise its regulatory and insurance architecture.

India presently relies on international reinsurance markets; panellists argued for a domestic risk pool, better actuarial capacity, clearer rules from IN-SPACe, and promotional measures to support first-time missions. The conversation concluded that insurance cannot remain an afterthought it must evolve into a strategic pillar for national space competitiveness.

# KEY RECOMMENDATIONS

1. **Introduce Targeted Insurance Subsidies for Startups:** Support early-stage missions and tech demonstrators through partial premium subsidies or viability-gap funding to improve market entry for new operators.
2. **Establish a Domestic Space Reinsurance Pool:** Create an India-based reinsurance mechanism potentially with government participation to reduce reliance on foreign underwriters and retain premium flows within India.
3. **Mandate Third-Party Liability Insurance with Clear MPL Rules:** Implement compulsory third-party liability coverage for all space missions, supported by IN-SPACe-issued, standardised **Maximum Probable Loss (MPL)** assessment guidelines.
4. **Adopt an Indemnity Cap / Government Backstop Model:** Consider US–Australia style indemnification, where government assumes liability beyond a capped limit to protect private industry from catastrophic third-party claims.
5. **Develop an Indian Space Sustainability & Risk Rating Framework:** Create a national rating system that evaluates operator sustainability practices, enhances risk transparency, and supports insurers in accurate pricing.
6. **Streamline Insurance Procurement & Data-Sharing Protocols:** Define unified templates for sharing technical, test, and flight-heritage data with insurers while protecting IP—reducing delays caused by fragmented processes.
7. **Tailored Insurance Products for OSAM & Debris Removal:** Develop new policy instruments for high-risk, first-of-its-kind missions in OSAM/ADR, supported by a national white paper on liability and jurisdictional issues.
8. **Promote Continuous Dialogue Between Ecosystem Stakeholders:** Institutionalise periodic roundtables between industry, insurers, reinsurers, and government to refine regulatory frameworks and co-develop India's space insurance market.

# Panel 17: Indigenisation for Strategic Autonomy in Space

**Chair:**
- Lt Gen RS Reen, Director General, QA

**Panellists:**
- Air Marshal G. S Bedi (Retd)
- Dr Ram K Aluru, CEO, Onnes Cryogenics
- Mr Siddharth Abburi, Director – Business Development, Avantel
- Mr Tushar Jadhav, CEO, Manastu Space


This session examined India's urgent need to move from partial import dependence to full **strategic autonomy in space systems**, especially as private-sector participation accelerates. The Chair noted substantial gaps across the value chain from **radiation-hardened electronics and high-resolution sensors to space-grade materials and secure communication systems.**

India currently holds **~2% of the global space economy,** and projections indicate that **India's space economy could reach ~USD 44 billion by 2033,** driven by launcher growth, satellite manufacturing, downstream applications, and services. Achieving this growth requires reducing operational vulnerabilities caused by long import lead times, restricted component access, and foreign dependency in core technologies.

A key emphasis was the **non-outsourcable nature of Space Situational Awareness (SSA**) for defence. Effective SSA requires abundant domestic sensing assets, high-fidelity data processing, and the sovereign ability to act (including manoeuvre and counterspace preparedness).

Startups highlighted challenges such as:

- restricted access to materials (e.g., composites, carbon fibre, epoxies),
- long import cycles and customs delays,
- absence of domestic testing, certification, and environmental qualification facilities,
- procurement models unsuitable for rapid iteration, and

• the need for predictable demand from government users.

The panel converged on the need for a cohesive national strategy balancing **high-end flagship systems** with **scalable, low-cost constellations,** enabling domestic players to rapidly build flight heritage. Strategic autonomy must be achieved not only in hardware but also in algorithms, software-defined radios, propulsion, and secure communication stacks.

## KEY RECOMMENDATIONS

1. **Streamline Defence Procurement & Commit to Indian Industry:** Implement dynamic, multi-year acquisition policies with **guaranteed procurement pathways for indigenous technologies.** Remove impractical requirements (e.g., "three OEM rule") for novel or first-of-its-kind systems on GeM.

2. **Invest in Critical Component R&D & Domestic Manufacturing:** Prioritise indigenous development of cryocoolers, rad-hard electronics, high-performance composites, sensors, and secure communication modules. Establish national centres for **radiation testing, vacuum testing, EMI/EMC, materials qualification.**

3. **Foster Defence–ISRO–DRDO–Industry Collaboration:** Create joint development programmes across the full chain: **design → prototype → qualification → production.** Form secure supply-chain consortia for restricted technologies.

4. **Build Scalable Constellations & Low-Cost Platforms:** Adopt a dual approach for high-end systems for strategic intelligence, and large numbers of lower-cost satellites for tactical awareness and high revisit. This builds industrial capacity and accelerates startup growth.

5. **Strengthen Sovereign SSA Capabilities:** Expand indigenous SSA sensors (optical, radar, RF), onboard autonomy, and rapid-response capabilities. Integrate satellite, drone, and terrestrial sensors for unified situational awareness.

6. **Develop Clear Testing Standards & National Infrastructure Access:** Issue unified space-grade testing standards; create **shared, affordable national facilities** under a Lab Management System (LMS) with predictable access for startups and MSMEs.

7. **Address Material & Component Bottlenecks:** Prioritise domestic production of carbon fibre, special alloys, rad-hard chips, epoxies, and propulsion materials to reduce reliance on restricted imports.

8. **Adopt a Long-Term Strategic Vision:** Institutionalise joint doctrine development, long-horizon technology planning, and continuous co-development cycles between defence and industry.

# Panel 18: The Next Era of Space-Enabled Maritime Connectivity

**Chair & Moderator :**

- Mr. SC Ahluwalia, Frm DDG Satellite, DOT

**Panellists:**

- Mr. Kumar Sundaram, Sr. Project Manager Anglo Eastern Ship Management
- Mr Rajdeep Sinh Gohil, Director – Sales, AsiaSat
- Mr János Solymosi, BHE Bonn Hungary Electronics Kft.
- Mr. Ajay Jethwani, Vice President, Sales- India & Africa, ABS Global
- Mr N Jairam, Sr Director, Hughes Communication


The session examined how space-enabled connectivity is reshaping maritime operations across safety, logistics, offshore operations, smart ports, and crew welfare. With digitalisation accelerating across the global shipping industry, satellite communication has become indispensable—particularly as vessels move into areas with no terrestrial coverage.

A major highlight was the transformative shift from GEO-only services to **LEO-driven high-speed, low-latency connectivity,** enabling real-time data transfer, remote diagnostics, predictive maintenance, and enhanced operational efficiency. Hybrid multi-orbit architectures (LEO–MEO–GEO) were identified as essential for achieving uninterrupted global coverage, mitigating regional regulatory restrictions, and ensuring network resilience.

The discussion also underscored the importance of **crew welfare,** with affordable broadband emerging as a critical requirement for mental health, communication, and access to online learning. Hardware challenges were highlighted, especially the need for rugged, miniaturised, energy-efficient maritime terminals capable of withstanding harsh ocean environments.

Regulatory clarity and cost optimisation remain key issues, particularly for small fishing vessels and coastal users. Satellite IoT is expected to play a major role in

vessel tracking, safety, and compliance. Overall, the maritime sector is entering a new era where digitalisation, multi-orbit satcom, and regulatory support will define the future of maritime connectivity and operational excellence.

## KEY RECOMMENDATIONS

1. **Implement Hybrid Multi-Orbit Solutions:** Integrate LEO, MEO, and GEO satellite services to ensure seamless global coverage, address latency requirements, and mitigate regional restrictions, creating a robust and redundant communication network for vessels of all sizes.

2. **Prioritize Crew Welfare through Connectivity:** Leverage advanced satellite connectivity to provide affordable broadband access for seafarers, enabling video calls, online education, and entertainment, thereby improving morale and mental well-being on long voyages.

3. **Invest in Digitalization for Operational Efficiency:** Utilize high-bandwidth satellite communication to support real-time data transfer for remote monitoring, diagnostics, maintenance, and compliance, leading to significant cost savings, enhanced safety, and proactive issue resolution.

4. **Develop Region-Specific and Cost-Effective Solutions:** Tailor connectivity offerings to diverse maritime users, such as small fishing vessels, by providing cost-effective terminals and flexible service plans (e.g., satellite IoT for basic communication and tracking), while adhering to local regulatory compliance.

5. **Advance Hardware and Software for Harsh Environments:** Focus on developing miniaturized, energy-efficient, and highly reliable satellite communication equipment for both space and ground segments, capable of withstanding extreme marine conditions and offering remote reconfigurability.

6. **Foster Regulatory Support and Open Sky Policies:** Encourage governmental policies that facilitate direct access to quality satellite capacity for service providers, reducing operational costs and accelerating the adoption of advanced maritime communication technologies.

7. **Strengthen Maritime Safety & Domain Awareness:** Expand satellite-enabled AIS+, weather nowcasting, and emergency alerting to build continuous maritime domain awareness across coastal zones, shipping lanes, and EEZ operations.

8. **Enable Green Shipping & Compliance Monitoring:** Use satellite connectivity for real-time emissions reporting, fuel-efficiency analytics, hull monitoring, and regulatory compliance (IMO, GHG norms), supporting India's transition to cleaner maritime operations.

9. **Build Public–Private Maritime Connectivity Corridors:** Develop satellite-backed "connectivity corridors" for high-traffic and high-risk routes through PPP models, ensuring uninterrupted communications for logistics, port operations, and coastal security agencies.

# Panel 19: IMEC Corridor: The Future of Space-Enabled Trade & Logistics

**Chair:**

- Dr. Chaitanya Giri, Space and Emerging Tech Fellow ORF

**Panellists:**

- Fmr Amb Sushil Kr Singhal
- Mr Rohil Vashist, Head Legal, Adani Ports
- Mr Arpan Sahoo, COO – Co-Founder, Satsure
- Cmde Sujeet Samaddar, Visiting Fellow, RIS


This panel discussion explored the transformative potential of space-based technologies within the India-Middle East-Europe Economic Corridor (IMEC), drawing inspiration from India's Gati Shakti initiative. The panelists, including Dr. Chaitanya Giri (Moderator), Fmr Amb Sushil Kr Singhal, Mr. Rohil Vashist, Mr. Arpan Sahoo, and Cmde Sujeet Samaddar, deliberated on how integrated data, digital platforms, and real-time infrastructure mapping can enhance cross-border logistics, multimodal connectivity, and bottleneck resolution, positioning IMEC as a global trade game-changer.

The conversation highlighted the indispensability of space technology for such an ambitious intercontinental corridor, drawing parallels with China's "Space Silk Road." Key areas for space tech application include initial planning (route optimization, digital elevation models), implementation (efficiency in route designation, logistics optimization), and efficient operations (predictive maintenance, AI-driven analytics, instant weather forecasts for maritime routes). The discussion also acknowledged the significant challenges, including geopolitical volatility, the need for substantial investment (estimated at $600-$700 billion), and the vast data processing infrastructure required (exabyte scale). The importance of private sector participation, multilateral and bilateral agreements, and a central secretariat for coordination were emphasized to overcome these hurdles and unlock the corridor's full potential for economic growth and clean energy trade.

# KEY RECOMMENDATIONS

1. **Necessity of Space Technology:** IMEC cannot be conceived or executed without extensive use of space-based surveillance, analytics, and communication for planning, implementation, and operational efficiency across land and maritime segments.

2. **Comprehensive Data & Infrastructure:** Anticipate and invest in supercomputing capabilities and large data centers to manage the exabyte-scale data volumes generated by the corridor, particularly from drone and satellite imagery for infrastructure management and monitoring

3. **Phased Investment & Funding Models:** Differentiate investment strategies for upstream (government-financed), midstream (public-private mix), and downstream (private sector-led) space activities. Leverage Development Financial Institutions and Sovereign Wealth Funds with clear business cases.

4. **Strategic Route Optimization & Safety:** Utilize space tech for dynamic route optimization, right-of-way management, and real-time monitoring of safety and security, especially in less civilized land segments, to support emergency response and medical aid.

5. **Digitalization and Regulatory Harmonization:** Implement advanced digitalization, interoperability, and payment innovations (e.g., UPI model with UAE) to streamline transit, customs, and regulatory requirements across multiple countries.

6. **Addressing Geopolitical Volatility:** Acknowledge and strategize for geopolitical risks. While business is generally possible, companies must weigh commercial interests against potential political repercussions. Prioritize multilateral arrangements and bilateral agreements for “low-hanging fruit” and phased infrastructure development.

7. **Establish a Secretariat:** Create a central secretariat to guide the entire IMEC process, ensuring fine coordination among participating countries and facilitating the stitching together of standard bilateral agreements into a cohesive multilateral framework.

8. **Beyond IMEC - Dual Use Technologies:** Encourage the development of space technologies with multifarious applications beyond IMEC (e.g., NHAI’s space-based toll collection) to maximize return on investment and foster broader innovation.

9. **Risk Mitigation & Appetite:** Develop robust risk identification and mitigation strategies using space-based technologies for early warnings. Foster a culture of calculated risk-taking within Indian space companies to capitalize on immense opportunities in challenging environments.

10. **Holistic Development:** Recognize IMEC as a bundled project encompassing clean energy (especially green hydrogen), digital connectivity, and multimodal transport, fostering new industrial hubs and smart cities along its route.

# Panel 20: Sustainable Space Missions: Designs and Operations

**Chair & Moderator :**

- Mr Sudheer Kumar, Former Director, CBPO, ISRO

**Panellists:**

- Mr Tushar Jadhav, CEO, Manastu Space,
- Mr Sakthi Kumar, CEO, Orbitaid,
- Mr Vineel Judson, Founder, Taramandal
- Mr. Amer Al Sayegh, Assistant Director General, MBRSC

**Keynote Address:**

- Ms Aya Iwamoto, Director, Japan Space Policy, Astroscale


The session focused on the growing urgency of space sustainability such as orbital congestion, debris proliferation, and rapid satellite expansion reshape operational risks. Discussion centred on transitioning from single-use satellites to serviceable, refuellable, and responsibly de-orbited systems. Key themes included: enabling rendezvous and proximity operations for repair and debris removal; adopting green propulsion and safer materials; designing standardized docking interfaces; and promoting reusable re-entry technologies. The panel also highlighted persistent gaps industry hesitancy to invest in green propellants without assured demand, lack of standardized servicing interfaces, and limited regulatory enforcement globally. Emerging innovations showcased included water-based propulsion, compact debris-deorbit kits, modular docking rings, and heat-shield technologies for satellite recovery. Startups stressed challenges around technical maturity, testing access, and market creation for still-nascent sustainability services. The overall message: sustainability cannot be optional policy, regulation, and industry incentives must now embed it from design through end-of-life.

# KEY RECOMMENDATIONS

1. **Standardise Servicing Interfaces & Modular Satellite Designs:** Develop national and contribute to international standards for docking rings, refuelling ports, and modular bus architectures to enable life-extension, debris capture, on-orbit servicing, and cross-operator interoperability.

2. **Incentivise Green Propulsion & Cleaner Mission Architectures:** Create fiscal incentives (tax credits, procurement preference, viability-gap funding) to accelerate adoption of green propellants and low-toxicity materials. Mandate sustainability-by-design for government missions, including propulsion choices and end-of-life plans.

3. **Build Domestic Production Capacity for Green Propellants:** Support joint ISRO–industry programs for large-scale production of green propellants (e.g., high-grade $H_2O_2$, ADN blends), backed by long-term government demand commitments to de-risk private investments.

4. **Mandate Active De-Orbit Systems & Promote Reusability:** Require all satellites in Indian registry to incorporate reliable, verifiable de-orbit mechanisms (propulsive or passive), and incentivize reusable technologies such as heat shields, parachute-based recovery, and modular return capsules.

5. **Accelerate Testing Access for Sustainable Technologies:** Create a sustainability-focused testbed program offering fast-tracked booking, subsidised testing time, and shared qualification pipelines for new propulsion systems, docking mechanisms, sensors, and thermal protection technologies.

6. **Build a National Ecosystem for On-Orbit Services (OOS) & Debris Removal:** Support early demonstrators for in-orbit refuelling, tow-truck missions, and debris capture. Introduce regulatory pathways and indemnity structures for first-time OOS/ADR operations to reduce operator liability concerns.

7. **Establish End-of-Life (EOL) Compliance & Licensing Obligations:** Integrate enforceable sustainability requirements into licensing — including disposal orbit criteria, propellant margins for EOL manoeuvres, and verification of de-orbit plans. Draw from global models where regulators enforce safe disposal as a legal obligation.

8. **Launch Joint India–Global Sustainability Missions:** Promote bilateral/ multilateral test missions for refuelling, docking, and debris removal with partners like Japan, France, UAE, and EU agencies to accelerate standards, capability-building, and market development.

9. **Create a Sustainability Credit or Rating Framework:** Develop an Indian "Space Sustainability Rating" tied to licensing, insurance benefits, and procurement scoring to reward operators who adopt green propulsion, ADR capabilities, and compliant EOL behaviour.

10. **Support Startups Bridging Design–Manufacturing Gaps:** Establish structured collaboration channels between startups and large satellite manufacturers to integrate innovative technologies (docking interfaces, de-orbit kits, heat shields) into real missions with qualification and flight opportunities.

# Panel 21: US-India Space Roundtable Accelerating Innovation and Collaboration

**Panellists:**

- Mr. Anil Prakash, Director General, SIA-India
- Mr. Rahul Sharma, Managing Director, U.S.-India Business Council
- Dr. Vinod Kumar, Director, IN-SPACe [Invited]
- Ms. Carey Arun, U.S. Department of Commerce | International Trade Administration
- Santosh Tiwari, Director, APCO Worldwide
- Udaya Arun


The roundtable highlighted the growing strategic alignment between the US and India in commercial space, emphasizing the need to convert political goodwill under iCET and the US–India Trust Initiative into tangible industry outcomes. Discussions focused on unlocking co-development opportunities in satellite communications, component manufacturing, EO solutions, launch services, and dual-use technologies. A central theme was reducing regulatory friction particularly around licensing, export controls, market access, and technology transfer to enable smoother B2B partnerships. The launch of The Pathway to Trust report underscored the need for predictable policies, interoperable standards, and bilateral mechanisms to accelerate joint R&D, manufacturing, and supply-chain diversification. Panelists agreed that expanding India's global space share toward the 10% mark will require coordinated government support, streamlined processes, and deeper commercial integration with the US ecosystem.

## KEY RECOMMENDATIONS

1. **Demystify Cross-Border Regulations:** Create clear, streamlined, and easily navigable licensing and compliance pathways for commercial space activities, avoiding legal complexity and enabling faster market entry for companies in both countries.

2. **Distinguish Civil and Defense Space Regimes:** Establish explicit separation of civil space collaboration from defense-sensitive domains to prevent security-related restrictions from slowing down commercial cooperation and technology flow.

3. **Ease Market Access & Export Controls:** Strengthen G2G engagement to address export-controls, FDI rules, and technology-transfer barriers; develop reciprocal fast-track channels for components, software, and dual-use technologies.

4. **Expand Structured B2B Collaboration:** Institutionalize platforms for US–India company matchmaking, co-development projects, and joint solution-building, supported by trade agencies to resolve operational roadblocks quickly.

5. **Strengthen Government Support & Industrial Readiness:** Align central and state-level policies to enable scale-up in manufacturing, testing, and R&D infrastructure; support the Indian industry's ambition to expand its global space economy share.

6. **Continuously Update the "Pathway to Trust" Framework:** Use ongoing industry feedback to refine the report as a living policy tool, tracking friction points and co-designing solutions for satcom, geospatial, components, and launch ecosystems.

7. **Build Bilateral Supply-Chain Resilience:** Jointly identify critical components (chips, sensors, materials, RF systems) and create trusted supply-chain corridors to reduce overdependence on third countries.

8. **Advance Joint Standards & Interoperability:** Coordinate on standards for satcom, EO, manufacturing, and cybersecurity so that products and services are interoperable across markets, improving reliability and lowering adoption costs.

# Panel 22: Estimating India's Space Economy with IN-SPACe: Progress, Policy, and the Road Ahead

**Panellists:**

- Prof Vinay Kumar Dadhwal, NIAS
- Dr. Vinod Kumar, Director, IN-SPACe
- Mr Brijendra Singh, Deputy DG, National Accounts Division, MoSPI


The session focused on India's ongoing effort to define, measure, and track the national space economy, an essential prerequisite for effective policy, investment planning, and benchmarking global competitiveness. India currently accounts for **about 2% of the global space economy**, and policy initiatives under IN-SPACe aim to expand this to **USD 40–44 billion by 2033**, driven by private sector participation, commercialisation, and new demand pathways.

A major challenge discussed was the **absence of a standardized definition of the space economy,** making it difficult to isolate space-related activities embedded within broader GDP categories such as manufacturing, telecom, electronics, and geospatial services. IN-SPACe and the Ministry of Statistics & Programme Implementation (MoSPI) have constituted a **Joint Working Group** and developed a detailed survey instrument to collect company-level data across upstream, midstream, and downstream activities.

The purpose of this exercise is not merely academic, it is meant to **inform policy, guide investment decisions, enable targeted incentives, and track India's competitiveness** relative to global markets. The panel emphasized that indirect economic effects (productivity gains, spillovers, improved governance outcomes) are important but challenging to quantify, underscoring the need for robust, repeatable data-collection frameworks and sustained industry participation.

The discussion reaffirmed that **accurate measurement is foundational** to expanding adoption of space-based products and services across ministries, states, and strategic sectors, and for attracting private investment at scale.

# KEY RECOMMENDATIONS

1. **Define Clear Economic Boundaries for India's Space Sector:** Adopt a national definition of the space economy distinguishing **core, enabling**, and **derived-value** activities, aligned with OECD/ESA frameworks while tailored to India's ecosystem.

2. **Strengthen Primary Data Collection Through Industry Surveys:** Operationalize the IN-SPACe–MoSPI six-page survey across startups, MSMEs, OEMs, and downstream service providers to capture verifiable, company-level economic data.

3. **Improve Granularity in National Accounts:** Develop methodologies with MoSPI to d**isaggregate space-related value added** currently submerged in transport, telecom, electronics, and manufacturing GDP categories.

4. **Institutionalize the Joint Working Group Mechanism:** Continue structured collaboration between IN-SPACe, MoSPI, industry bodies (SIA-India), consultants, and think tanks to harmonize definitions, metrics, and analytical models.

5. **Support Investment Through Data-Backed Policy Design:** Use validated economic data to shape incentive schemes, procurement reforms, R&D programmes, and anchor-demand strategies necessary for reaching the **USD 40–44 billion aspiration.**

6. **Expand Adoption Across Ministries & States:** Design awareness and training programmes for central ministries, PSUs, and state governments to drive demand for EO, satcom, PNT, and geospatial services.

7. **Create Evidence-Based Performance Metrics:** Establish annual benchmarks covering private investment mobilised, exports, jobs created, downstream adoption, and comparison with OECD peers.

8. **Promote Transparency & Confidence for Investors:** Publish periodic "State of India's Space Economy" assessments to provide predictable, credible information for domestic and global investors evaluating India's market.

# Panel 23: National Framework for Space Sustainability

- Video Message from Ms Aarti Holla-Maini, Director, UNOOSA
- Dr. A K Anil Kumar, ISTRAC and ISRO's System for Safe and Sustainable Space Operations Management (IS4OM)
- Prof Dr Kai-Uwe Schrogl, President of the International Institute of Space Law (IISL) and Special Advisor for Political Affairs, European Space Agency (ESA)
- Dr Sudharshana Ramaraju, Founder, Nabhah Cosmos Foundation
- Dr. VS Hegde, Former Scientific Secretary, ISRO and CMD Antariksh
- Ms Aya Iwamoto,Director, Japan Space Policy, Astroscale
- Dr Bineesha P, ED, International Institute of Waste Management
- Mr Tanveer Ahmed, CTO, Digantara


The session examined the governance, technological, and policy imperatives for building a national framework for space sustainability amid rising congestion, debris proliferation, and megaconstellation growth. Speakers emphasized the gap between global acceptance of the UN Long-Term Sustainability (LTS) Guidelines and their limited on-ground implementation, calling for results-oriented national action.

India's leadership potential was highlighted—ISRO's **"Debris-Free Space Missions by 2030"**, IS4OM, and its heritage in responsible operations provide a strong baseline. However, panelists stressed that sustainability now requires active measures: proactive space traffic management (STM), national debris-monitoring networks, design-for-demise, post-mission disposal compliance, and the creation of early markets for on-orbit servicing and debris remediation.

International perspectives underscored growing momentum, such as ESA's **Zero Debris Charter** and Japan's structured regulatory frameworks for OOS/ADR. Industry voices pointed to the need for viable business models, standardised interfaces, and regulatory certainty before large-scale deployment. The panel noted that challenges resemble terrestrial waste-management problems—requiring economic incentives, clear accountability, and multi-stakeholder coordination.

# KEY RECOMMENDATIONS

1. **Systematic, Measurable Implementation of LTS Guidelines:** Move from voluntary adoption to **structured implementation plans**, with national standards, compliance checklists, and periodic reporting aligned with UN LTS and emerging ESA/Japan models.

2. **National Convergence on Space Sustainability:** Establish a unified national platform combining ISRO, IN-SPACe, armed forces, academia, and industry to coordinate debris mitigation, capacity building, and R&D similar to India's integrated missions in climate and disaster management.

3. **Build Indigenous SSA & Tracking Capabilities:** Prioritise investment in **ground-based optical networks, millimetre-wave radars, and space-based sensors,** and develop an **indigenous, transparent space-object catalogue** to support STM and policy enforcement.

4. **Accelerate ADR & OOS Ecosystem Development:** Support technology demonstrations, standard docking interfaces, and early procurement pathways to create a viable domestic market for debris removal and life-extension services.

5. **Proactive STM Regulations & Economic Instruments:** Draft a national STM framework addressing operator obligations, post-mission disposal, casualty-risk thresholds, and potential economic tools (e.g., orbital-use fees or insurance-linked incentives) to encourage responsible behaviour.

6. **Enforce Debris-Free Mission Commitments:** Operationalise ISRO's "Debris Free Space Missions by 2030" through mandatory design-for-demise, end-of-life passivation, and verified disposal timelines for all Indian-licensed missions.

7. **Address Emerging Sustainability Risks:** Plan ahead for issues such as **upper-atmosphere pollution from mass de-orbits, fuel residues, ISRU-derived debris,** and sustainability impacts of mega-constellations.

8. **Integrate Social Responsibility & Risk Communication:** Develop protocols for public communication, casualty-risk management, and ethical responsibility regarding re-entry debris and hazardous materials.

9. **Explore Civil Space Sustainability Authority:** Conduct feasibility studies for a national or regional civil body dedicated to sustainability distinguished from defence operations to coordinate STM, regulation, and international engagement.

10. **Promote Recycling & Safer Materials:** Encourage R&D on recycling of decommissioned components, safer materials, and reduction of toxic substances in spacecraft leveraging India's strong terrestrial recycling ecosystem.

# Panel 24: Empowering Command & Control Through Space

**Chair & Moderator :**

- Lt Gen PJS Pannu (Retd), Sr Advisor SIA-India and Fmr DCIDS (Ops)

**Panellists:**

- Air Cmde S P Singh (Retd)
- Mr Krishna Chandra, Chief Mentor and Head of Strategy, C2C Advanced Systems
- Mr Donald Chew, VP – Sales, Asia Pacific, Rivada Space Networks
- Mr Noel Ballot, EVP Sales & Marketing, Safran Data Systems


The session focused on how space-based technologies are transforming modern Command and Control (C2) systems across defense operations. Speakers emphasized that future military effectiveness depends on accurate sensing, assured communication, and multi-domain synchronization, with space serving as the backbone of secure and resilient decision-making. They discussed the growing need for low-latency networks, particularly through Low Earth Orbit (LEO) constellations, to ensure real-time coordination and data integrity. The discussion also highlighted the importance of sovereignty in communication networks, advocating for sovereign-by-design systems that maintain national control over data flows. Strengthening cybersecurity and adopting quantum-resilient frameworks were identified as key to ensuring operational trust and resilience. The panel further underscored the need for interoperability between indigenous and legacy systems, trustworthy supply chains, and standardization across C2 architectures. The session concluded that integrating space assets into command frameworks will enable faster decision cycles, enhance situational awareness, and ensure secure, autonomous defense capabilities aligned with national interests in an increasingly contested and interconnected space domain.

# KEY RECOMMENDATIONS

1. **Make Space the Core Backbone of India's C2 Architecture:** Prioritise sovereign satellite infrastructure ISR, SATCOM, PNT as the foundational layer for joint force C2, ensuring real-time sensing, assured communication, and multi-domain synchronisation.

2. **Build Sovereign, Low-Latency Defence Networks (LEO + Optical ISLs) :** Enable defence-grade LEO constellations with inter-satellite links to deliver ultra-low latency, bypass ground gateways, and ensure uninterrupted C2 during contested operations.

3. **Protect Data Sovereignty with Sovereign-by-Design Networks:** Ensure all mission-critical C2 traffic is routed, processed, and stored on domestic infrastructure with policy-driven pathways for coalition operations no foreign choke points in the data path.

4. **Establish Defence-Grade SSA:** Develop indigenous SSA for monitoring threats, manoeuvres, and co-orbital behaviour, with automated early-warning systems for protecting national defence satellites.

5. **Strengthen Cyber & Quantum Resilience of Space-C2 Systems:** Mandate quantum-resistant encryption, secure key management, and continuous cyber-monitoring across satellites, ground systems, and tactical terminals.

6. **Enforce Interoperability Standards Across Indigenous + Legacy Systems:** Define open, secure interface standards enabling seamless integration between Indian systems, imported platforms, and new space-based C2 layers.

7. **Compress the Defence OODA Loop Through Space-Enabled ISR Fusion:** Use fused ISR from EO, RF sensing, SIGINT, and LEO constellations to deliver real-time, verified targeting and decision support for high-speed operations.

8. **Modernise C2 for the Drone-Missile-Autonomy Era:** Integrate satellite-enabled control loops for UAV swarms, long-range precision missiles, and autonomous assetsensuring resilient command even in GNSS-denied or jammed environments.

9. **Build a Trusted, Traceable Defence Supply Chain for Space-C2 Hardware:** Mandate verification and certification of vendors, components, and firmware to eliminate hidden vulnerabilities and ensure secure implementation of C2

systems.

10. **Develop a Layered National C2 Architecture:** Create selective isolation for sovereign missions and flexible integration for coalition operations, allowing India to maintain independence while supporting partnerships.

# Panel 25: Cybersecurity for the New Space Age

**Chair & Moderator :**

- Shri Narendra Nath, Officiating DG, National Security Council Secretariat

**Special Guest:**

- Shri Anand Khare, Member Services, DCC, Ministry of Communications

**Panellists:**

- Lt Gen PJS Pannu (Retd), Sr Advisor SIA-India and Fmr DCIDS (Ops)
- Mr. VV Rao, Scientist, CERT-In
- Mr Bhupesh Janoti, Senior Manager, Business Transformation & Security, DSCI
- Mr. Rajsekhar Pullabhatla, Director, ISAC Foundation


The session explored the growing overlap between cyberspace and outer space, highlighting how modern satellites and ground systems, being software-driven and highly interconnected, are increasingly vulnerable to cyberattacks. Panelists emphasized that cybersecurity must be built into every stage of space mission development, from design to deployment, through a secure-by-design approach. They discussed the need for clear, practical, and adaptive regulations that safeguard national interests while still enabling innovation and private sector participation.

The conversation stressed the importance of developing sovereign digital infrastructure to ensure data protection and operational control within national boundaries. Strengthening cloud governance and ensuring accountability in incident response were also key priorities. The panel further underlined the urgency of building a skilled cybersecurity workforce, appointing strong leadership in every organization, and conducting regular risk assessments and security audits.

Collaboration among government bodies, industry associations, and research institutions was seen as essential for knowledge sharing and resilience building. Ultimately, the session concluded that a truly cyber-resilient space ecosystem can only emerge through continuous awareness, shared responsibility, and the integration of cybersecurity into the very fabric of India's expanding space enterprise.

# KEY RECOMMENDATIONS

1. **Integrate Cyber and Space Operations:** Cybersecurity should be an inseparable part of every space mission. Dedicated teams for cyber and space operations must work together to design systems that remain secure against evolving threats. This includes ensuring that all communication links, from satellites to ground systems, are monitored and protected in real time to prevent disruption or unauthorized access.

2. **Adopt Secure by Design Development:** Security should be embedded in the earliest stages of system development, not added later as a patch. This means identifying risks during design, conducting periodic audits, and following national cybersecurity frameworks to maintain system integrity throughout the mission lifecycle.

3. **Enable Balanced and Practical Regulation:** Regulatory frameworks should be transparent, supportive of innovation, and easy to follow. The goal is to promote growth while maintaining national security. Consultation between government, industry, and research institutions is crucial for setting realistic rules that foster confidence and efficiency.

4. **Strengthen Data Sovereignty and Infrastructure:** Sensitive mission data should be stored and processed within the country to maintain full control and reduce exposure to foreign interference. Building sovereign data centers and secure national networks will ensure that critical information remains protected and accessible during crises.

5. **Optimize Cloud Usage and Governance:** Cloud systems should only be used for non-critical tasks, while mission-sensitive data should remain within secure infrastructure. Space organizations must clearly define roles for incident management, cost control, and data recovery to prevent service interruptions and misuse.

6. **Build Leadership and Workforce Capacity:** Every organization in the space sector should appoint a Chief Information Security Officer to lead cybersecurity governance. Structured training programs, cyber simulations, and professional certifications should be established to develop experts in threat detection, forensic analysis, and incident management.

7. **Foster Sector Partnerships and Collaborative Frameworks:** Partnerships among industry associations, research institutions, and cybersecurity

agencies are essential for collective defense. Establishing formal collaboration frameworks ensures uniform training, certification, and access to reliable cyber advisories across the entire sector.

8. **Strengthen Hardware and Supply Chain Integrity:** Hardware components used in satellites and ground systems should be verified through strict testing and certification.

# Panel 26: Management and Air Defence through Space

**Chair & Moderator :**

- Lt Gen Dushyant Singh (Retd) Director General, Centre for Land Warfare Studies (CLAWS)
- Special Guest:

**Panellists:**

- Lt Gen AP Singh, Former, DG-AD
- Maj Gen Sanjeev Grover, Advisor, Elena Geo Systems
- AVM Rajiva Ranjan, Fmr ACIDS


The session explored how space technology is transforming national defense and air operations, emphasizing that outer space has become the new strategic high ground for secure communication, navigation, and intelligence gathering. Panelists highlighted that traditional air defense systems are increasingly inadequate against modern threats such as drones, hypersonic missiles, and swarm attacks. The discussion underscored the need for integrated, multi-layered air defense architectures that combine satellite networks, advanced sensors, and artificial intelligence to ensure faster detection and effective interception.

Speakers emphasized the growing role of collaboration between government agencies, defense organizations, and private industry in accelerating innovation and improving cost efficiency. Policy reforms and clearer governance structures were seen as vital for enabling rapid technology deployment and enhancing civil-military cooperation. The session also pointed out that future readiness will depend on developing quantum communication systems, resilient satellite-based networks, and GNSS-independent navigation to maintain operational security. Ultimately, panelists agreed that a space-enabled defense ecosystem, built on self-reliance, advanced technology, and public awareness, is essential for national resilience and strategic superiority in an increasingly contested space and air environment.

# KEY RECOMMENDATIONS

1. **Challenges in Air Defense:** Modern warfare demands an advanced, layered air defense system capable of countering emerging threats like drones, hypersonic missiles, and autonomous swarms. Integrating artificial intelligence, satellite-based detection, and real-time data analytics will allow faster responses and more accurate interception.

2. **Role of Space Technology in Defense:** Space assets such as satellites, high-altitude platforms, and near-space systems must be used together for comprehensive surveillance and target tracking. Continuous monitoring, even under harsh conditions, will strengthen early warning and defense readiness.

3. **Industry Collaboration:** Encouraging private sector participation will accelerate innovation in imaging, analytics, and radar technologies. Joint ventures and partnerships with national research organizations will enhance indigenous manufacturing, reduce dependency on imports, and strengthen overall capability.

4. **Operational and Tactical Considerations:** An integrated defense network linking space, air, and ground systems is vital. Data fusion from satellites, sensors, and drones should support faster decision-making. Enhanced situational awareness and accurate geospatial intelligence will give armed forces a tactical edge.

5. **Future Roadmap:** The long-term vision should focus on developing quantum communication, resilient data networks, independent navigation systems, and AI-driven command and control tools. Collaboration across research institutions, government bodies, and industry partners will drive innovation. Public awareness programs and early warning systems should also be expanded to ensure national resilience and security.

# Panel 27: Space Security is Integral to National Security

**Chair & Moderator :**

- Lt Gen V G Khandare (Retd), Fmr Principal Advisor, Ministry of Defence

**Panellists:**

- AVM Rajiva Ranjan, Fmr ACIDS
- Mr Sai Krishna, CEO, Saptang Labs
- Mr Pranav R Satyanath, Policy and Govt Relations, Dfy Graviti technologies
- Mr Arun Radhakrishnan, Chief Growth Officer, Inspecity Labs


The session highlighted that space is a critical pillar of national security, with applications far beyond the military, extending into economic, technological, energy, and environmental domains. Panelists stressed that resilience, redundancy, and entanglement are essential for safeguarding space assets against soft and hard attacks. Modernizing ISR, Satcom, GNSS, and weather satellites, along with developing modular small satellites, on-orbit servicing, and proximity operations, was identified as a strategic priority. Cybersecurity was deemed non-negotiable, with AI-enabled threat detection and industry-wide data sharing essential for collective defense. Public-private collaboration, supported by a unified National Space Security Strategy led by the MoD and Department of Space, will improve preparedness and integrated governance. Counter-drone measures and affordable indigenous solutions were recommended to address emerging threats. The panel also urged shifting disaster management from reactive relief to predictive strategies using satellite data and AI. Strengthening domestic expertise in space law and integrating space capabilities into governance, infrastructure, and environmental monitoring will maximize national growth. Overall, space's dual-use nature demands close cooperation between civilian, private, and military sectors to ensure resilience and strategic advantage.

# KEY RECOMMENDATIONS

1. **Space as a Critical National Security Domain:** Space is essential for national security across military and civilian sectors. Satellite-based geospatial imagery and intelligence support economic planning, resource monitoring, and strategic decision-making. Integrating space capabilities with private industry enhances resilience and drives technological advancement. A unified Space Security Strategy is vital.

2. **Role of Private Industry in Space Security:** Private sector involvement in space security must deepen, with cybersecurity treated as a strategic priority. Companies should share intelligence via platforms like Space Applications and Inspace, and support civil-military integration to create entanglement that complicates adversary targeting.

3. **Satellite Servicing and Proximity Operations:** To safeguard space assets, India should develop satellite servicing for fault repair and enable Rendezvous and Proximity operations. Deploying guardian modules—nano-satellites capable of defensive or offensive maneuvers can enhance deterrence and operational flexibility.

4. **Cybersecurity Integration:** Cyber threats to space infrastructure demand robust defenses. AI-enabled, rule-based systems can detect anomalies, and industry-wide data sharing is crucial for collective response. Cybersecurity must be embedded within the broader space strategy.

5. **Integration with National Growth:** Space capabilities should be harnessed for national development citizen mapping, river interlinking, infrastructure planning, traffic management, and climate monitoring. This integration can transform governance and enhance public services.

# Panel 28: Business Models & Opportunities in GSaaS Space-based Geospatial

**Moderator :**

- Ms Kriti Khatri, Dy Director, IN-SPACe

**Panellists:**

- Mr Keyur Gandhi, Director - Space Regulatory & Policy, Dhruva Space
- Mr Noel Ballot, EVP Sales & Marketing, Safran Data Systems
- Mr Adrian Sheils, Business Development Manager Asia , KSAT
- Mr Siddharth Abburi, Director – Business Development, Avantel


The session on “Business Models & Opportunities in GSaaS Space-based Geospatial” highlighted the evolving landscape of Ground Station as a Service (GSaaS) in India. The panelists addressed key challenges and proposed actionable solutions to unlock the sector’s potential. Regulatory uncertainty around spectrum allocation and licensing was identified as a major hurdle, with recommendations for liberalized policies and clearer guidelines from DoT and TRAI. To tackle high capital expenditure, shared infrastructure models like antenna farms and hosting-as-a-service were suggested to lower entry barriers for startups. Technological limitations of traditional ground stations were addressed through advanced antenna systems such as phased arrays and multi-mission antennas.

For data bottlenecks, integrating AI and edge computing at ground stations was proposed to enable faster, on-site processing. Security concerns were met with calls for end-to-end encryption, dedicated antennas for sensitive missions, and quantum encryption trials. While Inter-Satellite Links (ISL) pose a potential threat to GSaaS, panelists emphasized their complementary role rather than replacement. Lastly, spectrum coordination issues were to be resolved through policy alignment and integration of ground stations with data centers. Overall, the session underscored the need for innovation, collaboration, and regulatory clarity to drive growth in India’s GSaaS ecosystem.

# KEY RECOMMENDATIONS

1. **Regulatory Uncertainty:** To address unclear licensing and spectrum policies, the Telecom Regulatory Authority of India (TRAI) has issued recommendations, and the Department of Telecommunications (DoT) is working on norms. A liberalized policy framework and clearer guidelines developed through industry-government collaboration will streamline compliance and attract private and foreign investment.

2. **High Capital Expenditure (CapEx):** To reduce the financial burden of building ground stations, shared infrastructure models like antenna farms and hosting-as-a-service are recommended. These allow multiple operators to use common sites or rent antenna space, making entry more affordable for startups and smaller players.

3. **Technical Limitations of Ground Stations:** Advanced antenna technologies such as phased array antennas and multi-mission systems can overcome current limitations by enabling simultaneous satellite tracking and broader compatibility. Dual-band operations and optical links can also improve bandwidth and reliability.

4. **Data Handling Bottlenecks:** Integrating edge computing and AI into ground stations allows for real-time, on-site data processing. This reduces storage overload on satellites and speeds up decision-making for critical applications like defense, disaster response, and commercial analytics.

5. **Spectrum Coordination Issues:** Improved coordination among policymakers, telecom operators, and space industry stakeholders is needed to manage high-demand bands like Ka-band. Integrating ground stations with data centers can further optimize spectrum use and infrastructure efficiency.

# Panel 29: Strengthening the Supply Side of India's Space Ecosystem

**Moderator :**

- AVM Khot, Director Strategy & Planning, IN-SPACe

**Panellists:**

- Mr Achyut Chandra, Group Manager & Lead, GovTech Strategy and Open Innovation, HCL
- Mr Vinay Simha, CEO, Skyserve
- Mr Nanduru Sarath Chandra,DGM – Marketing, L&T PES


The session on "Strengthening the Supply Side of India's Space Ecosystem", focused on bridging gaps in India's space industry to meet rising demand. Panelists emphasized that low customer awareness is a major barrier, and IN-SPACe is addressing this through Space Applications Adoption Workshops and buyer–supplier forums. To tackle weak supply readiness, large firms like L&T and HCL are encouraged to support startups by sharing infrastructure and scaling production. Infrastructure gaps especially in data centers, GPUs, and chipsets can be addressed by leveraging public-sector assets and building state-level manufacturing clusters. The panel also highlighted a severe talent shortage, recommending tiered skilling programs from school to industry-linked graduate training. Startups often lack clarity on real-world use cases, so co-creation with government departments and open-source tools are vital. Fragmented data access was another concern, with a call to create a national digital public infrastructure for space data.

Finally, collaboration between large companies and startups was seen as essential, promoting a "survive together first, then compete" model. The session concluded with a clear roadmap: drive awareness, expand infrastructure, develop talent, unlock data, and foster collaboration to ensure India's space supply chain keeps pace with its growing ambitions.

# KEY RECOMMENDATIONS

1. **Weak Supply Readiness:** To meet growing demand, India must strengthen its supply chains for sensors, data systems, and devices. Large firms are encouraged to open their infrastructure to startups, enabling collaborative scaling and bridging capital gaps through shared facilities and mentorship.

2. **Infrastructure Gaps:** India needs to build indigenous capacity in data centers, GPUs, testing facilities, and chipsets. This can be achieved by repurposing underused public-sector assets, investing in state-level manufacturing clusters like Karnataka's 100-acre initiative, and partnering with electronics and semiconductor industries to reduce foreign dependency.

3. **Talent Shortage:** States like Karnataka are pioneering tiered skilling programs that begin with early awareness in schools, integrate space-related curricula in universities, and offer industry-linked training for graduates. Incentives for companies that upskill employees in space technologies will help build a future-ready workforce.

4. **Limited Understanding of Use Cases:** To ensure relevance, startups should co-create solutions with government departments. A growing repository of use cases such as those identified in Assam and Kerala can guide development. Promoting open-source tools and affordable applications will further broaden adoption across sectors.

5. **Fragmented Data Access:** India should establish a national digital public infrastructure for space data. This platform would offer standardized formats, accuracy benchmarks, and open access to critical datasets, empowering startups, SMEs, and research institutions to build and validate AI/ML models.

6. **Limited Collaboration:** Large companies and startups must move from siloed operations to a collaborative "umbrella" model. Large Industry leaders, can act as enablers by sharing infrastructure and expertise, fostering a "survive together first, then compete globally" mindset to strengthen the ecosystem.

# Panel 30: Space Bridges between India and Hungary

**Moderator :**

- Mr Zsigmond Perenyi, Inforter

**Panellists:**

- Mr Aron Selmeci, MANT, Hungarian Astronautical Society
- Mr Arisz Kecskes, 4iG
- Mr Jonas Solymosi, BHE-Bonn, Hungary
- Ms Kriti Khatri, Dy Director, IN-SPACe


The Hungarian–Indian panel at the Indian Space Congress 2025 focused on strengthening cooperation in space technology, defense innovation, and education between the two countries. Speakers highlighted that while India has a rapidly expanding private space sector and strong policy support, Hungary brings valuable expertise in electronics, power systems, materials, and satellite technologies.

The key challenges discussed included limited awareness between the two ecosystems, differing work approaches, and the absence of a structured framework for collaboration. Both sides emphasized the need to build trust, share knowledge, and promote direct engagement between startups, researchers, and government agencies.

Proposed solutions included forming joint working groups, organizing startup and academic exchange programs, and promoting bilateral missions under India's open space policy. Education and talent development were also identified as priorities, with recommendations for joint student projects and competitions. The panel concluded that sustained collaboration, early engagement, and mutual understanding can help both nations co-develop affordable and innovative space solutions while expanding their global presence in the space industry.

# KEY RECOMMENDATIONS

1. **Strengthening Collaboration Networks:** To enhance cooperation between India and Hungary, IN-SPACe may facilitate joint delegations, startup exchanges, and bilateral workshops connecting startups, researchers, and space organizations from both countries.

2. **Harmonizing Work Approaches:** Joint working groups and standardized project frameworks will be established to combine India's fast-paced innovation with Europe's structured execution methods, ensuring smoother collaboration.

3. **Creating a Formal Partnership Framework:** New agreements and memorandums of understanding (MoUs) will help promote co-production, technology sharing, and joint research in emerging space technologies.

4. **Fostering Education and Skill Development:** Both countries will collaborate on STEM initiatives such as student satellite projects, youth exchange programs, and competitions to strengthen technical education and create a future-ready workforce.

5. **Expanding Access to International Funding:** A trilateral cooperation model between India, Hungary, and the European Union will enable joint participation in research programs and access to EU-backed funding opportunities.

6. **Encouraging Knowledge Exchange and Market Awareness:** Dedicated investment and technology forums will highlight niche strengths on both sides ranging from data applications to satellite components encouraging cross-border partnerships.

7. **Simplifying Policy and Investment Processes:** Relaxed foreign investment rules and coordinated government support will make it easier for space startups and industries from both nations to collaborate and co-develop projects.

# Panel 31: Investing in India's Space Boom: Unlocking Opportunities for Global Players

**Moderator :**

- Mr. Rajesh Doshi, Managing Director, Steer Advisory

**Panellists:**

- Col Sarjeet Yadav, SM Retd, Venture Partner,, Mountech India
- Mr Akshant Johri, Asst GM (Transaction Advisory), IIFCL Projects
- Mr Girish, Exec Director and Fund Manager, Your Nest
- Mr Manan Anand, Investt Associate, GROWX


The session focused on the evolving investment landscape in India's space industry, highlighting how policy reforms and private participation are driving rapid growth. Speakers discussed how India has transitioned from a government-dominated ecosystem to one that welcomes private and international collaboration. The Indian Space Policy has opened opportunities for startups and mid-sized firms to enter both domestic and global markets, supported by new funding models and government-led initiatives.

Key challenges identified included limited early-stage financing, long technology development cycles, and risk aversion among investors. The panel emphasized that investors must balance innovation with realism, focusing on viable business models rather than purely experimental technologies. The discussion also underscored the importance of global partnerships, blended financing models, and technology transfer to strengthen India's capabilities.

Looking ahead, panelists highlighted the need to bridge gaps between venture capital, private equity, and debt funding; promote collaboration between the government and private sectors; and recognize space as critical infrastructure. Overall, the session concluded that sustained policy support, patient capital, and international cooperation will be vital to unlocking India's full potential in the global space economy.

# KEY RECOMMENDATIONS

1. **Boost Early Stage Funding:** To strengthen India's growing space startup ecosystem, the panel recommended establishing dedicated government-backed innovation funds that share financial risk with private investors. These funds can support proof of concept development, early testing, and market entry. Additionally, a blended financing model combining equity, grants, and soft loans can ensure startups have continuous support as they transition from idea to execution.

2. **Build Investor Awareness in Deep Tech:** Many investors in India are unfamiliar with the long development cycles and high entry costs of space ventures. The session suggested creating awareness programs and workshops to educate venture funds and institutional investors about the long-term profitability of deep tech. Establishing space-focused investment funds and co-investment platforms can also attract more patient capital into this sector.

3. **Encourage Technology Transfer and Local Manufacturing:** To reduce dependency on foreign technology, the panel encouraged joint development partnerships where foreign and Indian firms co-design and co-produce systems. Local manufacturing supported by technology transfer will not only strengthen India's self-reliance but also enable export opportunities for space-grade components and small satellite systems under the "Make in India" framework.

4. **Create Flexible Financial Instruments:** Traditional financing models do not suit long gestation space projects. The discussion proposed developing low-interest, long-duration loans and government-backed credit guarantees for viable projects. Mechanisms such as viability gap funding and deferred interest support can make it easier for startups and mid-sized firms to scale without facing liquidity challenges.

5. **Simplify Policies and Regulations:** Although India's space policy is progressive, bureaucratic hurdles often slow down execution. The panel recommended streamlined FDI norms, a single window clearance system, and faster turnaround times for approvals related to licensing, funding, and satellite launches. IN-SPACe can act as a central coordination body to make these processes transparent and efficient

# Panel 32: India's SATCOM Regulatory & Policy Landscape

**Chair :**
- Mr. H Rayappa, Director SATCOM PO, ISRO HQ

**Moderator :**
- Ms. Seema Jhingan, Partner, Lex Counsel

**Panellists:**
- Mr Rajiv Khattar, Consultrk Associates
- Mr Amritpal Singh, IP Star
- Mr Jitendra Ahuja, Head & Product Solutions, Nelco Limited


The session focused on India's evolving satellite communication (Satcom) policy and regulatory framework, which has transformed significantly since 2020. Panelists highlighted how government reforms, including the creation of IN-SPACe and the introduction of the Indian Space Policy 2023, have shifted the approach from control to enablement, allowing greater private participation and investment. Earlier, Satcom activities were primarily managed by government entities, but now private players can independently launch, operate, and lease satellite capacity, supported by transparent approval mechanisms and simplified FDI norms.

Experts discussed the challenges of building a sustainable business ecosystem, addressing long gestation periods, funding gaps, and limited domestic demand. They emphasized the need for infrastructure status for the space sector, which would ease financing and attract long-term investments. The session also stressed balancing national security with open market policies, improving spectrum allocation processes, and expanding government-supported projects to generate demand.

Overall, the discussion concluded that the reforms have created a solid foundation for India's Satcom growth, but continued efforts in policy clarity, demand generation, and risk management are essential to make the sector globally competitive and inclusive.

# KEY RECOMMENDATIONS

1. **Simplified Licensing and Regulatory Framework:** The government has introduced major reforms to make the satellite communication sector more open and accessible. Licensing procedures have been simplified, allowing private players to launch, operate, and lease satellite capacity with greater ease. The creation of IN-SPACe as a single window authority has streamlined coordination between government agencies and private companies, ensuring faster approvals and reducing bureaucratic delays. The new policy also permits full foreign direct investment, attracting global expertise and capital into India's space ecosystem.

2. **Government Support for Startups and Innovation:** To help startups overcome long development timelines and high entry costs, new initiatives now provide funding assistance, incubation support, and access to ISRO's testing and launch facilities. The government is also promoting public private partnerships to help small and medium enterprises scale up operations. Dedicated innovation programs and research grants are being launched to encourage new satellite applications, enhance indigenous manufacturing, and improve competitiveness.

3. **Expanding Domestic Market Demand:** Recognizing that the growth of Satcom depends on end-user adoption, the government is actively creating demand through national connectivity programs. Projects focused on rural internet coverage, disaster management, and digital inclusion are increasing the need for reliable satellite-based communication. Greater collaboration between ministries and private operators is being advanced to integrate Satcom services across agriculture, logistics, and defence networks, thereby generating predictable and sustainable demand for satellite communication capacity, distinct from Earth-observation data–driven use cases.

4. **Stronger Coordination and Risk Management:** To maintain operational safety and reliability, IN-SPACe and ISRO are establishing national monitoring and control centers for space traffic and frequency management. These centers will help track satellite activities, manage orbital slots, and address liability issues in a multi-operator environment. This system ensures accountability, minimizes operational risks, and promotes responsible space practices among all players.

5. **Efficient Spectrum and Frequency Allocation:** Improved spectrum coordination mechanisms have been introduced to ensure fair and efficient use of satellite frequencies. The Department of Telecommunications is working closely with IN-SPACe to streamline spectrum allocation and avoid interference between operators. Transparent auction and allocation processes are also being developed to support the rapid expansion of satellite broadband and data services across the country.

# Panel 33: Satcom's Role in Northeast India & Beyond

**Chair :**

- Shri PLN Raju, Special Secretary, Assam Govt.

**Panellists:**

- Mr Sushil Kumar, Former, Addl DG, North East, LSA
- Col Varun Tanwar (Retd), Head BD, Astrome


The session focused on the crucial role of satellite communication in connecting India's Northeast region, which continues to face challenges due to difficult terrain, limited infrastructure, and frequent natural disasters. Panelists highlighted that while projects under BharatNet and other government schemes have improved 4G coverage, several remote and border areas still lack connectivity, making satellite a "parallel mode of connectivity" vital for security, education, healthcare, and agriculture.

Speakers emphasized that integrating satellite and terrestrial networks is essential to create reliable communication systems, especially during floods or emergencies when fiber networks fail. The discussion also stressed the importance of developing local startup ecosystems, establishing more 5G innovation labs, and promoting public–private partnerships to accelerate regional development.

The panel concluded that tailored communication solutions, investment in resilient infrastructure, and policy support for satellite–terrestrial integration will ensure inclusive digital growth. With better collaboration between government, industry, and academia, the Northeast can emerge as a model for sustainable satellite-based connectivity that supports both social welfare and national security.

# KEY RECOMMENDATIONS

1. **Integration of Satellite and Terrestrial Networks:** Establishing seamless interoperability between ground-based mobile networks and satellite systems will ensure continuous connectivity in remote or disaster-affected regions. This hybrid model will allow users to switch between networks automatically, maintaining communication even when terrestrial infrastructure fails.

2. **Development of Localized Communication Infrastructure:** The Northeast requires customized, region-specific connectivity solutions rather than a one-size-fits-all approach. Small satellite terminals and portable antennas can provide coverage in remote valleys and mountainous areas where it is impractical to build traditional towers.

3. **Promotion of Public–Private Partnerships :** Collaboration between government agencies, research institutions, and private innovators will accelerate the deployment of satellite communication services. The government can fund essential infrastructure while private firms bring technology and implementation efficiency.

4. **Support for Education, Health, and Agriculture:** Satellite communication should be leveraged to strengthen telemedicine, e-learning, and smart agriculture programs. Remote hospitals and schools can be connected through satellite links, enabling real-time access to specialists, online classes, and weather-based agricultural advisories.

5. **Expansion of Startup Ecosystem and Innovation Labs:** Establishing more 5G and IoT innovation labs in universities across the Northeast will nurture local talent and create employment. Encouraging youth-led startups in communication technology will ensure that regional challenges are met with locally developed solutions.

6. **Resilient Communication Infrastructure for Disaster Management:** Satellite networks should be integrated into emergency response systems to maintain real-time coordination during floods, landslides, and other calamities. Rapid-deployment satellite terminals can restore communication within hours, saving lives and improving recovery operations.

7. **Policy and Standards for Interoperability:** Adopting global standards such as 3GPP Release 17, which supports integration between terrestrial and non-terrestrial networks, will help unify communication systems across agencies. This ensures smooth data transfer, improved connectivity, and better policy alignment for long-term growth.

# Panel 34: Building a Shared Future in Space with India

**Moderator:**

- Dr. VS Hegde, Former Scientific Secretary, ISRO and CMD Antariksh

**Panellists:**

- Dr Siriluk Prukpitikul, Ph.D., Deputy Executive Director, GISTDA
- Mr Champion Gautier, Deputy General Manager, CNES
- Dr. Robertus Heru Triharjanto, Chairman, Research Organization for Aeronautics and Space, ORPA, BRIN
- Mr Áron Selmeci deputy SG, MANT


The session focused on how India is fostering international collaboration to build a shared and inclusive future in space. The discussion emphasized India's growing leadership in global partnerships through its evolving space ecosystem and recent reforms that enable greater participation from private industries. Panelists discussed the importance of cooperation across upstream, downstream, and auxiliary sectors to advance technology, research, and policy development.

Key themes included the need for stronger international frameworks, enhanced data sharing, and greater involvement of private enterprises in joint missions. Delegates highlighted how collaboration in areas such as climate monitoring, disaster management, and satellite communication can promote mutual benefits and global sustainability. The session also underlined the importance of skill development, joint research initiatives, and standardized regulations to simplify cross-border cooperation.

In conclusion, the discussion reaffirmed that India's open policies, innovative approach, and readiness to share knowledge position it as a crucial partner in shaping the global space ecosystem. By integrating academic, industrial, and government efforts, India and its international collaborators aim to create a cooperative framework that drives long-term growth, resilience, and sustainability in the global space community.

# KEY RECOMMENDATIONS

1. **Develop Multi-Level Collaboration Frameworks:** Establish flexible cooperation mechanisms at government-to-government (G2G), business-to-business (B2B), and government-to-business (G2B) levels. This will make international partnerships more inclusive and efficient, allowing nations and industries to co-develop projects in areas such as climate monitoring, remote sensing, and disaster management.

2. **Encourage Joint Industrial Participation:** Integrate private industries and startups into global space missions by facilitating co-development of satellites, joint manufacturing, and shared payload design. This approach promotes technology exchange and strengthens industrial capacity across partner nations.

3. **Expand Training and Knowledge Exchange Programs:** Launch dedicated exchange initiatives to train scientists, engineers, and students through collaborative research projects and internships. Shared training programs will build skilled manpower and enhance mutual technical capabilities in emerging space economies.

4. **Establish Mutual Data-Sharing Agreements:** Create transparent mechanisms for sharing satellite, climate, and agricultural data among partner countries. Open access to such data will enhance research outcomes, improve disaster preparedness, and strengthen trust among collaborators.

5. **Adopt Standardized Policies and Model Contracts:** Develop common standards for licensing, project approval, and technology transfer to simplify collaboration. A uniform regulatory approach will encourage smoother cooperation and ensure mutual accountability in joint projects.

# Panel 35: Expanding Horizons for Global Partners in India's Commercial Space Sector

**Chair & Moderator:**

- Dr. VS Hegde, Former Scientific Secretary, ISRO and CMD Antariksh

**Panellists:**

- Dr Thierry E. Klein, President, Nokia Bell Labs Solutions
- Mr Jaime Solano, Business Development Manager, DHV Technology
- Mr Paul Krzystoszek, Solutions Director – Government, Defence, and Space (APAC) at Intelsat
- Mr. Rakesh Bhan, Head of Space manufacturing, TASL
- Mr Kunal Raina, Global Partnerships & Business, Axelspace Corporation


The session centered on India's rapidly evolving commercial space ecosystem and its growing potential for international collaboration. With the space sector now open to both domestic and foreign private industries, panelists emphasized that India is transitioning from a government-driven program to a globally connected commercial marketplace. The discussion highlighted how recent policy reforms and regulatory simplifications are attracting foreign investors, startups, and technology developers to partner with Indian entities across manufacturing, communication, and satellite services.

Speakers stressed the importance of creating long-term, stable policy frameworks that signal confidence to investors and encourage sustained participation in joint ventures. They emphasized the need for smoother supply chains, skill development programs, and transparent licensing mechanisms to support both startups and established industries. The discussion also underlined that global partnerships should focus on innovation, shared research, and co-development of new technologies rather than just service exchange.

In conclusion, the session reaffirmed that India's commercial space reforms, inclusive policies, and growing private capabilities are laying the foundation for a vibrant global partnership ecosystem. The panelists collectively envisioned India as a central hub for collaborative space innovation, manufacturing, and satellite-based services.

# KEY RECOMMENDATIONS

1. **Strengthen Public–Private Partnerships:** Encourage closer collaboration between government agencies, established private industries, and emerging startups to jointly design, develop, and implement space technologies. Such partnerships can help share financial and technical risks while accelerating innovation across launch services, satellite manufacturing, and data applications. By pooling expertise and resources, India can create a stronger innovation ecosystem capable of competing globally.

2. **Ensure Long-Term Policy Stability:** Provide clear, consistent, and long-term policy frameworks that allow private investors to plan confidently for large-scale projects. Stable government demand through procurement or anchor contracts can assure the private sector of sustained business opportunities. This long-term vision will also help align industrial and academic R&D with national priorities in communication, navigation, and earth observation.

3. **Simplify Regulatory and Licensing Frameworks:** Reduce bureaucratic delays and make approval processes—such as spectrum allocation, orbital slot coordination, and satellite launch licensing—more transparent and time-bound. A predictable regulatory environment will attract domestic and international players, encourage healthy competition, and speed up project execution.

4. **Facilitate Technology and Knowledge Exchange:** Encourage cross-border cooperation in component development, satellite subsystems, and research programs. Joint ventures and academic-industry collaborations can help transfer advanced know-how to Indian firms while enabling global partners to leverage India's cost-effective manufacturing capabilities. This exchange will also promote innovation tailored to emerging markets.

5. **Support Supply Chain Resilience and Skill Development:** Build a reliable domestic supply chain to reduce dependence on foreign vendors for critical components. Investment in local manufacturing clusters, testing facilities, and logistics networks will enhance India's self-reliance. Simultaneously, collaboration between academia and industry should focus on training engineers, technicians, and researchers with specialized space-sector skills to meet growing workforce demand.

# Panel 36: Data Fusion, AI, and Analytics: Turning Pixels into Profits

**Chair & Moderator:**

- Mr Manoj Chugh, Manoj Chugh Advisory

**Panellists:**

- Wg Cdr Srambikal Sudhakaran (Retd) CEO, QuGates Technologies
- Mr Dipyaman Banerjee, CEO, AI4ICPS, IIT Kharagpur
- Mr Vinay Simha, CEO, Skyserve
- Mr Árisz Kecskés, Head of Business Development, 4iG Space and Defence Technologies


The session explored how India can transform the massive volume of earth observation data collected by satellites into meaningful insights and commercially viable applications. Speakers highlighted that while hundreds of terabytes of data are captured daily, the true value lies in intelligent processing, data fusion, and real-time analytics rather than raw imagery. The discussion emphasized the growing importance of artificial intelligence, edge computing, multi-sensor integration, and automation in extracting actionable intelligence for sectors such as agriculture, disaster response, defense, and urban planning.

Panelists also noted that the definition and understanding of AI is often misunderstood, and stressed the need to move beyond simple predictive models toward more contextual, cognitive, and mission-aware systems. They discussed challenges related to data silos, space to ground latency, regulatory complexities, and the risks posed by over-reliance on foreign technologies. The panel underlined the urgency of building sovereign data capabilities, enabling on-orbit processing, and ensuring responsible AI development.

Overall, the session positioned India at a pivotal moment: with the right policy support, stronger R&D ecosystems, and coordinated government–industry collaboration, the country can lead in next-generation EO analytics, autonomous satellites, and value-driven geospatial applications.

# KEY RECOMMENDATIONS

1. **Promote Integrated Data Fusion Ecosystems :** Encourage collaboration across sensor types such as optical, radar, RF, and hyperspectral to eliminate fragmented data pipelines. Fused datasets provide richer insights for monitoring oceans, borders, infrastructure, and climate patterns. Creating unified platforms will enable users to access multi-sensor information seamlessly instead of purchasing disjointed data streams.

2. **Advance On Orbit Processing and Edge Compute Capabilities :** Support the development of satellites capable of processing imagery and signals onboard. This reduces bandwidth load, minimizes cloud cost, cuts latency, and provides users with ready-to-use intelligence rather than large raw datasets. On-orbit analytics will make EO solutions faster, more affordable, and scalable for global markets.

3. **Build Clear and Modern AI Frameworks:** Develop guidelines to distinguish between automation, machine learning, and higher-level AI systems. Better clarity on definitions and expected capabilities will prevent misuse of the term “AI,” support responsible deployment, and guide researchers toward cognitive, mission-aligned models instead of superficial predictive outputs.

4. **Strengthen National Data Sovereignty and Cyber Resilience:** Prioritize secure and sovereign data pipelines for EO, ensuring sensitive information is processed, stored, and trained within national boundaries. Reducing dependence on external platforms will protect India from intelligence leakage, manipulation, or foreign jurisdiction risks in critical sectors such as defense and governance. .

5. **Prepare for Ethical and Cognitive AI Systems :** Support research into cognitive intelligence and AGI-related concepts, acknowledging that future security and sovereignty will depend on mastering advanced AI rather than relying on foreign systems. India must build its own foundational capabilities to avoid strategic vulnerability

# Panel 37: Space-Based Bio-manufacturing: The Next Industrial Revolution?

**Moderator:**

- Dr Addanki Vamsi Krishna, Scientist, Department of Biotechnology

**Panellists:**

- Dr Shridhar Narayanan, Indian Pharmaceutical Alliance
- Dr Siddharth Pandey, Founder, Protoplanet
- Mr Rahul Shetty, Chief Business Development Officer, RSAT Labs
- Mr George Weinman, MD, Wei Li Capital


The session focused on how space-based bio-manufacturing and microgravity research can accelerate drug discovery, enable advanced biological production, and open new commercial opportunities for India. Speakers emphasized that microgravity conditions significantly improve protein crystallization, organoid development, cellular behavior studies, and materials formation, offering major advantages to the pharmaceutical, biotech, and medical research sectors. India has strong scientific capabilities, but access to orbital platforms, standardized payload systems, and rapid experiment turnaround remain major bottlenecks.

The discussion highlighted the growing need for co-funded programs between biotechnology and space agencies, as well as coordinated collaboration between government, industry, and startups. Panelists also noted that universities and research institutions require training, infrastructure, and hands on exposure to microgravity workflows to build a future ready workforce. There was consensus that building domestic manufacturing capabilities for payload hardware, establishing national testbeds, and expanding international partnerships will be critical to developing a globally competitive ecosystem.

Overall, the panel viewed space bio manufacturing as a transformative frontier for India. With sustained investment, regulatory clarity, and a strong innovation pipeline, the country can position itself as a leader in microgravity driven biotech research and advanced therapeutic development.

# KEY RECOMMENDATIONS

1. **Establish Joint Funding Programs Between Biotechnology and Space Agencies:** Encourage collaboration across sensor types such as optical, radar, RF, and hyperspectral to eliminate fragmented data pipelines. Fused datasets provide richer insights for monitoring oceans, borders, infrastructure, and climate patterns. Creating unified platforms will enable users to access multi-sensor information seamlessly instead of purchasing disjointed data streams.

2. **Expand Routine Access to Space with Faster Experiment Turnaround:** Enable more frequent launches, suborbital flights, and small free-flying platforms dedicated to biological research. Develop reliable sample return systems so experiments can be retrieved, analyzed, and iterated quickly. Reducing experiment cycles from years to months will make microgravity research practical for pharma and biotech applications.

3. **Standardize Payload Interfaces and Build National Ground Test Facilities:** Define common electrical, environmental, and data interfaces so experiment modules can be plugged into multiple spacecraft without redesign. Set up domestic testbeds for vibration, thermal vacuum, radiation, and automated culture systems to shorten qualification timelines and lower hardware development costs.

4. **Develop Contract Research and Accelerator Programs for Space Biology :** Support organizations that provide end-to-end services from experiment design and hardware integration to flight operations and post-flight analysis. Establish accelerator programs that offer mentorship, seed funding, and guaranteed flight opportunities to help startups scale validated technologies.

5. **Strengthen Education and Workforce Training in Microgravity Research :** Integrate space biology modules into engineering, life sciences, and applied research programs. Enable universities to access simulators, rotating bioreactors, and microgravity analog environments. Build specialized training tracks for technicians, payload operators, mission engineers, and biological data analysts.

6. **Promote Collaborative R&D Between Industry and Academia:** Encourage industry to define real-world problem statements—such as improved biologics stability, enhanced crystallization, or better cell growth models—and match them with academic researchers. Co-developed experiments will lead to commercially relevant outcomes and reduce the risk of isolated

research.

7. **Create Transparent Regulatory Pathways for Biological Payloads:** Develop predictable, single-window processes for biosafety approvals, payload clearances, transport of biological materials, and export permissions. Clear guidelines and timelines will allow startups and pharma companies to plan experiments more efficiently and reduce administrative uncertainty.

8. **Build Domestic Manufacturing Capabilities for Space Bio Hardware:** Support local production of microfluidic systems, culture chambers, sterile biocapsules, sensors, and environmental control units. Domestic manufacturing lowers costs, reduces dependence on imports, and enables rapid hardware iteration for frequent missions.

9. **Strengthen International Collaboration and Data Sharing:** Pursue partnerships with global space agencies, universities, and research consortia to access advanced platforms, share validated methodologies, and jointly develop high-value scientific missions. Standardized data formats and shared repositories will amplify research impact and accelerate scientific discovery.

10. **Encourage Outcome-Based Business Models:** Promote models where companies deliver validated insights, experiment kits, or high-value biological products rather than selling raw flight time. This approach will make the sector commercially viable and attract sustained private investment.

# Panel 38: Beyond Earth: Building the Outer Space Economy

**Moderator:**

- Dr. VS Hegde, Former Scientific Secretary, ISRO and CMD Antariksh

**Panellists:**

- Dr. Siddharth Pandey, Protoplanets
- Mr Arun Radhakrishnan, Chief Growth Officer, Inspecity Labs
- Mr. Rajat Kulshreshtha, CEO, Space Machines Company
- Dr. Ashok Saxena, CEO, Space TS
- Mr. Naresh Kannan, Business Development- Lead, OrbitAid


The session explored the emerging off-Earth economy and the technologies needed to build and sustain activity beyond low Earth orbit. Discussion focused on three interlocking themes: security and sustainment, and resource utilization. Panelists emphasized the growing role of in-orbit servicing, assembly manufacturing, and resource extraction for extending satellite life, enabling complex missions, and lowering long-term costs. Analogs and field testbeds were highlighted as vital for maturing robotics habitat life support and human factors before committing to lunar and planetary operations. Refueling, refabrication, and modular servicing architectures were presented as practical near-term steps that unlock further-term ambitions such as mining and habitats.

The panel also noted the importance of clear regulatory frameworks, coordinated policy incentives, and joint funding mechanisms to stimulate industrial investment. Finally, the conversation underscored that progress will require cross-sector collaboration between government research institutes, academia, and private firms, plus standards for interfaces and data sharing to scale a resilient and commercially viable deep space ecosystem.

# KEY RECOMMENDATIONS

1. **Establish a national roadmap for beyond Earth activity:** Create a clear strategic plan that sequences near-term infrastructure, such as servicing and refueling stations, then moves to assembly and resource utilization. A roadmap signals priorities to investors and aligns research portfolios.

2. **Fund joint research and demonstration programs:** Set up co-funded calls that require mixed teams from industry, academia, and government. Funded demonstrators should prioritize technology readiness for docking, refueling, robotics, and reentry return capsules.

3. **Prioritize in-orbit servicing and life extension capabilities:** Support development of docking interfaces, refueling adapters, and standardized servicing ports so operators can extend satellite lifetimes and reduce debris creation.

4. **Develop regional analog and test facilities:** Scale high-fidelity analog sites and robotics yards to validate hardware and operations in relevant terrestrial environments. Make testbeds accessible to startups, universities, and mission teams.

5. **Create interoperable technical standards and interfaces:** Define common mechanical, electrical, and communications interfaces for servicing mobility and payload modules to enable multiple vendors and lower integration risk.

6. **Design regulatory and commercial incentives for sustainability:** Introduce procurement signals, tax credits, or matched funding for missions that adopt life extension servicing or debris mitigation. Clarify export controls and licensing for servicing activities.

7. **Build workforce pathways and cross-disciplinary training:** Launch education tracks, internships, and exchange programs focused on robotics, human factors, life support, and mission operations to grow the talent pool fast.

8. **Support small-scale operational pilot projects**: Fund outcome-oriented pilots that show immediate value, such as on-orbit inspection mission life extension demonstrations and small-scale resource processing proofs of concept.

9. **Coordinate international norms and liability frameworks:** Engage in multilateral dialogues to develop norms for resource use, traffic management, and liability so commercial activity can scale with legal certainty.

# RECOMMENDATIONS

## STRATEGIC RECOMMENDATIONS FOR STRENGTHENING INDIA'S SPACE ECOSYSTEM

| Strategic Bucket | Issue / Gap Identified | Key Recommendations |
|---|---|---|
| Recognising Space as Critical National Infrastructure | Space systems today underpin telecommunications, financial networks, disaster response, transportation, energy, and digital governance. Their disruption has economy-wide consequences. | • Notify Space and Satellite Infrastructure as Critical Infrastructure, with the National Critical Information Infrastructure Protection Centre (NCIIPC) under MeitY, in coordination with DoT, DoS and MHA, formally extending critical-infrastructure protections to space systems so that priority protection, resilience planning, and time-sensitive clearances become standard practice.<br>• Include Space and Satellite Infrastructure in the Harmonised Master List of Infrastructure, with the Ministry of Finance (DEA/DFS) recognising space infrastructure alongside other core sectors to unlock long-tenor institutional finance and reduce the cost of capital for capital-intensive space investments.<br>• Integrate satellite systems into national infrastructure resilience and contingency frameworks, with NDMA and MHA working alongside DoS and DoT to ensure satellite networks are embedded within disaster preparedness, continuity planning, and national resilience strategies.<br>• Recognise SDA/SSA and PNT resilience as components of national infrastructure protection, with DoS, the Defence Space Agency and the National Security Council Secretariat incorporating space situational awareness and navigation resilience into broader national security and infrastructure protection frameworks. |

| Strategic Bucket | Issue / Gap Identified | Key Recommendations |
|---|---|---|
| Regulatory Coherence, Predictability & Legal Certainty | Fragmented regulatory processes, evolving policy frameworks, and absence of statutory clarity create approval uncertainty and increase compliance and transaction costs for space activities. | • Establish a digitally integrated single-window clearance system, with IN-SPACe anchoring the interface and coordinating with DoT and DoS, so that mission authorisations, satcom licences, gateway approvals, and hosted payload clearances move through a predictable and transparent regulatory pathway.<br>• Issue a unified national regulatory framework for satcom, NTN, D2D, and satellite IoT services, with DoT in coordination with IN-SPACe and DoS clarifying landing rights, gateway norms, lawful interception, and cross-border data flows to reduce regulatory ambiguity for operators.<br>• Introduce clearly defined regulatory timelines for mission approvals and service licences, with IN-SPACe and DoT adopting time-bound processing norms that improve investor certainty and reduce project delays.<br>• Align customs and trade classifications for civil space items with updated HSN, SAC, and SCOMET frameworks, with CBIC and DGFT working alongside DoS to minimise classification disputes and customs delays for legitimate civil space imports and exports. |

| Strategic Bucket | Issue / Gap Identified | Key Recommendations |
|---|---|---|
| | | • Clearly demarcate civil-commercial and defence space activities within licensing and compliance frameworks, with DoS and MoD establishing separate but coordinated regulatory tracks to avoid compliance overlap and approval uncertainty.<br>• Progress toward a comprehensive Space Activities Act, with DoS leading inter-ministerial consultations with the Ministry of Law & Justice to provide statutory clarity on liability, insurance, intellectual property, and regulatory powers in the space sector.<br>• Develop clearer national frameworks for liability attribution in multi-party and hosted-payload missions to reduce ambiguity in incident scenarios.<br>• Embed debris mitigation, end-of-life disposal, and sustainability compliance into licensing conditions, with IN-SPACe integrating these requirements into mission authorisations so that sustainability becomes a baseline regulatory expectation rather than a voluntary commitment. |

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| Sovereign Capability & Industrial Self-Reliance | India's space sector continues to face high import dependence in mission-critical subsystems, limited domestic depth in space-grade manufacturing, and constrained access to qualification infrastructure, creating supply-chain vulnerabilities and strategic exposure in a sector that underpins national security, connectivity, and economic resilience. | Prioritise Mission-Critical Technology Sovereignty in strategically sensitive and high-dependency areas such as rad-hard electronics, detectors, RF systems, propulsion subsystems, photonics, and space-grade materials, with DoS and MeitY aligning national R&D priorities and funding support toward these segments.<br><br>Create National Space Manufacturing & Qualification Ecosystems<br><br>• Develop dedicated space manufacturing clusters supported by DPIIT and state governments, with shared access to testing, qualification, and certification infrastructure so that industry can meet space reliability standards domestically rather than relying on overseas validation.<br><br>• Expand Structured Industry Access to ISRO/DoS Infrastructure<br><br>• Enable predictable, fee-based access for private industry and MSMEs to ISRO and DoS testing, environmental qualification, and reliability facilities so that national infrastructure serves as a capacity multiplier for the ecosystem. |

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| | | • Use Targeted and Time-Bound Incentives for Strategic Components<br><br>• Introduce milestone-linked and sunset-bound incentives for import-dependent components through DPIIT and Ministry of Finance frameworks, ensuring support is targeted, performance-linked, and fiscally prudent.<br><br>• Rationalise Duties for Non-Substitutable Imports<br><br>• Undertake periodic review by the Ministry of Finance and CBIC to rationalise duties and IGST on components with no viable domestic substitutes so that indigenisation goals do not inadvertently raise system-level costs.<br><br>• Adopt Calibrated Import-Bridging with Clear Indigenisation Roadmaps<br><br>• Allow controlled import-bridging for critical subsystems, with DoS and DGFT linking approvals to defined indigenisation timelines and technology absorption pathways.<br><br>• Promote Trusted International Co-Development<br><br>• Encourage technology partnerships and joint development with trusted international partners where they strengthen domestic capability, accelerate learning curves, and support integration into global value chains without creating structural dependency. |

# RECOMMENDATIONS

## STRATEGIC RECOMMENDATIONS FOR STRENGTHENING INDIA'S SPACE ECOSYSTEM

| Strategic Bucket | Issue / Gap Identified | Key Recommendations |
|---|---|---|
| Satellite Manufacturing | High import dependence; certification bottlenecks | • Prioritise indigenous development of space-grade electronics, RF components, sensors, propulsion subsystems, and optical payload materials<br>• Establish dedicated space component manufacturing clusters with shared testing, qualification, and certification infrastructure<br>• Need for a space-specific PLI or milestone-based manufacturing incentive scheme focused on import-dependent components<br>• Enable structured access for private industry and MSMEs to ISRO/DoS qualification, environmental testing, and reliability facilities<br>• Streamline customs and clearance procedures, and rationalise duties and IGST for components with no domestic substitutes<br>• Promote co-development, JVs, and technology partnerships with trusted international suppliers<br>• Introduce controlled import-bridging mechanisms with defined sunset clauses<br>• Support MSME participation through bonded warehousing, common facilities, and export readiness |

| Strategic Bucket | Issue / Gap Identified | Key Recommendations |
|---|---|---|
| Launch | Limited flight heritage for private players | • Use government anchor payloads and missions to provide initial flight heritage and credibility for private launch vehicles<br>• Institutionalise a government-backed anchor customer programme for early commercial launch services<br>• Provide time-bound and predictable launch authorisation and range-clearance timelines for private launch operators<br>• Streamline export clearances and diplomatic approvals for commercial launch services to international customers<br>• Enable and encourage rideshare and demonstration missions for private launch vehicles using government and institutional payloads<br>• Support flight-proven validation through national missions and technology demonstrators prior to full commercial operations<br>• Establish clear policies for foreign customer payload launches from India, including export control and liability clarity |

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|---|---|---|
| Satellite Manufacturing | High import dependence; certification bottlenecks | • Prioritise indigenous development of space-grade electronics, RF components, sensors, propulsion subsystems, and optical payload materials<br>• Establish dedicated space component manufacturing clusters with shared testing, qualification, and certification infrastructure<br>• Need for a space-specific PLI or milestone-based manufacturing incentive scheme focused on import-dependent components<br>• Enable structured access for private industry and MSMEs to ISRO/DoS qualification, environmental testing, and reliability facilities<br>• Streamline customs and clearance procedures, and rationalise duties and IGST for components with no domestic substitutes<br>• Promote co-development, JVs, and technology partnerships with trusted international suppliers<br>• Introduce controlled import-bridging mechanisms with defined sunset clauses<br>• Support MSME participation through bonded warehousing, common facilities, and export readiness |

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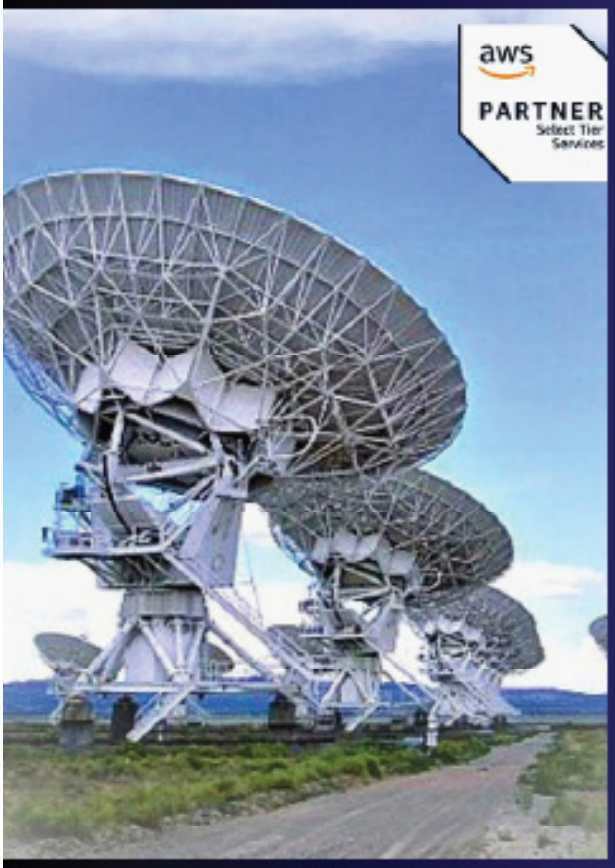


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# Message from the DG's Desk

It is with immense pride and gratitude that I reflect on the success of the India Space Congress 2025. This edition marked a significant step forward in consolidating India's position as a global force in space innovation, commercialisation, and international cooperation. What made ISC 2025 truly special was not only the quality of discussions or the strategic outcomes achieved—but the spirit of collaboration that brought them to life.

On behalf of SIA-India, I extend my heartfelt thanks to our Esteemed Guests of Honour, VIPs, and all distinguished speakers, who shared invaluable perspectives that shaped the discourse throughout the three days. My sincere appreciation goes to the delegates, students, and international country partners—including Australia (NSW and WA), Italy, Hungary, UAE, Singapore, Norway, the United States, and more—for their active participation and enduring partnerships.

We are especially grateful to our sponsors and industry partners—whose belief in this platform fuels our collective ambition. I would like to acknowledge our MoU partners, Knowledge partners, Exposition Partners, and the dedicated teams that made the Congress operationally seamless. Your support makes this ecosystem possible.

A special note of appreciation goes to our institutional collaborators, including IN-SPACe, ISRO, DRDO, MoD, MEA, DPIIT, MoSPI, ICMR, and our academic and research allies such as IIT Kharagpur, NIAS, ANRF, and many others who contributed rich knowledge and thought leadership.
Finally, I thank the entire SIA-India team and our strategic media and outreach partners for their tireless efforts behind the scenes. Together, we have set a new benchmark for multi-stakeholder dialogue in the space sector.

As we carry forward the momentum of ISC 2025, we remain committed to building a globally respected, innovation-driven, and industry-led space ecosystem for India.

With gratitude and determination

Mr Anil Prakash, Director General, SIA-India

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