



INDIAN DEFSPACE SYMPOSIUM 2025

7th-9th April 2025

Manohar Parrikar Institute for
Defense Studies and Analyses
(MP-IDSA), New Delhi



**Air Chief Marshal
VR Chaudhari (Retd)**
PVSM AVSM VM
Former Chief of Air Staff



**Lt Gen
NS Raja Subramani**
PVSM AVSM SM VSM
Vice Chief of Army Staff



General Anil Chauhan
PVSM UYSM AVSM SM VSM
Chief of Defence Staff



**Vice Admiral
SN Ghormade**
PVSM, AVSM, NM (Retd.)
Former Vice Chief of the
Naval Staff, Indian Navy



**Air Marshal
SP Dharkar (Retd)**
PVSM AVSM SM VSM
Vice Chief of Air Staff

Technical Report prepared and Compiled By



TECHNICAL REPORT





OVERVIEW

The ISpA Indian DefSpace Symposium 2025 is a premier forum dedicated to strengthening India's defence space ecosystem. It brings together global experts, policymakers, and industry leaders to explore technological advancements, geopolitical challenges, and strategic collaborations shaping the future of defence space capabilities.

THEME

The theme of the symposium "Securing the Space Domain: Collaboration, Capabilities and Strategic Vision" explores enhancing the potential of space capabilities to bolster national security. The Symposium aims to forge a path towards a secure and collaborative future in the critical space domain.

KEY HIGHLIGHTS



500+
Participants



20+
Exhibition



60+
Stalls



100+
Speakers
Organizations

NEED FOR NEXT-GENERATION DEFENCE SPACE ASSETS

1. Secure Space Dominance – Ensuring military superiority in space operations.
2. Resilient ISR Capabilities – Enhancing intelligence, surveillance, and reconnaissance.
3. Rapid Response Mechanisms – Strengthening counter-space and deterrence strategies.
4. Advanced Cybersecurity – Safeguarding space assets from cyber threats.
5. Global Strategic Alliances – Strengthening international collaborations in space defence

WHAT WAS GAINED

- Gained strategic insights
- Engaged with global leaders
- Explored cutting edge tech
- Network with key stakeholders
- Shape defence space policies
- Discover collaboration opportunities



AGENDA

DAY 01	Theme: "Strengthening India’s Space Defence Foundations"
09:00–09:45 hrs	Registration and Networking Tea
09:45–10:45 hrs	Inaugural Session
10:45–12:15 hrs	Session 1: “Space Threat Analysis: Adversaries Space Capabilities and Consequent Geopolitical Threats”
12:15–12:45 hrs	Lunch Break
12:45–14:45 hrs	Session 2: “Communications: Ensuring Secure and Resilient Defence Networks”
14:45–15:00 hrs	Networking Tea
1500–1600 hrs	Exhibition Visit and Networking
1600–1730 hrs	Session 3: “Beyond the Horizon: Space-Based ISR for Multi-Domain Operations”

DAY 02	Theme: “Indigenous Development and Global Competitiveness”
09:00–09:45 hrs	Opening Session
09:45–10:45 hrs	Session 4: “Mission DefSpace Update: Progress, Challenges and Future Roadmap”
11:00–12:30 hrs	Session 5: “International Cooperation in Defence Space”
12:30–13:00 hrs	Lunch Break
13:00–15:00 hrs	Session 6: “Space Domain Awareness: Strengthening India’s Strategic Edge”
15:00–16:00 hrs	Session 7: “Advanced Technologies and Sensor Ecosystem: Driving Future Space Operations”
16:00–16:45 hrs	Exhibition Visit and Networking Tea
16:45–17:45 hrs	Session 8: “Propulsion & Launch Vehicles: Advancing India’s Space Capabilities”



DAY 03	Theme: “Advancing Space Security and Strategic Capabilities”
09:30–10:00 hrs	Opening Session
10:00–11:00 hrs	Dedicated Industry Session by MAXAR Technologies
11:00–12:45 hrs	Panel Address: “Cyber Security in Space Operations”
12:45–14:00 hrs	Lunch Break
14:00–15:00 hrs	Special Address: “Quantum Communication Technology”
15:00–15:30 hrs	Presentation on Strategic Projects in IAF 2024
15:30–16:30 hrs	Session 9: “Leadership Doctrine in the Age of AI: India’s Strategic Sovereignty in Space, Defence, and Economic Corridors”
16:30–17:00 hrs	Closing Remarks

PLATINUM SPONSORS



DAY 01 | THEME: "STRENGTHENING INDIA'S SPACE DEFENCE FOUNDATIONS"

INAUGURAL SESSION



Opening Address by Mr Jayant Patil, Chairman ISpA:



Delivering the welcome address at the **Indian DefSpace Symposium**, **Shri Jayant Patil** highlighted that **India's space sector stands at a pivotal inflection point**, with the defence industry playing an increasingly strategic role in shaping its future trajectory. He emphasized that **with the government's ambitious plan to launch over 52 dedicated military satellites and a growing thrust on private participation**, India is steadily building a secure and

self-reliant ("Atmanirbhar") space ecosystem, ready to confront emerging strategic challenges head-on. Shri Patil spoke with pride about **India's indigenous technological accomplishments**, including communication and surveillance satellites, jammers, and tracking radars—testaments to the capability and maturity of the Indian space industry. He stressed that **future progress lies in deeper collaboration between public and private sectors**, which will be essential to accelerate innovation and enhance national security through space.

He also painted a vibrant vision for the future, where **India's private space startups are rising independently**, often without substantial external funding, and generating their own sponsorships and support. This entrepreneurial spirit, he noted, is a cornerstone of the Atmanirbhar Bharat initiative in the space and defence sectors. Shri Patil referred to the **75 technology challenges identified by the Ministry of Defence**, underscoring the importance of developing **communication services, navigation systems**, and other mission-critical technologies through indigenous efforts. He also mentioned the **SPS (Space-Based Services) programme**, stressing



the importance of **absolute transparency and accountability** in national security applications.

Reflecting on India's position in the global space race, he pointed out that **space is the ultimate equalizer**—a domain where India, with its scientific talent, technological capabilities, and visionary leadership, holds a unique opportunity to leapfrog and shape the future of global space defence strategies. He concluded by addressing the pressing need for a **unified space defence ecosystem**, calling for synergy among stakeholders, including the armed forces, private industry, research institutions, and international allies. While reforms such as the establishment of the Defence Space Agency (DSA) and the evolution of New Space India Limited (NSIL) mark critical milestones, **India must continuously innovate, adapt, and collaborate** to assert global leadership in the space domain. Finally, Shri Patil invoked the guiding principle that **space should ultimately serve the public good, while ensuring robust defence mechanisms to secure national interests in the space domain**.

**Address by Chief Guest: General Anil Chauhan
PVSM UYSM AVSM SM VSM, Chief of Defence
Staff, Indian Armed Forces**

General Anil Chauhan PVSM UYSM AVSM SM VSM, Chief of Defence Staff, Indian Armed Forces, underscored the growing strategic importance of space in national defence and the broader geopolitical landscape. He reflected on how conversations around space, the cosmos, and cosmology continue to inspire, as seen in cultural

narratives such as Star Trek and Interstellar. While these portrayals captivate the imagination, he emphasized that the true significance of space lies in its critical role in national security and technological advancement.

Tracing the evolution of the symposium, General Chauhan recalled how the inaugural edition focused on enhancing warfighting capabilities via space-based systems, while the second explored the armed forces' vision for the future of warfare in space. **He invoked India's ancient connection with the cosmos, referencing the philosophical concept of Brahmand—the universe—as explored by Indian sages, which resonates with modern theories such as the Big Bang and the expanding universe.** He expressed concern over the fading of this once-vibrant "space culture."

Drawing historical parallels, General Chauhan compared today's space dominance to the maritime supremacy of nations like Portugal, Spain, and England, and later the aerospace leadership of countries like the United States. India, he asserted, must now work to cultivate a robust space-oriented ecosystem—spanning academic institutions, journals, societies, and educational programs—to foster "space thinking" across all sectors, especially the defence forces.

He stressed that while science fiction envisions distant interstellar travel, the military's immediate focus should remain on Earth's orbital zones—LEO, MEO, GEO, and cislunar space—likened to territorial





waters in maritime doctrine. Strengthening capabilities and securing these zones is vital for developing space-based doctrines and strategies, especially in light of global advances in space warfare, including the formation of aerospace forces and on-orbit maneuvers by adversaries.

General Chauhan emphasized the need for a comprehensive understanding of satellite functions, orbital dynamics, and threat perception for effective military use of space. He highlighted significant reforms in recent years, including the establishment of the Defence Space Agency (DSA) in 2018, NewSpace India Limited (NSIL) in 2019, the liberalization of the space sector in 2020, the creation of IN-SPACe in 2021, and the Indian Space Policy of 2023. These, along with relaxed FDI norms, are laying the foundation for India's rise as a space power and a global investment hub.

Looking ahead, he shared that the DSA is integrating satellite constellations across orbits to ensure secure, resilient communications. IN-SPACe projects **India's space economy to grow to \$44 billion by 2033**, making space a vital pillar in the nation's 2047 vision. He urged deeper collaboration among the armed forces, DRDO, IN-SPACe, and private industry to drive innovation in advanced technologies for a self-reliant space defence architecture.

Addressing Space Situational Awareness (SSA), General Chauhan detailed its components—**Space Domain Awareness (SDA) Space Situational Awareness, Military Space Situational Awareness, and Operational Space Situational Awareness**. He noted initiatives like Project NETRA, which tracks and analyses space threats, as examples of India's commitment to space safety. Military SSA focuses on protecting critical assets during operations, while Operational SSA ensures real-time application of this awareness.

He highlighted the dynamic involvement of private industries, citing successful satellite launches, a hyperspectral constellation, and surveillance satellites deployed under DSA. He also noted ISRO's first satellite docking and supported innovation through initiatives such as the ₹1,000 crore space capital fund and the ₹500 crore technology development fund by IN-SPACe.

He also mentioned **India's forward-looking national space ambitions, including missions to Venus, Chandrayaan-4, the establishment of a space station by 2035, and plans for Internet-enabled moon landings by 2040**. He acknowledged the role of DRDO in facilitating these efforts and cited the iDEX challenges launched in October 2022 as crucial early-stage funding mechanisms for space startups. Programs like iDEX ADITI, ADITI 2.0 and 3.0, and other defence-linked innovation schemes were spotlighted as essential enablers of public-private synergy.

On military preparedness, he discussed **Antariksh Abhyas**—India's first space exercise conducted in November 2024, which brought together the tri-services, HQ IDS, ISRO, and other key agencies to simulate scenarios involving threats to and from space-based assets.

He announced that the DSA is drafting a Military Space Doctrine and formulating a National Military Space Policy. Additionally, a major initiative involving the **launch of 52 ISR satellites under a public-private partnership** is underway. Communication advancements include adopting Defence Operational Payloads, GEO constellations, and developing an integrated satellite communication architecture to enhance India's defence communications.

In conclusion, General Chauhan reaffirmed India's ambition to capture 10% of the global space economy by 2040. He emphasized the role of strategic simulation, international cooperation, and infrastructure development in achieving this vision. He called for continued innovation in critical space technologies and deeper collaboration across the armed forces, private industry, DRDO, and IN-SPACe.

He concluded by commending the Indian Space Association for organizing the third edition of the symposium and expressed confidence that the dialogue would help pave the way for a strategically secure and space-empowered India.



Felicitations: ISpA Patron Hon'ble Gov Shekhar Dutt, SM, IAS, Former Governor of Chhattisgarh, Former Defence Secretary, Govt. of India.



Felicitations of ISpA Patron Hon'ble Mr. Shekhar Dutt, SM, IAS: ISpA honoured Hon'ble Mr. Shekhar Dutt, SM, IAS, for his unwavering support and remarkable contributions to India's defence, energy, and strategic sectors. As the Patron of the Indian Space Association (ISpA), Mr. Dutt has been instrumental in nurturing India's space and defence industry ecosystem, particularly by fostering high-level policy dialogue, championing public-private collaboration, and supporting strategic symposiums such as this.

He has been cited as a distinguished public servant and decorated military officer, continuing his legacy of visionary leadership in advancing India's renewable energy initiatives and policy advocacy. A

1969-batch Indian Administrative Service (IAS) officer from the Madhya Pradesh cadre, Mr. Dutt has had a sterling career in both military and civil services. Notably, he served as a commissioned officer in the Indian Army and was awarded the Sena Medal for gallantry during the 1971 Indo-Pakistan War in the western sector-testimony to his courage and dedication to national service. Mr. Dutt assumed office as the Governor of Chhattisgarh on 23rd January 2010 and had earlier served as the Deputy National Security Advisor from 2007, handling critical portfolios related to defence, national security, and strategic affairs. His tenure as the Defence Secretary, Government of India, marked a period of pivotal policy evolution and modernization in India's defence landscape.



Keynote Address by AVM Pawan Kumar VM, Director General, Defence Space Agency (DSA)



Delivering the keynote address at the symposium, AVM Pawan Kumar VM, DG DSA presented a forward-looking roadmap for India's defence space ecosystem with a strategic vision spanning the next 10 to 15 years. He emphasized the unique characteristics of space-its global perspective, global access, and global reach-which together underscore the critical need for India to build independent and resilient capabilities in surveillance, positioning, and communication. **Aligned with the symposium's theme of "Strengthening India's Defence Space Foundations,"** he highlighted five core verticals essential for this transformation: **Intelligence, Surveillance and Reconnaissance (ISR), Communication, Positioning, Navigation and Timing (PNT), Space Situational Awareness (SSA), and Space Weather.**

In the ISR domain, AVM Kumar outlined the **requirement for persistent surveillance capabilities, swath imaging, agile and high-precision payloads, neuromorphic sensors, edge computing, and AI-driven pattern and predictive analytics.** He stressed the need for faster and more secure data translation and the creation of

hyperspectral libraries to support rapid decision-making. On communication architecture, he proposed a **hubless, interoperable, and band-agnostic mesh network integrating LEO, MEO, and GEO satellites.** This would include space and ground segments using software-defined technologies and support post-quantum encryption mechanisms to ensure secure communications.

Regarding PNT, he shared that India would achieve **full NaVIC capability with a constellation of seven satellites by 2027, enabling accurate regional positioning up to 1500 km from India's borders.** He highlighted opportunities for academia, startups, and industries to innovate in developing compact and high-dynamic receivers suitable for a wide range of platforms, including aerial, land, and underwater systems. In SSA, he envisioned an integrated architecture combining space and **ground-based optical and RF sensors,** supported by analytical platforms and simulators capable of training and replicating operational scenarios. He also emphasized the often overlooked but critical domain of **space weather,** citing real-world incidents of satellite damage due to geomagnetic storms. He



called for the development of predictive infrastructure, including the indigenous manufacturing of magnetographs and coronagraphs to monitor solar activity.

AVM Kumar affirmed India's capability to achieve this ambitious vision, especially in light of the Government of India's proactive space reforms and the enabling Space Policy of 2023, which encourages non-governmental entities to provide end-to-end solutions. He emphasized the importance of innovation and collaboration—both domestic and international—in areas like semiconductor chips, detectors, and solar cells. He recommended establishing multi-university collaborative platforms to engage with startups and

strategic stakeholders. Moreover, he underscored the necessity of aligning technological advancements with the operational requirements of the armed forces, pointing out that around 80% of India's data is consumed by the strategic community.

He concluded with a call to accelerate the development of dual-use technologies and scale user-driven applications across civilian domains such as urban planning, logistics, transportation, and railways. Stressing the importance of seminars like this in fostering dialogue and innovation, he reaffirmed the collective responsibility to transform India into a formidable spacefaring nation with credible deterrence capabilities through demonstration of space-based competencies.

Address by Guest of Honor: Amb Sujan R. Chinoy, Director General, MP-IDSA



Ambassador Sujan R. Chinoy, Director General of MP-IDSA, conveyed his appreciation for ISpA for its timely and strategic initiative in organizing this significant event. He acknowledged that MP-IDSA, a premier institution dedicated to defence and strategic affairs, has consistently championed policy analysis in emerging domains, including the growing relevance of space in India's national security framework.

Ambassador Chinoy emphasized the theme of the symposium—"Strengthening India's Defence Space Foundations"—as highly pertinent in today's

geopolitical and technological context. He noted that the boundaries between space and aerospace are rapidly diminishing, and while terrestrial domains are limited, space and aerospace remain boundless, constrained only by the extent of technological advancement. In this regard, he remarked that **future military superiority will be determined by nations that excel in space-based communication, ISR (Intelligence, Surveillance, and Reconnaissance), and cyber capabilities, driven by cutting-edge innovations in artificial intelligence and quantum computing.**



He drew attention to the rapid pace of militarization in the space domain, citing **how satellites, UAVs, hypersonic vehicles, and AI-powered surveillance platforms are transforming the battlespace**. He highlighted that thousands of satellites-particularly microsatellites-are now orbiting the Earth, significantly enhancing real-time situational awareness, resilient navigation systems, and survivable communication networks. He warned that as space becomes a critical frontier for warfare, it also opens avenues for asymmetric conflict, allowing even technologically modest adversaries to disrupt superior powers by targeting their space-based infrastructure. Ambassador Chinoy underscored the growing importance of AI and quantum computing, especially in terms of encryption and data security, cautioning that these technologies could eventually be weaponized to compromise or take control of space-based assets. He stressed that India must prepare itself for such eventualities by strengthening its defensive and offensive space capabilities.

He also spotlighted the pivotal role of the private sector in advancing space technology. Drawing

parallels with global pioneers like SpaceX and the development of systems such as Starlink and Starship, he emphasized that private enterprises are fast becoming key players in domains spanning land, sea, cyberspace, aerospace, and AI. In this light, he advocated for a robust public-private partnership model in India, lauding the efforts of IN-SPACe in fostering such collaboration and unlocking the nation's full strategic potential.

Recognizing the contributions of ISRO to both national development and defence preparedness, Ambassador Chinoy also praised the efforts of the Defence Space Agency and DRDO in enhancing India's space security architecture. He called for greater cooperation and agility across stakeholders, both public and private, to realise the country's space vision for 2047. In closing, Ambassador Chinoy expressed confidence that the Indian Defence Space Symposium 2025 would serve as a meaningful platform for dialogue, collaboration, and innovation-ultimately contributing to India's emergence as a space power committed to strategic autonomy and global leadership in the evolving space domain.

**Address by Guest of Honour: Air Chief Marshal VR Chaudhari PVSM AVSM VM (Retd),
Former Chief of the Air Staff, Indian Air Force**





Air Chief Marshal VR Chaudhari (Retd) expressed his deep honour at being present for the third edition of the symposium and extended heartfelt congratulations to the organizers for consistently hosting such an impactful event. He shared a personal anecdote from his childhood, recalling the momentous Apollo 11 moon landing in 1969. At just eight years old, he was captivated by the grainy footage of Neil Armstrong descending the lunar module ladder. The scenes, viewed repeatedly on a home projector, left an indelible mark on his imagination. He reflected on how that singular event inspired countless young minds and symbolized a massive leap in technological achievement—especially considering the limited tools and rudimentary computing power available at the time.

Air Chief Marshal Chaudhari **highlighted the exponential growth of technology since then, particularly in the semiconductor and information technology domains.** He referenced Moore's Law and pointed out **how computing power on chips has increased over a billion times, while physical chip sizes have shrunk dramatically.** This, he emphasized, has **revolutionized satellite design—from massive multi-ton structures to compact cube satellites** just 10 cm in dimension that can now perform tasks once handled by much larger systems.

He stressed the transformative power of **Artificial Intelligence (AI) and its integration into space systems**, both onboard satellites and ground-based infrastructure. AI, he noted, is enhancing autonomous operations, decision-making speed, and situational awareness. He spoke about the emergence of AI-driven digital twins for Earth and space observation, and how **nanotechnology is enabling the development of smaller, more efficient space objects**—thus addressing concerns like space debris while maintaining capability.

Air Chief Marshal Chaudhari spoke about the growing significance of **edge computing and onboard satellite data processing**, which may eventually render traditional ground stations less relevant. He also emphasized the **critical role of 5G in enabling low-latency, high-speed, and secure communications in space environments.** India, he noted, possesses the capability to develop both hardware and software for space-based 5G networks—presenting a major opportunity for innovation.

He then turned to **quantum communication**, stating that this emerging domain is already undergoing field testing. The promise of increased processing speeds, reduced power consumption, and secure data transmission makes quantum technology a key area for future space missions.

Addressing the strategic aspect of space, he discussed the shift from using a few large satellites to deploying proliferated satellite networks composed of many small, low-cost satellites that are resilient and rapidly deployable. He reiterated that space is no longer just the "final frontier" but a domain that is congested, contested, and increasingly conflict-prone.

He noted the changing nature of warfare, where complexity now trumps complication. In a complex world, predicting outcomes becomes nearly impossible, making resilience in space operations essential. The concept of Air and Space as a continuum, first truly tested during the 1991 Gulf War, is now even more relevant as space has become central to both civilian and military operations.

Air Chief Marshal Chaudhari cautioned against the threat of space weaponization, stating that it's no longer a question of "if" but "when." Several nations are already developing or testing technologies capable of disrupting or destroying satellites. The growing strategic importance of space assets means they are becoming new "centres of gravity" in modern conflicts.

He acknowledged the Indian government's landmark decision to open the space sector to private industry, noting that the creation of IN-SPACe and other institutional frameworks has paved the way for Indian industry and startups to play a critical role in space innovation. He encouraged startups and companies to stay focused, not get overwhelmed, and invest in core areas with high potential returns—especially AI, nanotechnology, and 5G communications.

He concluded by calling for a fast-tracked evolution of India's space capabilities through stronger integration of defence and civilian requirements. Collaboration between space agencies, private industry, and academia, he emphasized, is key to ensuring that India not only keeps pace with global advancements but leads the way in emerging domains of space technology.



Vote of Thanks: Lt Gen AK Bhatt PVSM UYSM AVSM SM VSM (Retd), DG ISpA



Lt Gen AK Bhatt (Retd), Director General of ISpA, expressed heartfelt gratitude on behalf of the organizers to all distinguished guests, speakers, and participants who graced the symposium. He began by acknowledging the presence of Mr. Dutt and all the esteemed members, noting that it was an honour to host them during this impactful three-day end-to-end session. The sessions, he said, were thoughtfully curated to encompass a wide range of critical topics, many of which were highlighted during the inaugural addresses.

He emphasized the significant strides made in India's space sector over the past year, notably the announcement of SBS-3 and the growing involvement of private entities in Earth Observation satellite constellations. Although still in progress, this initiative has seen interest from 26 companies, with 5–6 forming strong consortia. These developments are expected to gain momentum in the coming months. Lt Gen Bhatt also highlighted the awarding of the first PSLV contract to HAL and L&T, noting the upcoming focus on LVM3 production under the Public-Private Partnership (PPP) model. What stood out most, however, was the capability and resilience shown by the private sector in developing

indigenous space solutions, even with minimal financial support.

He shared examples of remarkable achievements, such as three hyperspectral Firefly satellites already in orbit-part of a planned constellation of 36 satellites-and India's first space domain awareness satellite, SCOT-1. He also celebrated the successful sub-orbital launches by two Indian space startups, acknowledging the crucial role of venture capital in enabling their growth.

While commending these successes, he acknowledged that more support especially in terms of funding and policy enablement is required for the private sector to thrive further. He extended special thanks to DG DSA for presenting a forward-looking constellation-based vision that has the potential to invigorate the private space ecosystem. The combination of GEO, MEO, and LEO systems presents both challenges and opportunities, he observed.

Referring to Air Chief Marshal Chaudhari's remarks, he echoed the notion that modern conflict is transitioning from being complicated to complex,



and therefore, India must be prepared-particularly in terms of space weaponization, which is no longer hypothetical but increasingly real. He urged startups not to get overly distracted by hype but to stay focused on core areas of innovation and service delivery, which are essential to meeting India's evolving space needs.

Lt Gen Bhatt outlined the symposium's three-day agenda. He expressed hope that meaningful policy

suggestions would emerge from these discussions and be shared with relevant government authorities.

In conclusion, he stressed that the most important element of the symposium is the **active participation and honest inputs of all attendees**. He emphasized that the outcomes of these sessions should not only feed into policy but also showcase the achievements and capabilities of the Indian space ecosystem.



Release of Post Event Report of Indian Space Conclave 2024 by Amity University:



Amity University was been honoured with a Prestigious Certificate of Appreciation and designated as a Distinguished Knowledge Partner at the Indian DefSpace Symposium 2025, organised by the Indian Space Association (ISpA).



Amity University has been honoured for its utmost commitment and outstanding contributions of **Amity Education Group** in the field of Space and Defence. It is the only University pronouncing **Amity Space Mission** in which seminal R&D contributions are being made in these fields of strategic importance. These include sending the first biological payload of spinach to Space, cognitive health monitoring of Spacecraft, debris management, remote sensing data analysis for societal applications, and AI involved image processing for Gaganaut's health monitoring, to cite a few examples.



SESSION I: “SPACE THREAT ANALYSIS: ADVERSARIES SPACE CAPABILITIES AND CONSEQUENT GEOPOLITICAL THREATS”



KEYNOTE SPEAKER: AVM Anil Golani (Retd), Director General, CAPS

Air Vice Marshal Anil Golani (Retd), Director General of CAPS, delivered a thought-provoking keynote address emphasizing the increasing complexity of space militarization and its implications for global security.

He began by acknowledging the transformative role space has played since the advent of technologies that enabled its use for strategic advantage. Although space was originally envisioned as a global commons to benefit all mankind, it has increasingly become an arena for national assertion and control—mirroring the adversarial nature seen in traditional conflict domains. AVM Golani remarked that in today's world, it is nearly impossible for any nation—or indeed, humanity—to function effectively if denied access to space. For militaries across the globe, this domain is now integral to operational effectiveness.

AVM Golani highlighted China's systemic efforts in

restructuring and integrating its space, cyber, and electronic warfare capabilities under its Strategic Support Force (SSF), with the PLA Aerospace Force reflecting a focused attempt to centralize command over critical space assets. This strategic consolidation has enhanced China's ability to manage its growing fleet of satellites and space-based systems, facilitating faster, more coordinated military responses.

He went on to reference **recent manoeuvres by Chinese satellites**, particularly the *Shijian-24C* series, which performed complex, lower orbit operations resembling traditional aerial combat—signaling the dawn of dynamic, tactical space warfare. **China's rapidly expanding satellite architecture now bolsters its ISR (Intelligence, Surveillance, and Reconnaissance), navigation, and communication capabilities.** These include covert military satellites operating under civilian disguise, offering secure command and control links.



He further elaborated on **China's deployment of high-resolution optical and radar imaging satellites, such as the Yaogan and Gaofen series**, which are enhancing situational awareness and enabling rapid targeting responses. In 2024, a notable shift was seen in China's acceleration of counter-space capabilities-some of which are now being tested in Low Earth Orbit. Technologies such as AI, quantum computing, and big data analytics are being integrated into its military space strategy to optimize satellite networks, improve ISR, and enable faster decision-making cycles.

AVM Golani cautioned that these advancements pose a significant global risk. He pointed out that the pace and diversity of China's space weapon developments are narrowing the technological gap and raising the risk of escalation in space. In this evolving scenario, space becomes not only a tool for national power projection but also a key pillar in strategic deterrence-especially in counterbalancing the capabilities of the U.S. and its allies.

He addressed the broader geopolitical context, noting how the current world order is increasingly unstable, with rising nationalism and the perceived failure of post-WWII institutions. These trends, he noted, are now resonating in the space domain as well. The increasing role of private companies offering strategic space services is reshaping the balance between state control and private enterprise.

He pointed out that while the U.S. Space Force and NASA aim to establish global norms and dominance in space, China's ambition to become the leading space power by 2049 underscores the intensifying geopolitics of space. Emerging players in Europe and Asia are developing indigenous capabilities, which will diversify the global space ecosystem and reshape strategic alliances.

AVM Golani emphasized that as space becomes more contested and congested, the risks of miscalculation and accidental conflict will rise. This underscores the urgent need for effective international norms and governance frameworks to ensure cooperation over confrontation. He stressed that India has a significant role to play in leading such dialogues and contributing to a balanced and inclusive space governance model.

In conclusion, AVM Golani quoted from a

forthcoming book titled *"Beyond Orbit: Fighting and Deterring the Coming Wars in Space"* by General Liu et al., who assert that the future battles for resources like space and knowledge will test the endurance and wisdom of military leaders and political decision-makers alike. He affirmed that space must become an integrated element of modern military thought, necessitating adaptation and foresight to meet the demands of future warfare.



Mr Navneet Singh, Chief Executive Officer, Kepler Aerospace provided a historical and strategic overview of the evolution of anti-satellite (ASAT) warfare, tracing its origins from the Cold War to current conflicts. He emphasized that satellites have become central to modern military operations, making them key targets in future wars.

He highlighted that ASAT capabilities, both kinetic and non-kinetic, have advanced over decades-from air-launched missiles to laser weapons and cyber-based jamming. Incidents like the Ukraine-Russia conflict have already demonstrated the real-world use of space denial tactics.

Mr. Singh underscored the importance of Space Situational Awareness (SSA), noting that while ground-based radars and sensors have long existed, a modern approach requires a layered, global sensor network. India must forge international partnerships to place sensors abroad and develop integrated SSA using both low-cost and high-fidelity systems, including space-based platforms.

He warned of the dangers posed by debris-generating ASAT actions, including the risk of Kessler Syndrome, and called for robust mitigation strategies



and deterrence capabilities. Credible counter-space systems—both kinetic and non-kinetic (like directed energy weapons and jammers)—are essential for strategic influence.

He stressed the urgency of moving beyond makeshift solutions, advocating for national investment in extra-heavy launch vehicles, scalable satellite manufacturing, and rapid replenishment strategies. A large, resilient satellite constellation was positioned as the cornerstone of survivability in space.

Finally, he urged India to act with ambition, drawing attention to China's aggressive dual-use space programs. He concluded with a strong message: space is now a warfighting domain, and India must shift from being a technology importer to an innovator with sovereign, strategic space capabilities.



Dr Ajey Lele, Deputy Director General, MP-IDSA provided a strategic overview of China's growing dominance in space, citing data from CSIS and other sources. While India once led in satellite launches, innovations by Elon Musk's SpaceX have redefined cost-efficiency in space, creating new benchmarks. Highlighting the shift in space activity from 2020 to 2024, the speaker noted a growing India-China activity ratio from 1:9 to 1:25. China's ability to learn from crises like the 2008 Wenchuan Earthquake has led to the development of integrated space capabilities, as seen in their 2025 disaster response. China's emphasis on Positioning, Navigation, and Timing (PNT), combined with space-based

surveillance and unmanned systems, is central to its cross-domain military strategy. Though still five years behind SpaceX, China is steadily closing the gap with a goal to dominate space by 2049, as outlined in its 14th Five-Year Plan.

By April 2025, China had deployed over 230 communication satellites and 696 remote sensing satellites, improving regional coverage and satellite revisit rates, especially over areas near India. They have also focused on developing high-resolution imagery, real-time data relay, and precise geolocation via CORS.

Despite falling short of their goal of 3,000 communication satellites by 2025, efforts like the VLM constellation (targeting 192 satellites by 2027) and enhanced BeiDou networks indicate sustained progress. The speaker also highlighted China's operational anti-satellite (ASAT) capabilities and active satellite maneuvering programs. Reforms have decentralized China's space responsibilities across provinces, reinforcing military-commercial integration. While challenges remain, China's persistent, structured, and long-term space ambitions are reshaping the strategic landscape which is concerning.



Mr. Tanveer Ahmed, Co-Founder & CTO, Digantara emphasized the urgent need for India to enhance its Space Situational Awareness (SSA) capabilities. He highlighted that while satellite detection is relatively easy, the real strategic edge lies in maintaining satellite "custody"—the ability to



continuously track and monitor satellites.

He noted that China currently possesses the infrastructure to comprehensively track satellite movements, even during conflict. He cited recent incidents where Chinese satellites came within close proximity of Indian assets, raising concerns over imaging and surveillance capabilities.

Mr. Ahmed also pointed to China's demonstrated coordination between multiple satellites, capable of formation flying and close-proximity manoeuvres-signifying a significant strategic advantage. He mentioned the existence of "mystery objects" launched alongside Chinese satellites, suggesting covert capabilities. He called attention to China's rapid growth in space operations-doubling capabilities year-on-year for the past 25 years-and the demonstration of counter-space technologies such as RF jammers, laser dazzlers, and kinetic interceptors capable of reaching up to 30,000 km in altitude.

Urging a shift from long-term planning to mission-mode execution, Mr. Ahmed stressed the need for faster decision-making, focused investments in tracking infrastructure, and greater confidence in India's technological readiness. He concluded by urging stakeholders to prioritize timelines, asking not just *how* India can act, but *how soon* it must.



Brigadier Anshuman Narang (Retd), Founder of Atmanirbhar Soch, served as the moderator for the session and provided a comprehensive overview of

China's current position in space technology, highlighting comparative statistics and strategic insights. He began by referencing global space leadership indices, pointing out that, according to CSIS and similar agencies, China has surpassed the United States in terms of space achievements, with 14 gold medals compared to the US's 12. He acknowledged India's emerging presence in the global space race, noting Pixxel India's bronze-level recognition. Brig Narang emphasized that the trends are not recent but have been building over years, indicating China's consistent rise. He illustrated how China's dominance extends to controlling over 50% of all isobars in orbit, underscoring the magnitude of their satellite infrastructure.

He presented a **stark contrast between India and China in satellite launches, showing that while India had 76 satellites to China's 704, the gap widened dramatically from 2018 to 2023**. In 2024 alone, China launched 43 different satellites, whereas India launched none in the same category. He urged the audience to accept this reality and recognize the urgent need for India to scale up its space capabilities. While India once held a competitive edge in commercial launches, particularly with its PSLV launches, Brig Narang noted that **companies like SpaceX have now revolutionized launch costs, shifting the dynamics entirely**.

Brig Narang delved into China's strategic application of space-based assets in military and humanitarian contexts. He cited the 2008 Sichuan earthquake as a lesson for China, where their lack of satellite coordination led to delayed response, and how by 2025 they had significantly improved their capabilities, deploying rescue operations efficiently with Y-20 aircrafts. He linked such cases to **China's broader approach of integrating positioning, navigation, timing (PNT), remote sensing, and communication systems into what he called an "Earth Observation Brain."** This system enables real-time satellite-to-satellite data relay and rapid ground response, facilitating cross-domain kill webs in multi-domain operations.



He highlighted China's long-term goals outlined in its 2049 space strategy and the ongoing 14th Five-Year Plan, which includes developing key technologies and expanding regional to global satellite coverage. Brig Narang mentioned that by March 2025, China had more than 230 communication satellites, aiming for a global system requiring at least 300 such satellites. He emphasized the creation of the Aerospace Force in April 2024, building on the Strategic Support Force established in 2016, and detailed the organizational integration across launch, tracking, and R&D departments.

Brig Narang presented China's claim of achieving a seven-minute turnaround for processed satellite imagery delivery via mobile requests. While acknowledging the likelihood of propaganda, he suggested that even a 70-minute delivery time would be a substantial achievement. He further elaborated on the decentralization of China's space ecosystem, where each province has been given specific roles—such as manufacturing satellites or building rocket stages—with 37 satellite manufacturing companies currently operational across the country.

According to Brig Narang, as of 7 April 2025, China had approximately 696 remote sensing satellites in

orbit, separate from its communication or PNT satellites. These include high-resolution electro-optical satellites with resolutions up to 50 cm, contributing to 24/7 persistent monitoring capabilities, including for ballistic missile defence and electronic intelligence. He cited a Chinese study focusing on Sichuan and Yunnan provinces, which demonstrated that civilian satellites could provide daily revisit rates of up to 45 images per day, a capability that could be mirrored for surveillance over neighbouring Indian states.

Brig Narang concluded by highlighting that China's space capabilities now enable remote sensing revisit times between 12 to 15 minutes during the day and about 2 hours at night. For communication networks, China plans to deploy 192 satellites in its V-band Low Earth Orbit (VLEO) network by 2027. However, Brig Narang pointed out that China is lagging behind its own ambitious timelines, with only half of the planned 3,000 satellites launched by 2025. He concluded by reiterating that although China is not invincible, its structured, reform-driven, and multi-stakeholder approach—blending military, commercial, and state-owned initiatives—has significantly advanced its space capabilities, leaving India with critical lessons to adopt if it wishes to stay competitive.



Question

After the 26/11 attacks, a decision was taken to establish a large number of coastal police stations to prevent incursions and safeguard national security. However, many of these stations lack sufficient infrastructure or operational activity, rendering them ineffective. Given the criticality of the task, do you believe that leveraging space-based surveillance is the solution? How can we ensure that such existential threats are addressed effectively?

Following the 26/11 attacks, India turned to Israel for technological solutions, particularly in the domain of Synthetic Aperture Radar (SAR). Subsequently, ISRO also made significant strides in developing its own SAR capabilities, and we now have several such systems operational. The importance of persistent maritime domain awareness has grown significantly. As you rightly pointed out, ground-based infrastructure alone cannot meet the requirements. We need a layered surveillance architecture where space-based assets play a pivotal role. There are several startups actively working on this, including Sora, GalaxEye, and Kawa, among others, who are developing innovative data aggregation models to ensure real-time insights. While systems like RISAT have laid the foundation, the loop must be closed by integrating space intelligence with actionable ground operations to avoid future vulnerabilities.

Question

Do we currently have satellite-based facial recognition capabilities that can detect, track, and match individuals along our vast coastline—say, spotting someone on the eastern coast and later again on the western coast? Can such visual intelligence be used to preemptively assess potential threats?

Yes, this is an area under active development. Several organizations and startups are working on visual recognition models and AI-based solutions for this exact purpose. While we cannot publicly disclose operational details, the direction of research and development is clear—towards enabling real-time, high-resolution visual analytics. These models are being trained to support advanced applications, including pattern recognition, movement tracking, and behavioral analytics. We'd be happy to discuss the technological capabilities and their application in a more detailed, separate setting.

Question

Despite their advancements, why has China not yet reached its intended targets in the space sector? Is it due to a lack of resources, technological challenges, or other systemic reasons?

China's primary challenge stems from prioritization. Their initial and continued focus has been heavily tilted towards ISR (Intelligence, Surveillance, and Reconnaissance) capabilities. However, their biggest bottleneck has been communication infrastructure—the volume of satellites and the bandwidth required to support large-scale operations is massive. Even with several reusable launch vehicle (RLV) projects underway, they haven't been able to meet their tonnage goals (exceeding 20 tons). Recent RLV trials have failed, underscoring the complexity. While China is conducting an impressive number of trials, until they overcome these dual challenges—effective prioritization and reliable, heavy-lift reusable systems—they will face difficulties in realizing their full data-space ambitions.



Question

From your research, it seems there is massive industrialization in China's space sector. Are they achieving this through a Public-Private Partnership (PPP) model like India's L1 bidding system, or is it being driven directly by state-owned enterprises?

Interestingly, China faces some of the same structural issues. For instance, in their recent bidding processes for mass satellite production, most civilian firms were unable to meet the government's technical standards. The final bidders were largely from state-owned entities in the southern provinces. This reflects a gap between the desired quality and private sector capabilities. Jilin-1, which is China's most promising remote sensing constellation, is a prime example—it's producing high-quality imagery but hasn't yet achieved the expected downstream revenue. The government continues to financially support such constellations. So, while China appears highly centralized and efficient from the outside, internally they face similar economic sustainability challenges and integration issues between government and industry. The difference lies in the top-down leadership-driven execution and alignment.



INDUSTRY SESSIONS

Larsen & Toubro (L&T): Mr. Sharath Chandra represented Larsen & Toubro, providing a comprehensive overview of the conglomerate's deep and long-standing involvement in India's strategic sectors, particularly its five-decade partnership with the Indian Space Research Organisation (ISRO). He positioned L&T not just as a component supplier but as a system integrator poised to play a larger role under the new Space Policy 2023.

Mr. Sharath detailed L&T's extensive contributions across the space value chain:

- **Launch Vehicles:** L&T's hardware, including **interstages, heat shields, motor casings, and nozzles**, has been integral to all ISRO launch vehicles from SLV to the present. He highlighted their current role leading the consortium responsible for integrating and delivering five PSLV launch vehicles under contract to NSIL. Furthermore, L&T manufactured a significant portion (70-80%) of the crucial crew escape system hardware and the human-rated boosters for the prestigious Gaganyaan mission. Leveraging their experience in building strategic missile launchers for the Ministry of Defence, L&T also possesses expertise applicable to mobile launch solutions for small satellites.
- **Satellites:** While historically focused on subsystems, L&T supplies critical components like tech panels (to ISRO and DRDO's Directorate of Special Projects), solar panel substrates for defence programs, and complex mechanisms such as solar array and reflector deployment systems (SADMs/RDMs) and hold-down release mechanisms, catering to both build-to-print and build-to-spec requirements.
- **Ground Segment & Infrastructure:** L&T's experience includes building C-band and S-band tracking radars currently used by ISRO, constructing Satcom gateways and ground stations (having installed 22 for ISRO on an EPC basis), providing network monitoring solutions, and developing



specialized test facilities like wind tunnels and high-altitude test facilities for ISRO. A notable international contribution mentioned was their role in manufacturing and delivering complex mirror support mechanisms for the multi-national 30m Telescope project.

- **Integration & Support:** L&T actively supports ISRO in launch vehicle Assembly, Integration, and Testing (AIT) operations at the Satish Dhawan Space Centre (SDSC) SHAR.

Concluding his presentation, Mr. Sharath acknowledged the positive momentum driven by the Space Policy 2023, enabling companies like L&T to pursue end-to-end space activities. He recognized the national goals (\$44Bn space economy, 10% global share) and noted progress in addressing impediments like funding (Taff initiative) while emphasizing the need for the pending Space Activities Bill and advocating for Quality and Cost Based Selection (QCBS) in procurement processes. He reaffirmed L&T's commitment to indigenous development and collaboration within the Indian space ecosystem.



SESSION II: “COMMUNICATIONS: ENSURING SECURE AND RESILIENT DEFENCE NETWORKS”



The afternoon proceeded with a crucial session dedicated to satellite communications, a cornerstone of modern defence operations. Moderated by **Mr. Vikram Rathore, Regional Business Head at Bharti Airtel**, the panel comprised experts from leading satcom service providers, equipment manufacturers, and a representative from the Defence Space Agency (DSA).

The discussion revolved around building robust, secure, and future-proof communication networks leveraging the evolving satellite landscape, particularly the integration of Low Earth Orbit (LEO) constellations alongside traditional Geostationary Orbit (GEO) systems.



Mr. Jitendra Ahuja, Head of Product and Solution at NELCO Ltd., emphasized Nelco's position as a technology-agnostic service provider. He stated their strategy involves offering multi-orbit solutions

(GEO, LEO, potentially MEO) tailored to customer application needs. Nelco plans to partner with multiple LEO constellation providers (explicitly mentioning OneWeb, Starlink, Kuiper, Telesat) without bias, managed through their Network Operations Centre (NOC). He advocated strongly for a flexible approach to spectrum management, suggesting efficient sharing mechanisms between defence and commercial users, enabled by advanced security technologies, rather than rigid band segregation, while respecting the need for exclusively reserved strategic spectrum.



Cdr Vidyut Kak (Retd), Chief Technology Officer at Hughes Communication India, provided a detailed perspective on achieving network resilience and security. He defined resilience multi-dimensionally: employing multi-orbit (GEO/LEO/MEO) and multi-media (satellite/terrestrial) approaches, diversifying ground infrastructure (multiple RFPs, data centers), and even building resilience at the application layer through error correction codes. On security, he outlined several layers: robust access control systems, techniques to mask transmissions (spread spectrum, noise floor operations), secure control channels, and advanced encryption key management. He particularly highlighted the use of **Quantum Random Number Generation (QRNG)**, noting successful implementation using indigenous DRDO technology, as a highly secure method for generating cryptographic keys. He contrasted this with the potential vulnerabilities (like Denial of Service) of Quantum Key Distribution (QKD) and pointed towards **Post-Quantum Cryptography (PQC)** –



developing algorithms resistant to quantum computers – as a significant area of ongoing research that could leverage existing network infrastructure. Cdr Vidyut also explained the role of **Software-Defined Wide Area Networks (SD-WAN)** in providing dynamic, centralized control for rapid provisioning, configuration updates, and automated security responses based on integrated threat analysis (both signature-based and AI-driven anomaly detection).



Mr. Amrit Pal Singh, Managing Director of IPSTAR India, focused on the continued relevance and evolution of GEO High Throughput Satellites. He reminded the audience of their pioneering role in bringing High Throughput Satellites to India and announced their upcoming deployment of two advanced **Software-Defined High Throughput Satellites** over India, promising over 50 Gbps capacity. He elaborated on the advantages of software-defined satellites, including the ability to dynamically shape beams, allocate power where needed ('bandwidth follows demand'), and create specialized beams like 'follow-me' beams for mobile assets – capabilities offering unprecedented flexibility from GEO. He maintained that GEO systems offer inherent security advantages with India-based

control centers and gateways, further enhanced by these new software-defined features, and mentioned their established partnership with Hughes for gateway technology and implementing additional security layers for defence clients.



Mr. Niladri Kundu, Director of Global Solution Engineering at Kymeta Corporation, presented their unique electronically steered flat-panel antenna technology. Designed for user-friendliness ('plug-and-play'), their terminals offer multi-orbit capability (GEO/LEO/MEO) and integrated LTE cellular backhaul within a single unit, providing exceptional resilience. He detailed the terminal's security features, including built-in anti-jamming, a **Zero Trust Architecture**, a physical 'zeroize' function to wipe the device if compromised, continuous monitoring for threats, and micro-segmentation to contain breaches. He confirmed Kymeta's close collaboration with Eutelsat OneWeb, incorporating features like rotating encryption keys, and expressed readiness to integrate emerging standards like 5G NTN and protected waveforms developed by Indian partners into their open-architecture platform (while noting the core antenna technology is proprietary). He assessed that fully integrated quantum-secure terminals are still some time away due to technology maturity.



Representing the user perspective, **Group Captain Rahul Basoya from the Defence Space Agency (DSA)** underscored the foundational importance of communication in warfare, enabling crucial **integration** across land, maritime, and air domains. This integration, he argued, leads to information and decision superiority, conferring strategic advantage. He stressed that satcom solutions must demonstrably **reduce operational timelines** – from planning to logistics. He articulated DSA's forward-looking plan to establish its own **integrated satellite communication grid**, carefully considering a mix of GEO, MEO, and LEO assets to meet future bandwidth, latency, security (including quantum), and coverage requirements. In the interim, he confirmed, the armed forces rely on existing dedicated military satellites supplemented by commercially hired bandwidth, viewing this as a necessary transition phase towards achieving full self-reliance (Atmanirbhar Bharat) in space communications. He explicitly acknowledged the importance of LEO constellations for meeting future low-latency demands essential for advanced military capabilities and deterrence.

The subsequent **Q&A session** touched upon several recurring themes. Concerns were raised about the reliance on imported satellite terminals and the need for indigenous development. A technical debate arose regarding quantum technologies, clarifying the distinction between quantum *encryption* methods (like QRNG, potentially usable with existing RF links) and true quantum *communication* (often relying on optical links), highlighting a potential gap between current industry offerings and future research directions. The GEO versus LEO debate continued, acknowledging the trade-offs (latency vs. persistence/coverage challenges). A crucial point emphasized, particularly from a military user perspective, was the vital need for **robust, secure, low-bandwidth (narrowband) communication links** for tactical users in the field, which often offer better resilience and link margins compared to high-bandwidth connections primarily needed for headquarters communication.





INDUSTRY SESSIONS

Eutelsat OneWeb



Ms. Nishta Kapoor, Director - Enterprise & Govt, at Eutelsat OneWeb, India presented the company's capabilities and progress in India using a compelling storytelling approach centered on partnerships and real-world impact. She positioned Eutelsat OneWeb uniquely as the only currently operational global operator offering both GEO and LEO services.

Instead of a traditional slide deck, Ms. Kapoor facilitated contributions from key partners:



Mr. Vikram Rathore, Bharti Airtel shared powerful anecdotes, including a successful trial providing unprecedented live video connectivity for the Indian Army from a moving vehicle in a challenging, network-deprived area near Joshimath. He also spoke of enabling vital communication for strategic military operations in extremely remote locations and, movingly, connecting soldiers at isolated border posts via video calls to their families for the first time, dramatically improving morale.

Mr. Niladri Kundu, Kymeta illustrated their terminal's utility through disaster recovery exercises in rugged terrain and highlighted critical real-world



deployments, such as rapidly restoring cellular networks in Taiwan post-earthquake and providing essential relief communication links in Thailand and Myanmar. He also alluded to the strategic importance of OneWeb as a reliable alternative in geopolitical hotspots.

Mr. Jayaram, Hughes Communication India : Detailed successful maritime proofs-of-concept on various defence vessels, showcasing how LEO connectivity enables new security applications and enhances high-speed mobility at sea. He emphasized a key learning: the effective **coexistence and interplay between new LEO services and existing legacy GEO networks** used by defence forces. He recalled Hughes and OneWeb's pioneering live demonstration of LEO services in India (May 2023), focusing specifically on defence use cases.

Ms. Nishta Kapoor strongly emphasized Eutelsat OneWeb's commitment to Indian regulations and security requirements. She confirmed the establishment of **two operational gateways on Indian soil** (Gujarat, Tamil Nadu), local data centers, adherence to domestic traffic routing mandates, provision for lawful interception through partners, and the implementation of strict **terminal geo-fencing** to prevent unauthorized usage. She proudly highlighted Eutelsat OneWeb being the first and currently only LEO operator to receive an IN-SPaCe license, build local gateways, conduct extensive testing with all three branches of the Indian Armed Forces, and offer secure, enterprise-grade B2B LEO connectivity. The final step awaited, she stated, is the crucial **spectrum allocation** from the Indian government, after which services can be launched nationwide. A particularly notable achievement shared was OneWeb's role in rapidly providing connectivity for the Indian Army-run hospital in Myanmar under **Operation Brahma**.



SESSION III : “BEYOND THE HORIZON: SPACE - BASED ISR FOR MULTI- DOMAIN OPERATIONS”

The final technical session of the day shifted focus to the cutting edge of space-based Intelligence, Surveillance, and Reconnaissance (ISR) and its integration into multi-domain military operations.

Keynote Address: Dr. PV Radhadevi (Director, ADRIN, ISRO):



Dr. Radhadevi delivered a comprehensive keynote titled "Strategic ISR: Unifying Space, Geospatial, and Digital Technologies for Multi-Domain Operations (MDO)." She argued passionately that effective MDO requires not only advanced satellite platforms but, critically, the seamless integration of modern geospatial and digital technologies (AI/ML, Big Data, Edge Computing, Digital Twins, Quantum) to dramatically shorten the data-to-intelligence cycle. Declaring it was "time to act," she outlined the stringent requirements for modern ISR: high information content, enhanced **timeliness and revisit frequency** (highlighting the gap between current capabilities and user needs), all-weather/day-night operation (necessitating SAR/Optical synergy), and user-friendly, automated information extraction.

Dr. Radhadevi detailed how ADRIN is working to fuse traditional geospatial techniques with new digital tools. She placed significant emphasis on the potential of **onboard processing (Edge Computing)**, revealing ADRIN has successfully simulated processing large raw satellite datasets down to actionable intelligence reports directly on

the satellite platform. This, she explained, could drastically reduce downlink times and bandwidth needs. She envisioned a future workflow where such processed intelligence is relayed via **Inter-Satellite Links (ISL)** from LEO reconnaissance satellites to GEO communication satellites for immediate dissemination to users anywhere on the globe. She also proposed exploring **Capability-as-a-Service (CaaS)** models for processing and dissemination to foster interoperability and standardization across agencies. While outlining this ambitious technological roadmap, she also candidly acknowledged existing adoption challenges, including data silos, lack of standardization, data sharing hurdles, and capacity building needs.



Lt Gen Dr. AKS Chande (Retd), President, Defence, Internal Security & Public Safety, GWCC: Moderator



Mr. Awais Ahmed, Founder & CEO, (Pixel Space): Focused on their unique **hyperspectral** imaging constellation (Firefly), providing high spectral resolution (5m GSD) for material identification and unique intelligence insights.



Mr. Kalyan Boppinedi, Director of Business Development, (Capella Space): Represented a leading commercial SAR provider, emphasizing data services, system sales, direct access models, and international collaboration



Mr. Krishanu Acharya, CEO, (Suhora Technologies): Introduced their indigenous **full-stack surveillance**

platform (Meghdoot), designed to fuse multi-source data (Optical, SAR, Thermal, Hyperspectral, RF, AIS) for comprehensive monitoring and analysis..

Mr. Suyash Singh, Founder & CEO, (GalaxEye):



Presented their novel approach of fusing **Multispectral and SAR sensors on a single satellite** to overcome weather limitations and enhance data interpretation, with their first satellite launch imminent.



Col HJ Singh, IAS (DIPAC): Provided the critical user perspective from the Defence Image Processing and Analysis Centre, emphasizing the paramount need for **timeliness** in intelligence delivery and the importance of robust **detection** capabilities (where SAR plays a key role) preceding identification.



KEY DISCUSSION THEMES

- **Technology Deep Dive:** Panelists elaborated on their specific technologies. GalaxEye addressed how they technically achieve co-registration of their fused sensors. Suhora confirmed the development of AI algorithms specifically for SAR target detection. Pixel Space detailed compelling hyperspectral use cases like differentiating real military assets from decoys based on material signatures, identifying specific infrastructure types (e.g., runways built for fighter jets), and detecting potential CBRN activities through chemical/gas plume analysis. The importance of onboard processing and rapid downlink for hyperspectral data's tactical relevance was stressed.
- **Data Fusion & Multi-INT:** The challenge of fusing data from disparate sources (different satellite sensors, UAVs, ground sensors, OSINT) into a coherent intelligence picture was a central theme. Mr. Boppinedi (Capella) noted the global need for robust multi-INT platforms and automated workflows. Mr. Acharya (Suhora) described their platform's approach to integrating diverse data streams for continuous monitoring. Col HJ Singh (DIPAC) confirmed that while DIPAC currently focuses on satellite imagery, effective multi-sensor fusion is indeed happening, but primarily at the tactical formation level rather than being fully integrated nationally.
- **Sovereign vs. Commercial Procurement & Collaboration:** The panel explored the optimal strategy for India. There was a consensus on the absolute need for sovereign ISR capabilities (driven by initiatives like SPS3 and the burgeoning startup ecosystem). However, panelists also acknowledged the practical necessity of procuring data from commercial providers (both domestic and international) to fill gaps, ensure redundancy, and access specific capabilities in the near-to-medium term. International collaboration was also seen as valuable. The need for hybrid models that leverage commercial innovation while maintaining national control over critical analysis and security was highlighted. Models like IDEX and IN-SPACe PPPs were cited as positive steps in fostering collaboration between startups and defence agencies.
- **Timeliness & Operational Relevance:** Col HJ Singh's emphasis on the need to drastically reduce the time from satellite tasking to intelligence delivery to the end-user resonated throughout the discussion. The startups showcased how their technologies (onboard processing, fused sensors, AI analysis) aim to address this critical requirement.
- **Systemic ISR:** The discussion touched upon moving beyond ad-hoc imaging to establishing persistent surveillance systems capable of continuous monitoring and automated change detection over areas of interest, a capability Suhora is actively developing.

Q&A Key Points: Questions probed the technical feasibility of fused sensors (GalaxEye), the need for a unified national platform or standards body to integrate inputs from various startups (a recognized challenge requiring government or potentially consultant leadership), and contingency planning for potential restrictions on deep-tech exports (an issue acknowledged but not fully resolved within the ISR context).



INDIAN DEFSPACE SYMPOSIUM 2025 – KEY TAKEAWAYS FROM DAY 1 PROCEEDINGS

Insights from the Leader's

Strengthening India's Space Defence Foundations

• Jayant Patil (Chairman, ISpA):

- o Emphasised building a self-reliant space ecosystem through public-private synergy.
- o Painted a vibrant picture of the collaborative potential between India's public and private sectors.
- o He spoke about achievements such as communication satellites, radars, and tracking technologies that have already proven India's technical prowess.
- o Emphasised the need for deeper collaboration between the defence and space sectors to address global opportunities and challenges.
- o With the government's commitment to launching 52 dedicated military satellites and expanding the ambit of private enterprise into defence technology, the Atmanirbhar Bharat (self-reliant India) initiative is gaining a cosmic dimension.

• General Anil Chauhan (CDS):

- o Stressed space as a warfighting domain akin to maritime and air supremacy.
- o Announced that India is developing its first military space doctrine, expected to be released within 2–3 months.
- o Emphasised the need for a "space culture" rooted in doctrine, strategy, and original thought.
- o Revealed the successful conduct of 'Antriksh Abhiyan,' India's first dedicated military space exercise, in November 2024.
- o Highlighted plans to launch a 52-satellite constellation for intelligence, surveillance, and reconnaissance (ISR), with 31 satellites to be built by the private sector.

• AVM Pawan Kumar (DG, DSA):

- o He laid out a roadmap for five key verticals: ISR, Communication, PNT, SSA, and Space Weather. He underscored India's well-defined decadal roadmap, which focuses on mission-critical areas like space-based Intelligence, Surveillance, and Reconnaissance (ISR), secure communication, Positioning, Navigation and Timing (PNT), and space weather monitoring.
- o These technologies are pivotal not just for defence preparedness but for ensuring day-to-day civilian utilities like navigation, disaster management, and communication networks remain operational and secure.
- o Advocated for AI, edge computing, and post-quantum encryption. Called for indigenous space weather infrastructure and user-driven applications.
- o The convergence of military and civilian uses in space is accelerating. Approximately 80% of defence space data is already consumed by the strategic community, emphasising the mutual dependence of these domains.



- o It is therefore essential to adopt a user-driven approach, integrating the needs of armed forces with cutting-edge innovation from research institutions, academia, and the private sector.

• **Amb. Sujan R. Chinoy (DG, MP-IDSA):**

- o The rules of warfare are being rewritten in an era dominated by emerging technologies such as Artificial Intelligence (AI), quantum computing, and hypersonic systems.
- o Called for a robust space doctrine that fuses deterrence with disruption is especially timely.
- o Warned of asymmetric threats and supported a strong public-private partnership model for space resilience.
- o India must invest not only in creating dual-use satellites capable of both civilian and military applications but also in ensuring these systems are survivable against potential threats like jamming, hacking, and physical destruction.

• **ACMVR Chaudhari (Retd):**

- o Discussed the transformation of satellites via AI, 5G, edge computing, and quantum communication.
- o Warned of weaponisation and urged the integration of civil and defence space initiatives.
- o Explained that the era of relying on singular, large satellites is giving way to resilient constellations of smaller, agile satellites designed for specific tasks.
- o These high-performing systems can operate across different orbits, offering capabilities like launch-on-demand, space-based 5G networks, onboard edge processing, and even quantum communications.
- o The shrinking of satellite size, coupled with their growing utility, has opened doors for unprecedented advancements in both civilian and defence sectors.
- o This paradigm shift is not just an opportunity but a necessity for India to secure its space assets and achieve self-reliance.
- o A robust space ecosystem built on innovation, collaboration, and sheer resilience is the way forward.

• **Gen A K Bhatt (Retd), DG, ISpA:**

- o Lt Gen AK Bhatt said speed and adaptability are the watchwords of modern space innovation. He Highlighted the symposium's role in fostering innovation and partnerships to strengthen India's defence space ecosystem.
- o Strategic partnerships will play a major role, but the real driving force will come from startups and private enterprises—entities that thrive on daring visions and rapid execution.
- o From hyperspectral imaging to software-defined payloads and quantum-resistant secure communications, the innovation cycle must keep pace with the demands of the defence forces and the civilian population.



KEY TAKEAWAYS FROM THE SESSION

Space Threat Analysis: China's Military Space Capabilities

- AVM Anil Golani (DG, CAPS): Analysed China's strategic integration of space, cyber, and electronic warfare under its SSF. Warned of tactical space warfare via Shijian satellites and China's use of dual-use systems.
- Mr. Navneet Singh (Kepler Aerospace): Stressed ASAT evolution, the threat of debris (Kessler Syndrome), and the need for global SSA infrastructure. Urged India to invest in counter-space capabilities.
- Dr. Ajey Lele (MP-IDSA): Traced China's rise from crisis response to global space leadership. Noted their emphasis on PNT, ISR, and integrated response systems.
- Mr. Tanveer Ahmed (Digantara): Highlighted the importance of "satellite custody" and tracking, stressing China's lead in SSA and formation flying.
- Brig. Anshuman Narang (Retd): Provided comparative stats, noting China's dominance in launches, imaging capabilities, and a decentralised yet efficient space ecosystem.

Space-Based Surveillance & Security

- On Coastal Security (Q&A): Stressed SAR satellites for maritime surveillance and integrating space data with ground operations. Startups like Sora and GalaxEye are contributing to this domain.
- On Facial Recognition from Space: Confirmed development of AI-based visual recognition technologies for security purposes.

Industrial Momentum in India's Space Sector

- Lt Gen AK Bhatt (DG, ISpA): Acknowledged milestones like the first PSLV contract to HAL & L&T, launch of hyperspectral satellites, and the need for more funding and policy push for startups.
- L&T (Mr. Sharath Chandra): Outlined L&T's role in PSLV, Gaganyaan, radar systems, and upcoming LATSAT demonstration.

Secure and Resilient Communications

- Multi-orbit, multi-vendor approach: Emphasised by Nelco, Hughes, and IPSTAR.
- Security Innovations: Utilise QRNG, SD-WAN, and post-quantum cryptography.
- LEO-GEO Synergy: Essential for both tactical and strategic communications.
- DSA (Gp Capt Rahul Basoya): Highlighted future communication grid plans and LEO's potential.

ISR for Multi-Domain Operations

- Dr. PV Radhadevi (ADRIN): Called for rapid fusion of geospatial and digital tech, edge computing, and AI-driven analytics to enhance strategic ISR.
- Panel of Startups & DIPAC:
 - Pixel, GalaxEye, Capella Space, Suhora: Demonstrated advanced imaging, sensor fusion, and AI tools.
 - DIPAC: Emphasised timeliness and multi-sensor fusion needs.



Key Policy & Strategic Recommendations (Day 1)

Need for Finalising the Space Activities Bill & Institutional Reforms

Sources:

- Lt Gen AK Bhatt (Retd), DG ISpA emphasised the importance of the pending Space Activities Bill and advocated for procurement reforms like Quality and Cost Based Selection (QCBS). He cited the role of IN-SPACe and NSIL in enabling PPPs.

Building Sovereign ISR Capabilities

Sources:

- Dr. PV Radhadevi (ADRIN, ISRO) advocated for sovereign ISR through integration of satellite-based intelligence with AI, edge computing, and digital twins.
- Col HJ Singh (DIPAC) stressed the need for ISR timeliness and sovereign tasking-to-delivery intelligence loops.
- Industry Panel (Pixel, GalaxEye, Suhora, Capella) called for a hybrid ISR model combining sovereign capabilities with commercial augmentation.

Enhancing SSA (Space Situational Awareness)

Sources:

- AVM Pawan Kumar (DG, DSA) outlined the need for ground and space-based SSA infrastructure with predictive capability.
- Mr. Tanveer Ahmed (Digantara) highlighted the strategic importance of continuous satellite tracking and China's superior SSA.

Encouraging Public-Private Partnership and Startup Integration

Sources:

- Jayant Patil (Chairman, ISpA) stressed Atmanirbhar Bharat and the need for startups to thrive with minimal government funding.
- Lt Gen AK Bhatt (DG, ISpA) emphasised industry resilience and called for more funding and enabling policy.
- Amb. Sujan Chinoy (DG, MP-IDSA) advocated for PPPs modelled on global examples like SpaceX.
- ACM VR Chaudhari (Retd) encouraged Indian startups to focus on AI, 5G, and nanotech integration in space systems.

Inter-Agency and Inter-Domain Integration

Sources:

- General Anil Chauhan (CDS) urged integration of DRDO, DSA, ISRO, IN-SPACe, and the Armed Forces.
- Dr. PV Radhadevi (ADRIN) called for standardization and interoperability across agencies to eliminate data silos.



Response to China's Strategic Space Advances

Sources:

- AVM Anil Golani (DG, CAPS) warned of China's centralisation and space weaponisation via SSF and dual-use systems.
- Brig Anshuman Narang (Retd) provided comparative statistics and emphasised the need for India to scale up.
- Dr. Ajey Lele (MP-IDSA) called for prioritisation in ISR and satellite communication to counter China's edge.

Leveraging Emerging Technologies

Sources:

- ACM VR Chaudhari (Retd) stressed AI, quantum communication, 5G, and edge computing for space-based operations.
- Cdr Vidyut Kak (Hughes) & Mr. Niladri Kundu (Kymeta) discussed post-quantum encryption, QRNG, SD-WAN, and resilience-focused technologies.



APRIL 8, 2025

DAY 02 | THEME: "INDIGENOUS DEVELOPMENT AND GLOBAL COMPETITIVENESS"

Opening Address: Lt. Gen VG Khandare, PVSM AVSM SM (Retd), Principal Adviser, Ministry of Defence



Lt Gen VG Khandare began his address by extending his compliments to ISpA (Indian Space Policy Association) for successfully hosting the previous editions of this important symposium. He acknowledged the presence of dignitaries from ISpA on the dais, as well as other luminaries who are leading transformative changes in the Indian space domain.

He addressed a common query-why such discussions are needed every year. He clarified that space and technology are evolving at an unprecedented pace and are deeply intertwined with geopolitics. Citing "Trumpism" as a relevant geopolitical reference, he underscored the urgency for indigenous development at high speed, to gain and retain strategic autonomy. Highlighting the journey of India's space sector, he noted that while ISRO was established in 1969, newer institutions like the Defence Space Agency (DSA) and the Defence Space Research Organisation (DSRO) have emerged recently. Dr. Anupam, currently heading DSRO, is only the second person to lead it. Lt Gen Khandare expressed admiration for the progress DSRO has made under such leadership and shared his personal optimism from interactions with Dr. Anupam.

He pointed to a significant policy shift in October 2021 when the Indian government initiated efforts to involve private players more actively in the defence and space sectors. Recalling a specific instance, he mentioned that on 21st October 2021, ten startups participated in a video conference chaired by Gen. Litter Hut with the Hon'ble Prime Minister in attendance. Since then, tremendous progress has occurred in

less than four years. Earlier, engaging private players in the defence sector was seen with hesitation and fear of the unknown. However, this perception has changed significantly. Senior officials, such as Gen. Rana and others, now directly engage with private industry, clearly articulating user requirements and expectations. This narrowing of the communication gap between users and industry is a critical improvement.

Another important trend has been the involvement of retired specialists, who are now working as mentors for startups. This has helped the number of space-related startups multiply dramatically. Cities like Bengaluru and Hyderabad have been traditional hubs, and now Pune is emerging as a new center of innovation.

Lt Gen Khandare outlined two key advantages of startups. First, they operate on limited budgets and apply the Indian principle of "jugaad" (innovative improvisation). Even ISRO historically operated with constrained resources, unlike the space programs of global superpowers. While ISRO's and DRDO's models are affordable and rugged, he stressed the need to accelerate delivery timelines. In today's rapidly changing tech environment, something new emerges every 18 months. Without speeding up execution, India risks falling behind in the technology cycle.

To address this, he emphasized the need for early and clear articulation of requirements by users, along with active collaboration between users and developers. Such synergy will enable faster and more effective outcomes. While startups are doing well in launch services, satellite manufacturing, and payload development, certain critical areas like **hyperspectral imaging** require more attention. He highlighted that in the civilian sector, hyperspectral imaging has advanced to the extent of detecting plant diseases with high precision. The military, however, still needs to define actionable applications for such technologies. He noted that for nearly a decade, there's been talk about the lack of a centralized directory or mechanism that helps users



work with intelligence agencies and tech teams to **find solutions**, rather than merely report problems.

He called for a faster pace in the space race, especially regarding national utilization of space and space-based assets. Another major challenge he highlighted is **human resource development**. He pointed out that the current approach must change—we need to train **specialists** with adequate knowledge and experience, ensuring long tenures and continuity in domains like space, cyber, and information warfare. These fields require agility, caution, and deep expertise.

Lt Gen Khandare also stressed the vital **integration of cyber and space domains**. As India gathers data from space assets, protecting that data is crucial. Without robust **cybersecurity and resilience**, even the best space-based efforts can be compromised. Therefore, cyber preparedness must go hand-in-hand with space advancements. He made an important appeal to the **industry**, particularly those hiring veterans. He urged them **not to use veterans merely as salesmen**, as that's not their area of expertise. Instead, use them as **mentors**, where their real value lies—they can help the industry succeed through their knowledge, leadership, and domain experience.

To foreign participants looking at India as a market, he offered a key recommendation: rather than merely

offering services, come with **joint venture proposals**. He encouraged them to choose Indian partners with ISpA's support. There is ample opportunity for meaningful collaboration not only within India but also to serve the broader Asian region. He reminded the audience that the world has seen an increasing push for **leveraging strategic assets** since the start of the year, and India must actively learn and respond to this global trend.

He concluded by expressing his appreciation for startups that are innovating within short timelines, as well as legacy industries like **Tata, L&T, and Godrej**. He acknowledged their decades of contributions, especially to ISRO's success, and stated that India's space journey has, in many ways, ridden on their shoulders.

In his final remarks, he shared two compelling insights:

1. **Dr. Samir V. Kamat** recently stated that India will likely achieve **90% Atmanirbharta (self-reliance)** in the space and defence sectors within the next **10 years**—a major encouragement and challenge.
2. When asked about India's most critical focus areas for the next decade, the **External Affairs Minister** replied succinctly: **Semiconductors and Space**.

These two areas, Lt Gen Khandare concluded, will define India's strategic and technological future.



Keynote Speaker: Dr Anupam Sharma, Director Special Project, DRDO



Dr. Anupam Sharma began his keynote address with an inspiring message that set the tone for his entire address. He stated that whenever he interacts with industries or startups, he sees them as a reflection of a new India. He often tells them in Hindi: **"Karo kuch aisa ki duniya banna chahe aapke jaisa"**- urging innovators to build something so impactful that the world aspires to follow their example. He emphasized that his talk wouldn't focus on where India is weak, but rather on the strengths the nation possesses and the ways to build upon them to reach the next level of technological advancement.

He highlighted four central themes of his address. First, he stressed the need for a unified vision where startups, industries, and R&D organizations perceive themselves as national contributors-soldiers without uniforms-working together for the greater good. Second, he pointed out that while the military has traditionally been seen as a hub of innovation, today the civilian sector is making equally remarkable strides. He advocated for a stronger military-civil fusion, where defence learns from the commercial world and adapts faster. Third, he posed a crucial question: if India were to face a war tomorrow, are we ready? He urged everyone to consider their role in such a scenario. Fourth, he pointed out the excessive reliance on imported, space-qualified solar cells and highlighted indigenous efforts that have begun addressing this gap.

Dr. Sharma then transitioned to the broader context, stating that space has become the fifth domain of warfare alongside land, sea, air, and cyber. For India, indigenous development in the space domain is not just a matter of pride but a necessity to establish credible and autonomous space defence capabilities. Real-time space situational awareness

(SSA) holds the potential to significantly enhance strategic operations. Historically, space played a supporting role in reconnaissance and communication, but over the past two decades, it has transformed into a more active arena of engagement, with kinetic and non-kinetic assets being targeted and used.

He pointed out the emerging opportunities for startups and industries, emphasizing that 30% of global space-related spending in the next five years will be on national security, 24% on satellite communications, and 21% on AI and edge computing for onboard satellite operations. India is already leveraging AI in satellite technologies, and there's immense potential to scale this further. Earth observation and remote sensing, though historically dominant, will account for just 10% of the upcoming global spending-signaling a shift toward dual-use and defence-centric technologies.

Dr. Sharma emphasized critical advanced technologies that are powering space operations. **Artificial intelligence and machine learning are vital for autonomous decision-making and real-time detection.** These tools are essential for managing constellations of satellites and ensuring synchronized operations. **Quantum sensors and gyroscopes offer the potential for navigation systems independent of GPS-vital in denied environments.** Hypersonic and reusable spacecraft will be key to enabling rapid deployment, blurring the lines between aerospace and outer space.

He also highlighted the importance of direct energy weapons, cyber capabilities, and scalable satellite constellations for ISR (intelligence, surveillance, and reconnaissance) missions. The trend is shifting from deploying a few high-reliability satellites to launching swarms of interconnected small satellites-providing resilience, cost-effectiveness, and coordinated action capabilities. Further, Dr. Sharma touched upon **inter-satellite communication, autonomous satellite management, and refuelling-areas where countries like China are aggressively advancing. The U.S. has already established a full-fledged Space Force and has demonstrated significant mastery over ISR capabilities, setting benchmarks for others.** India,



too, has notable strengths. **He cited success stories of Indian startups that have drastically reduced costs—such as building an unfurlable antenna at one-tenth the cost, and manufacturing solar panels at a fraction of the global price.**

Dr. Sharma proudly pointed out that **India has launched over 400 satellites for 31 countries using platforms like PSLV, GSLV, and SSLV. Our software base, data fusion capabilities, skilled manpower, and advancements in cyber and electronic warfare have laid the foundation for a strong space ecosystem. DRDO's ASAT test, BMD programs, and integrated C4ISR frameworks reflect this growing capability.** He acknowledged the government's proactive role in supporting startups and private industry through initiatives like IN-SPACe, iDEX, the 2023 Space Policy, and liberalization of FDI. Today, India boasts over 200 space startups, backed by more than \$124 million in private investment. These startups have developed sensors, green propulsion systems, hyperspectral payloads, and real-time space situation awareness technologies. Notably, some of these propulsion systems are 30% more efficient than traditional hydrogen-based ones.

He shared his vision of building a military-industrial ecosystem where academia, startups, government

R&D, and defence contractors co-develop cutting-edge technologies. The aim is to establish Space Innovation Hubs capable of delivering dual-use technologies at scale. A seamless military-research-industry coordination will bolster national deterrence and enable rapid development of critical technologies without compromising on indigenous sovereignty. While recognizing the achievements, Dr. Sharma did not shy away from addressing challenges. These include dependence on foreign semiconductors, radiation-hardened chips, and the need for an indigenous space-grade manufacturing ecosystem. He emphasized the need to overcome bureaucratic delays and streamline funding processes. Additionally, India's SSA assets and capabilities must be rapidly expanded to match global developments in the weaponization of space.

In conclusion, Dr. Sharma called for strengthening the role of the Defence Space Agency (DSA), which has been operational since 2018, and integrating space warfare doctrines into national military strategies. He stressed the importance of developing export-worthy systems and proudly shared that every month, the Ministry of Defence evaluates proposals for exports developed by Indian startups. This, he said, is a testament to the growing confidence in India's private sector and the country's journey toward self-reliance in the space defence domain.



Address by Guest of Honour: Vice Admiral SN Ghormade PVSM AVSM NM (Retd), Former Vice Chief of Naval Staff, Indian Navy



Vice Admiral SN Ghormade PVSM AVSM NM (Retd), Former Vice Chief of Naval Staff, Indian Navy appreciated the conceptualization and execution of the event that brought together leading minds from the scientific community, entrepreneurs, academia, and the space industry to deliberate on diverse topics. He noted that India's space policy is undergoing a remarkable transformation, shifting from a primary focus on socio-economic development to include national security and international prestige. The Indian space industry, projected to grow to \$44 billion by 2033, has immense scope for expansion, particularly for the private sector. Under the visionary leadership of Honourable Prime Minister Shri Narendra Modi Ji, India is establishing itself as a credible space power through ambitious missions like Gaganyaan and the Indian space station initiative. **The strong foundation of indigenous capabilities, commercial space ventures, and plans for space exploration present significant opportunities for private players to contribute innovations, especially through models that emphasize acquiring solutions over assets, thus reducing investment costs and procurement time.**

He emphasized that the **Indian Armed Forces are keen to leverage such models for fulfilling their space-based Maritime Domain Awareness (MDA) needs.** Indian industries must compete in satellite-based services and ground systems, contribute components, and become key players in defence startups. As the global space economy approaches the \$1 trillion mark, India must build its indigenous technological capabilities to become a significant player. This was echoed in the inaugural session and

subsequent discussions. Nurturing a robust space ecosystem is crucial to potentially disrupting global space dynamics and enhancing India's operational readiness.

Despite advancements, he pointed out that India still lags behind some neighboring countries that have rapidly expanded their space programs. This gap can be bridged by investing in advanced space assets, leveraging cutting-edge technologies, and forging strategic R&D and industry partnerships. The integration of space systems into defence operations is a force multiplier. The rise of private sector involvement and defence startups presents a historic opportunity to enhance capabilities in surveillance, navigation, and strategic communication. He stressed the importance of capitalizing on recent national policy reforms to ensure global competitiveness.

Several Indian startups are already contributing to India-US space and defence collaborations, emphasizing the need to strengthen partnerships and adopt emerging technologies such as agile satellites, synthetic aperture radar, AI/ML, edge computing, laser ranging, miniaturization, quantum communications, cyber hardening, on-orbit maintenance, and defence applications. However, he acknowledged challenges such as funding gaps, limited early-stage investment, a shortage of skilled professionals, and the lack of specialized educational programs. Only one dedicated Indian Institute of Space Technology exists, indicating the need for more institutions and academia-industry collaborations. While India has developed launch capabilities, many startups still rely on foreign rockets due to cost and capacity limitations. Developing reusable launch vehicles is crucial to reducing this dependence.

He also emphasized that while non-cost and non-commercial (NCNC) models may sound attractive, success demands commitment and some level of investment. There must be a sense of ownership from both users and entrepreneurs. Startups and MSMEs must be treated as project partners, not just vendors. Currently, India's regulatory framework for space is fragmented and



lacks a unified legislative mandate. **He recommended steps like expanding private funding, supporting domestic investments through initiatives like the Kavach fund, boosting R&D, and strengthening infrastructure. Production-linked incentives (PLI) should be introduced for space-grade components, adding space as a sector alongside the existing 14 under PLI.** He called for establishing more space-focused academic programs in IITs and other institutions, and creating dedicated space industrial corridors like Florida's Space Coast. India should strengthen bilateral agreements with agencies like NASA, ESA, and Roscosmos, and encourage rideshare missions for startups. ISRO's technology transfer initiatives must be expanded to help startups commercialize innovations. Space-based applications for agriculture, disaster management, and urban planning will drive future growth. Promoting indigenous manufacturing of space-grade electronics is essential for technological independence and long-term national growth.

A comprehensive Indian space law and integrated regulations are needed, along with inclusion of space electronics in STEM education, defence collaboration, and a national strategic investment roadmap. He particularly highlighted the need for indigenous LEO SatCom service providers for maritime operations in the Indian Ocean region. Presently, forces rely on foreign systems, which come with high costs and security concerns. Indigenous development of compact maritime SatCom terminals and inter-satellite links is essential. Financial

and procedural provisions must be adapted to promote procurement from domestic industry, startups, and MSMEs.

He stressed the **importance of revisiting mandates like LST or OT conditions to allow hiring and leasing of space-based services, with clear Minimum Order Quantities (MOQ) for strategic sectors.** A strong organizational mechanism is needed to promote synergy between DRDO, ISRO, and private players to fully realize developed technologies. India must also focus on building its own ground station network and data relay satellites. Currently, Indian firms rely on foreign networks like Amazon Web Services, raising data security issues. Indigenous ground stations would support "Ground Stations as a Service" models and improve turnaround times for satellite data delivery.

He concluded by saying that with robust collaboration between government bodies like ISRO, private enterprises, and defence forces, India can transform its space capabilities and strategic standing. Given the global momentum, a "whole-of-nation" approach is needed to build a comprehensive space ecosystem. He called upon all stakeholders to embrace innovation, invest in advanced research, and build a self-reliant, technologically advanced space and defence ecosystem. The future belongs to those who dare to innovate, and with collective effort, India will not only keep pace with global developments but set new standards. He commended ISpA for organizing an enriching symposium and expressed gratitude for the opportunity to share his thoughts.



Address by Guest of Honour: Lt Gen DS Rana PVSM AVSM YSM SM, DG DIA



He highlighted that the event stands as a strong example of India's progressive path in the space sector. He emphasized that it provides a platform for all stakeholders to engage in important discussions about current and future challenges in space. He pointed out that in today's complex political environment and rapidly changing technology landscape, space is no longer the "next frontier" but the current frontier, offering huge advantages to those who can harness its potential.

He explained how space-based technologies have become essential in military operations. These technologies support reliable communication, battlefield awareness, high-precision strikes, and operations with minimal damage. Drawing from recent conflicts, he cited the Russia-Ukraine war as a powerful example. Ukraine used commercial satellite imagery, GPS, and communication support from the US and Europe to gain a tactical edge. Russia, initially at a disadvantage due to older technology, quickly upgraded its surveillance systems by deploying high-resolution satellites such as the Bars-M series. Russia also used electronic warfare capabilities to disrupt Starlink, GPS, and Galileo communications, showing its ability to counter space-based assets.

He pointed out that today's wars clearly indicate that the militarization of space is real and no longer a science fiction concept. He recalled that the launch of the Corona spy satellites by the US in 1959 marked the beginning of space-military interaction. Over time, there has been intense competition in this area, especially between major powers. Thankfully, the Outer Space Treaty of 1967 has so far prevented the use of weapons of mass destruction in space.

After the fall of the Soviet Union, China rose as a major

space power. China realized the importance of space during multi-domain operations in events such as the Gulf War, the Taiwan Strait Crisis of 1996, and the Kosovo and Afghanistan conflicts. In response, China made long-term plans and integrated space into its national missions. Through military reforms in 2015, China brought space under the PLA Strategic Support Force and has now formed an independent PLA Aerospace Force. China has drastically increased its satellite launch numbers, carrying out about 70 launches in 2023 alone, compared to India's 6-7 launches. China's satellite systems offer a fast revisit time of 15 minutes and continuous coverage of the Pacific and Indian Ocean regions. By installing its Beidou system in Pakistan, China has also ensured highly accurate targeting capability in this region. He mentioned that China has also achieved advanced capabilities like in-orbit satellite refueling, repair operations, quantum experiments, and high-speed optical communication. Moreover, China has established ground stations in 17 countries and is using space diplomacy to expand its influence. Pakistan's space program is also growing with China's help. In 2023 and 2024, Pakistan has conducted satellite launches and is partnering with countries like Turkey, Saudi Arabia, Russia, and France.

He acknowledged India's remarkable space achievements through ISRO, including missions like Chandrayaan and Gaganyaan. He added that India is now working on more ambitious goals such as manned space missions and building an Indian space station. He believes this creates great opportunities for the private sector to contribute and help bridge the technological and capability gaps. He appreciated the Indian government's efforts to involve private players through space policies announced in 2022 and 2023. He noted with encouragement that there are currently over 200 space startups in India, and the country has already made progress in key areas like hyperspectral imaging, high-resolution satellites, and indigenous space situational awareness capabilities.

Lt Gen Rana stressed that technology is evolving rapidly. What is new today can become outdated tomorrow. He emphasized that sensor resolution and sensitivity are improving significantly, and India must focus on advancing in technologies like free-space



optical communication, 3D manufacturing, miniaturized systems, and quantum computing. These require synergy among all stakeholders, including partnerships with friendly foreign countries—just as the European Space Agency collaborates across borders. He also spoke about the need for India to work on reusable rockets to enable fast satellite launches during crises. An integrated communication grid made up of high-band satellites in multiple orbits is essential to support defence communication systems and reduce decision delays. He encouraged greater exploration of near-space and investment in very low Earth orbits for faster data coverage.

Finally, he emphasized that India must not focus only on launching satellites, but also on developing software and analytics tools to fully utilize the data collected from space. This, he said, is another important area for the private sector to contribute. He concluded by urging all stakeholders to collaborate, adapt to new technologies, and drive India's leadership in the evolving global space domain.

Special Address: Lt Gen N.S Raja Subramani, PVSM AVSM SM VSM, Vice Chief of Army Staff, Indian Army



In his special address, Lt Gen N.S. Raja Subramani, PVSM, AVSM, SM, VSM, Vice Chief of Army Staff, Indian Army, outlined what the Indian Army needs from the space ecosystem. To explain this, he began with four real-world examples. **The first was from the Israel-Hamas conflict, where an individual firing a rocket launcher was identified and neutralized within 30 seconds, showcasing the power of real-time observation.** He emphasized that the Indian Army's primary need is to know the exact location of the enemy—this relates to Intelligence, Surveillance, and Reconnaissance (ISR). The second example was from Israel's defence strategy, where satellite imagery was used to detect tunnel locations with high precision. Another example was from Palantir, a company that demonstrated its ability to track and predict movements of Iranian high-value assets over time, which helped identify when and where those assets would gather. This demonstrated the importance of reducing the

time from sensing a threat to targeting it effectively.

He also cited how, during the early phase of the Russia-Ukraine war, Russia disabled Ukraine's communications, which were later restored with help from Elon Musk's Starlink. Real-time imagery and intelligence provided by the U.S. and Europe enabled Ukraine not only to continue fighting but also to target Russian assets effectively. Additionally, Russia quickly adapted by using electronic warfare to neutralize many European precision weapons. These examples highlight the **critical need to detect and target enemies swiftly and accurately.**

Based on these insights, Lt Gen Raja Subramani laid out specific requirements for the Indian Army. **Firstly, the need for comprehensive ISR capabilities—day and night—using optical, infrared, and other sensors. Persistent ISR is essential, and with more satellites being launched, the time to get usable imagery is shrinking.** Ideally, the Army should be able to identify a target within 15 minutes and have satellites or sensors directed to areas of interest. But observation alone isn't enough—there must be infrastructure for transmitting, processing, and interpreting the data in real time using ground stations and AI tools.

He stressed the **importance of robust C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance) systems.** High-bandwidth networks, both terrestrial and space-based, must



ensure the timely delivery of imagery and data. These networks should be resilient to cyber and electronic warfare, which are increasingly used by adversaries to target communications. For this, military communications must use a mix of geostationary and low-Earth orbit satellites to ensure constant connectivity, while being secure and high-performing.

The third key point **he emphasized was precision navigation. While ISR tells the Army where the enemy is, and C4ISR supports decision-making, precise navigation ensures the Army knows its own location accurately to conduct precision strikes.** For this, the NavIC system needs rapid expansion. He also pointed out that as land forces move, it's vital to track enemy satellites-knowing their orbits and timings helps in planning movement, deception, and avoiding detection.

Lt Gen Subramani also highlighted the urgent need to defend India's space assets. As the country expands its presence in space, it must prepare to protect its

satellites from Rendezvous and Proximity Operations (RPO), cyber-attacks, directed energy weapons, and electronic warfare. Therefore, space defence must include cybersecurity, electronic countermeasures, and physical protection of assets in orbit.

He emphasized the importance of having the ability to launch satellites quickly in emergencies. This requires reusable launch vehicles, more launchpads, and the development of small, miniaturized satellites. As the Vice Chief of Army Staff, he urged the industry to focus on these capabilities to ensure India can respond in real time.

In conclusion, he pointed out that as India continues to build indigenous space capabilities, it will also become globally competitive due to lower costs. He stressed the need to indigenize critical components and promote civil-military fusion. With this approach, India can develop a powerful deterrent and significantly enhance its operational strength in the space domain.



Lt Gen A.K. Bhatt, DG, ISpA delivered Vote of thanks by expressing gratitude to Lt Gen VG Khandare, PVSM AVSM SM (Retd) for initiating the session, summarizing his key message that the future lies in “semiconductors in space,” and that India must now focus on this area. He extended special thanks to Dr. Anupam Sharma, Director Special Projects, DRDO for consistently participating in such forums and providing valuable insights into current developments and future directions. He appreciated Dr. Sharma’s clarity in highlighting the challenges, especially those impacting the private sector, and for detailing the role of DRDO in supporting the Indian defence forces, while underlining the importance of robust supply chains to help startups avoid the “valley of death.”

Lt Gen Bhatt also expressed his deep appreciation to the Vice Admiral SN Ghormade PVSM AVSM NM (Retd) who comprehensively articulated the requirements of the armed forces. He emphasized the critical need for Memorandums of Understanding (MoUs) between the industry and defence sector.

Acknowledging both Lt Gen DS Rana PVSM AVSM YSM SM, DG DIA and the Lt Gen N.S Raja Subramani, PVSM AVSM SM VSM, Vice Chief of Army Staff, Indian Army, he thanked them for clearly explaining the defence forces’ needs and for discussing the technological capabilities of India’s adversaries. He highlighted key areas like reusable rockets, cost-effective satellites, and the strategic importance of exploiting Low Earth Orbit (LEO), along with the innovative concept of “massed assets.”

He offered special thanks once again to the Lt Gen N.S Raja Subramani, PVSM AVSM SM VSM, Vice Chief of Army Staff, Indian Army for not only taking time to attend but also, like a true infantryman, laying out space-related military requirements in a straightforward and clear manner. Lt Gen Bhatt concluded by thanking the audience, especially members of the private sector, for being present to hear directly from the users about what is required for India’s defence preparedness.





SESSION IV: "MISSION DefSpace UPDATE: PROGRESS, CHALLENGES AND FUTURE"

Keynote Speaker: Dr (Smt.) Ranjana Nallamalli, Director, Directorate of Futuristic Technology Management (DFTM), DRDO



Dr. (Smt.) Ranjana Nallamalli, Director, Directorate of Futuristic Technology Management (DFTM), DRDO, shared insightful remarks during the session. She appreciated being part of the gathering and highlighted that the current session would focus on the progress made since 2022, moving beyond just identifying goals to examining real achievements. She mentioned that Admiral D V Khot would be leading the session and expressed her happiness that out of the 75 problem statements given in 2022, many startups have actively engaged and produced impactful results. She acknowledged initiatives like TDF and IDEX for bridging significant gaps and appreciated how they are driving innovation.

Referring to a recent university visit with Dr Anupam, she shared that students were working on satellite application projects. **Their advice to the students was not to start from scratch but to build upon existing work, leveraging available mentorship and resources to avoid reinventing the wheel.** She stressed the importance of breaking down a problem into constituent technologies, algorithms, semiconductors, ground stations, and clearly specifying the requirements. She emphasized that there is ample expertise available today, particularly in intelligent electronics and system design, and suggested that startups and young innovators focus more on system engineering and paper-based design before proceeding to hands-on development.

Dr. Nallamalli emphasized the critical need to address the "valley of death" in innovation—where technologies fail to translate into usable products due to lack of demand or lifecycle support. She encouraged thoughtful, paper-based planning for about 40% of the design phase to ensure robustness before implementation. She noted that TDF and IDEX

are fulfilling important roles in advancing defence-related innovation and startups.

She identified a gap in opportunities for students and academicians interested in space-related research and explained how **DRDO has addressed this by establishing 15 Defence Industry Academia Centers of Excellence, each focusing on specific technology verticals.** For example, additive manufacturing for space applications or high-temperature conditions has been given as a thrust area to drive focused research. She explained that design requirements vary greatly depending on the application—Space, Aero, etc. even if the underlying technology remains the same.

Dr. Nallamalli listed DRDO's key focus areas in space, including space-based communication with space-qualified SDRs, regenerative transponders, and adaptive optics for space situational awareness. DRDO is working on detection and tracking of satellites through both ground and space-based sensors, multi- and hyperspectral optical sensors, and long-range radar systems. Antennas, control systems, and deployable structures were also highlighted as critical research areas.

She proudly announced the **establishment of a new "Space Systems for Defence" vertical at IIT Hyderabad under a Center of Excellence.** While based at IIT Hyderabad, this vertical is open to academicians across the country. **Challenges related to hyperspectral sensors, space robotics, power and thermal management, and application of existing technologies (sensors, radars, semiconductors, metamaterials, tracking systems) to space have been issued under this initiative.**

The focus is on applying available technology rather than starting from scratch. For example, while laser-based technologies are already being developed for power transmission, manufacturing, and communication, their application in space is a current challenge area. She noted that defence mechanisms in space and modeling of space debris are also high-priority areas, particularly for protecting assets in space.



Dr. Nallamalli elaborated on how research outputs are being integrated into mainstream technology development. **Modeling and simulation tools from academia are being directly utilized by DRDO labs. Moreover, a mechanism now exists for direct academia-industry collaboration. Academia can now take industry onboard as Co-PIs (Co-Principal Investigators) on a work-share basis.** When industry investment is needed, it's possible under this model. **Alternatively, academia can transfer technology (ToT) directly to industry or startups.**

She mentioned that 11 such tripartite MoUs-between academia, DRDO, and industry-have already been executed, with 4-5 more underway. Though aligning

the priorities of three stakeholders is challenging, the progress has been promising. This model aims to bridge the "valley of death" by translating academic prototypes into visible, usable products.

Finally, she emphasized that anyone wishing to engage through this ecosystem should come with a well-thought-out plan and not just an idea. The pre-project phase must involve clear designs and planning to move quickly and effectively. She encouraged innovators to utilize the DRDO platform, visit the DRDO website, and use the dedicated email channels for communication. In conclusion, she emphasized that with collective efforts, tangible advancements in space and defence innovation are within reach.



Moderator: AVM DV Khot, AVSM VM (Retd), Principal Consultant, IN-SPACe



AVM DV Khot, AVSM VM (Retd), Principal Consultant at IN-SPACe, began the session by introducing the distinguished panelists and expressing excitement for the stimulating discussion ahead. He thanked the speakers from the inaugural session and highlighted key points leading up to the panel. He acknowledged the various challenges faced by the space sector, referencing the **"75 mission defspace" initiative**, which is two to five years old, and emphasized that it was a good time to review the progress made and identify what still needs to be done. He pointed out that there were obstacles to overcome and that the journey so far had been a learning process.

He recalled the first meeting held on May 29, 2022, when the initiative was launched in a complex and uncertain environment. Despite initial doubts, AVM Khot commended the leadership and collective efforts that turned the concept into a tangible outcome. In just four to five months, the team had transitioned from having limited knowledge of the tasks ahead to compiling a list of 75 challenges. This remarkable progress was made possible by the combined expertise and the support of various agencies, many of which were present in the room. By October 2022, the 75 challenges had been identified, and by December of the same year, the first selection round was completed. By January, the team had

finalized different aspects, and by February 2023, they had already signed the first contract with the Ministry of Defence (MoD), marking the launch of the first challenges.

He further explained that this rapid progress was part of a new approach, which, although innovative, had roots in the earlier iDEX program that began in 2014. The "75 challenges" initiative is a product of the reforms in the space sector that started with the opening of defence production to the private sector, which had primarily been limited to being part of the supply chain. This shift began in 2014 under the guidance of the Defence Minister and evolved into a broader scope where private industry could take on end-to-end production responsibilities. The reforms continued to grow over the years, culminating in the development of the "75 challenges" initiative in 2022.

AVM Khot also reflected on how the space reforms have been a long-term process, stretching from 2001 to 2022, and highlighted that while the policy and vision were clear, it wasn't always evident at the time. The initiative has been a significant contribution to policy and reform, and he emphasized the importance of collaboration among multiple stakeholders in the process. The challenges were not just technical but involved aligning the efforts of different organizations, including the Ministry of Defence headquarters, space agencies, and industry players. He acknowledged the complexity of working with such a diverse range of stakeholders but praised the efforts of all involved.

He introduced the distinguished panelists from various organizations, including iDEX-DIO, Army HQ, DSA, CYRAN AI Solutions, and Azista Industries Pvt Ltd, and expressed his confidence that the discussion would provide valuable insights into the future of space innovation and defence collaboration.



Gp Capt HS Prasanna, DSA



Gp Capt HS Prasanna Defence Space Agency (DSA) began by welcoming everyone and provided an overview of the Mission DefSpace challenges, which aim to protect India's space assets and boost indigenous capabilities through local development. He explained that this initiative is part of the **iDEX (Innovations for Defence Excellence)** under the “Make” scheme, designed to tap into innovative solutions from Indian industry and academia. Out of the 75 identified challenges, 45 have been placed under iDEX for solution development.

He broke down the 75 challenges based on their domains: **29 are related to Payload and Communication, 28 to Satellite Systems, 7 to Launch Systems, 5 to Software Systems, and 6 to Ground Systems.** These details are available on the official website. **Of the 45 challenges under iDEX, 20 are in the Payload and Communication domain, 15 in Satellite Systems, 1 in Launch Systems, 4 in Software Systems, and 5 in Ground Systems.** The aim is to leverage startups, academia, and MSMEs for rapid prototyping and solution validation.

Gp Capt Prasanna mentioned **the launch of new initiatives such as the ADITI platform and its 2.0 version, which are helping incubate higher-cost innovations. For the 28 challenges under DSA's purview, 12 are under the Make category and 16 under iDEX—divided into 5 under DISC (Defence India Startup Challenge) and 11 under Prime.**

He updated the current status of these 28 challenges: 10 have completed the High-Powered Steering Committee evaluation, 14 winners have been declared, and those winners are either in the prototyping or contractual phase. Six projects are currently in progress (five under Prime, one under

DISC), while feasibility studies for Make category projects have been initiated. **Under ADITI 1.0, four projects have completed their high-level scrutiny. In ADITI 2.0, one major challenge has been launched—focused on developing space weather monitoring systems, including onboard AI software for processing and predicting solar radiation, plasma density, and magnetometer data, along with data fusion with ground-based systems.**

He also discussed the distinction between iDEX and Make projects. **iDEX includes DISC, Prime, and ADITI tracks. For DISC, the funding model is a 50-50 cost-sharing between the government and the applicant-₹1.5 crore from each side. In Prime, the government supports projects with up to ₹10 crore. However, challenges arise for innovators—especially fresh graduates or startups—when matching the required co-funding.** While institutes like IITs may access support through grants such as those from SIDBI, many private vendors struggle to secure investment due to difficulties in establishing Minimum Order Quantities (MOQs), which deters potential investors.

In closing, he emphasized the need to institutionalize a mission-mode approach, encourage faster prototyping, and support industry-led innovations, which would be discussed in more depth during the session.

Air Vice Marshal D.V. Khot expressed appreciation for the insights by Gp Capt HS Prasanna and highlighted a key observation—that the technologies identified under the initiative were often those that India did not yet possess or had not yet developed to an operational level. In many cases, these were not complete, end-to-end products but rather component-level technologies. As a result, several challenges had to be broken down into smaller, more manageable sub-challenges.

He explained that the process of developing a product involves integrating multiple technologies, often from various domains. This interdisciplinary nature made it clear that no single agency could develop an entire solution on its own. Instead, specialized entities had to work on their respective



components, while a central integrator had to take ownership of the overarching challenge and bring everything together into a unified solution. This understanding evolved over the course of the project.

AVM Khot also referred to the introduction of a scheme named ADITI, which emerged from the need for an intermediate funding structure. It was observed that existing funding levels under DISC and Prime were too low, whereas the “Make” category projects were too high in terms of financial requirements. To bridge this gap, an interim funding

level was introduced, offering a structure of ₹25 crore from both sides (government and industry), amounting to a total of ₹50 crore. This filled the crucial funding void and enabled support for larger but not overly resource-intensive innovations.

He moved further by inviting Mr. K. Mahala from iDEX, who has been part of the initiative since its inception, to share his perspective. AVM Khot requested him to highlight major milestones, reflect on whether the initiative's progress was on track, identify the primary challenges encountered, and elaborate on the solutions that were devised along the way.



Lt Col Sanjay Kumar Mahala (Retd), Program Director, iDEX-DIO



Lt Col Sanjay Kumar Mahala (Retd), Program Director of iDEX-DIO, offered a detailed perspective on the funding dynamics and the progress of various projects under iDEX. He began by addressing the dual challenges observed in the funding model. **Firstly, he pointed out that the maximum contribution expected from startups can itself be a limiting factor. Secondly, the total fund allocation for some projects remains relatively low. Many of the initiatives span both the Make and iDEX categories—each with distinct timelines and requirements.**

He explained that while iDEX is progressing with approximately 60% of its challenges in the development stage, many Make projects are still in the feasibility stage, indicating a slower pace. **For context, the funding framework allows for ₹25 crore from government sources, with a matching contribution from the startup, totaling ₹50 crore.** However, even this amount is often insufficient for space-related projects, particularly those requiring rigorous testing, including space trials.

Lt Col Mahala highlighted that the initiative originally started with 35 major challenges and 40 sub-challenges, totaling 75. iDEX initially launched with 35 challenges. Observing its momentum, an additional 10 challenges were added during 2023–24, bringing the total to 45. Of these, about 60% are currently in the development stage, and approximately 15–20% have reached the integration phase.

To explain the progression, he broke down the project lifecycle into six milestones, where Milestone 0 represents the kickoff and Milestone 5 marks the completion of trials. Milestones 0 to 3 are considered the development phase, while Milestones 4 and 5 fall

under integration. The bulk of the challenges are currently progressing within the development milestones.

He also emphasized the technological complexity of some of the recent “ADITI” challenges, particularly those migrated from Make to iDEX in 2024. These include highly niche technologies such as neomorphic sensors and mobile ground stations, which inherently demand more time and effort due to their novelty and complexity.

Lt Col Mahala candidly acknowledged the initial skepticism from the Services, who were unsure about the feasibility and applicability of these technologies. Many of them initially viewed the proposed innovations as “James Bond-like” concepts. However, over the course of two years, there has been a shift in mindset, and Services have begun to see the potential and feasibility of these solutions.

Another significant insight he shared was the complexity of working with component and composite challenges. While integrating technologies from different startups may appear straightforward on paper, the practical execution is far more challenging. Often, three or more companies work at different paces and on diverse technologies, making integration difficult. Nonetheless, efforts are underway to foster collaboration among startups, with many of them now proactively communicating and coordinating to make the ecosystem function more effectively.

AVM D. V. Khot reflected on the involvement of the Indian Army in the iDEX initiative, specifically highlighting that the Army had the smallest share of handheld technology-related challenges at the outset. He recalled several engaging discussions that emerged around this aspect.

He then turned the conversation toward the structural and operational uniqueness of the Army Headquarters. Unlike the relatively streamlined structures of the Navy or the Air Force, the Army Headquarters is vast and complex, often likened to an ocean due to its multiple verticals and layered



organization. This structural complexity led to unique challenges, especially in terms of cross-vertical communication and coordination.

AVM Khot posed a critical question to Col Kishor Yewale, Col SP (Space), Army HQ, about how these initial hurdles were addressed. He inquired whether the Army had managed to streamline its internal processes to better engage with the iDEX ecosystem and whether these efforts had paved the way for identifying new areas of interest. He was particularly keen to understand if, over the past two and a half years, the Army had identified additional operational or technological domains it now intends to bring forward as part of future challenge statements.



Col Kishor Yewale, Col SP (Space), Army HQ



Col Kishor Yewale, Col SP (Space), Army HQ reflected on the evolution of the DefSpace initiative, expressing gratitude to ISpA for the opportunity to share his perspectives. He acknowledged that the early phase was marked by significant challenges—challenges that the stakeholders collectively navigated. He noted that even the initial task of curating problem statements posed difficulties. Each stakeholder was tasked with identifying issues that could eventually be transformed into use cases relevant to defence applications. While iDEX and Make challenges had previously been undertaken, thinking along these lines for the space sector was entirely novel at the time. The idea itself was in its infancy, making the curation process complex. However, with the concerted efforts of the Service Headquarters, DSA, IN-SPACe, and ISpA, a set of relevant challenges was formulated.

These early steps, he remarked, were truly “humble beginnings.” Over time, considerable progress has been made. Reflecting personally on the journey, Col Yewale admitted to having mixed feelings—partly satisfied with the achievements thus far, but also aware of the pace-related gaps. He acknowledged that the initial progress was understandably slow, given the novelty of the initiative, but expressed optimism that the pace would pick up in the future.

He cited the dynamic nature of technological advancement and pointed to remarks by Col Mahala regarding the progress metrics—60% development and 15–20% at the integration stage—as not quite adequate to meet the military's pressing needs. However, he remains confident that these timelines can be accelerated with more streamlined systems and inter-agency coordination.

On the matter of new challenges, Col Yewale confirmed that the Army has indeed moved forward. Through multiple iterations and engagement with industry and other stakeholders, important lessons have been learned. A fresh set of challenges has already been prepared and is expected to be released under DefSpace 2. He also candidly shared some operational pain points, such as inter-agency coordination involving a wide range of players—user agencies, private industry, DIO, DSA, and others. The structure of “composite” or “mother” challenges involving multiple vendors sometimes led to confusion or overlaps. Despite these teething issues, he noted that the processes are now stabilizing.

A specific example he provided related to challenges requiring dedicated SATCOM bandwidth. Initially, no clear roadmap existed for allocating this bandwidth. It was only when industry partners began requesting it that the need for a predefined plan became apparent. Iterative engagement with stakeholders has since helped to address such oversights. He concluded by emphasizing that these have been valuable learning experiences. With continued collaboration and refinement, he is confident that the process will evolve further and yield fruitful outcomes for all stakeholders involved. His tone was one of cautious optimism and determination to build on the foundation laid so far.

Air Vice Marshal D V Khot turned the discussion towards the industry representatives, beginning with Azista Industries Pvt. Ltd., one of the winners of a Mission DefSpace challenge. He sought the insight from Mr Bharath Simha Reddy Pappula, AGM: Space Systems, Azista Industries Pvt Ltd into how the initiative was received within the industry when it was first announced. He asked them to reflect on their initial reaction to Mission DefSpace being launched—how the industry perceived the announcements and the media outreach at the time. Specifically, he inquired whether the industry was hopeful or skeptical about the opportunity and what kind of impact the initiative had across the industrial landscape.

In the second part of his question, AVM Khot asked for feedback on the selection process and its subsequent evolution. He was keen to understand



the primary challenges that were encountered from an industry point of view, and whether these were addressed internally or resolved through systemic support.,

Mr. Bharath Simha Reddy Pappula, Assistant General Manager – Space Systems at **Azista Industries Pvt. Ltd.**



He began by expressing his gratitude for the opportunity to be part of the panel and thanked all the distinguished participants for their presence and insights. Reflecting on the announcement of the Mission DefSpace challenges, he shared that the initial response from his team and many other Indian startups was one of great excitement. It marked a pivotal moment, offering a much-needed platform for private industry to step up and contribute meaningfully to the space and defence ecosystem. However, alongside the enthusiasm, there was also a degree of skepticism and anxiety about the feasibility of implementing a programme of such magnitude.

Mr. Reddy elaborated that early interactions with some officers and representatives from the Service Headquarters revealed a limited understanding of the space sector. This created initial challenges in communication and collaboration, where both the industry and the defence services had to work together to comprehend and define requirements, delivery models, and logistics like MOQs (Minimum Order Quantities), MPQs (Maximum Production Quantities), and more. For instance, as another panelist had just shared, understanding something as specific as SatCom bandwidth allocation required deep learning and cross-agency interaction, highlighting the complexities involved.

Despite these challenges, Mr. Reddy maintained that

the experience has overall been very positive. However, echoing previous sentiments, he stated that neither the armed forces nor the industry are fully satisfied yet both stakeholders aspire to achieve much more. He emphasized that while progress has been made, several systemic and structural gaps still exist. One of the foremost points he raised was the urgent need for the **inclusion of the space sector in the Defence Acquisition Procedure (DAP) 2020**. Clarity on how space-related technologies and solutions should be handled within the DAP framework would immensely benefit the defence services, public sector undertakings, and industry players alike.

He further urged the **IDEX and DIO ecosystem** to consider **extending open challenges** beyond DISC (Defence India Startup Challenge) to IDEX Prime and ADITI. He noted that while innovative ideas do emerge, the existing funding limits (e.g., ₹1.5 crore) are insufficient for developing ambitious technologies like satellite systems or launch vehicles—leading startups to then seek MAKE-I or MAKE-II avenues, which come with their own set of complexities.

Mr. Reddy made a powerful analogy: to make a "giant leap," one must first have the space for a "run-up." He highlighted that when demands like achieving 10 cm GSD from a 500 km orbit are made, it's important to first establish intermediate steps—such as progressing from 50 cm to 30 cm GSD—rather than expecting overnight breakthroughs. He then turned to the subject of **knowledge dissemination and technical dialogues**, stating that while policy and strategic discussions are frequent, there is a glaring lack of forums that invite **scientific papers, research abstracts, and deep technical exchange**. Drawing attention to how scientific progress in other countries is often traceable through published literature, he lamented the lack of Indian-authored scholarly publications in this domain, especially post the last DSP book released years ago. He called for reinvigorating India's academic and industrial research culture to match international standards.

Another key recommendation he made was the **creation of a dedicated Directorate General for Quality Assurance (DGQA) for the space sector** within the services. Currently, inconsistency in technical definitions (e.g., "super resolution" vs.



“native resolution”) highlights the absence of a standardized benchmark. A focused DGQA would ensure consistent evaluation parameters, facilitate benchmarking against global best practices, and streamline defence-related space quality assurance processes. Mr. Reddy also acknowledged the sincere efforts of the nodal officers involved in framing MAKE challenges, appreciating their commitment and the inspiration they bring to the ecosystem. However, he pointed out a practical bottleneck: **a single officer is often responsible for managing 20–30 complex and niche technology challenges**, making it nearly impossible to provide the required depth of engagement. He recommended assigning multiple officers per challenge to ensure focused attention and continuity, especially since frequent officer transfers often disrupt the momentum of ongoing projects.

He concluded with a strong message, emphasizing the importance of **peace through strength**, and urged all stakeholders to collaboratively strengthen the ecosystem to deliver state-of-the-art solutions for national security.

Air Vice Marshal D.V. Khot acknowledged the significant points raised by **Mr. Bharath**, emphasizing their relevance and impact. He appreciated the speaker's articulation, particularly on the issues of *understaffing* and *rapid personnel turnover* within service headquarters. AVM Khot noted that while their teams had worked extensively with service headquarters, and credit must be given for their responsiveness-especially in addressing

tenure issues-this rapid turnover remains an inherent challenge that continues to need resolution. He expressed gratitude for the thoughtful insights that brought these concerns to the forefront.

Shifting the focus to Professor Manan Suri, AVM Khot highlighted the unique contributions made by him even before the inception of Mission DefSpace. He recalled that Professor Suri was instrumental in addressing the **first-ever space-related challenge under iDEX**, long before the launch of Mission DefSpace, during a time when only RDX (Rapid Development Experimentation) challenges existed. His successful execution of an AI-based challenge, developed in collaboration with some key stakeholders, stood as a pioneering effort and continues to serve as a **flag bearer** for the potential of engineering-led innovations in the space domain.

AVM Khot acknowledged the **risks undertaken and sacrifices made** during that early phase, underscoring Professor Suri's long-standing and firsthand engagement with the evolution of space innovation frameworks in India. Addressing Professor Suri directly, he appreciated his role as a **ringside observer** to the process-someone who witnessed the journey from the original schemes to the more structured Mission DefSpace initiative. He concluded by inviting Professor Suri to share his **reflections on how the DefSpace initiative has progressed**, and whether, two and a half years later, it has reached a more robust and mature stage compared to its early beginnings.



Dr Manan Suri, Founder, CYRAN AI Solutions



Dr. Manan Suri, Founder of CYRAN AI Solutions, reflected on the evolution of innovation within the defence-tech ecosystem, sharing candid insights from his own journey. He noted that while his team eventually succeeded in winning iDEX Challenge 4—the first AI-focused challenge in the space domain—they had previously faced multiple rejections in earlier editions, including iDEX 1, 2, 3, 6, 8, 10, and iDEX Prime. Despite these setbacks, he emphasized that each attempt brought valuable experience, progressively enhancing their understanding of the process and refining their approach. According to him, the iDEX ecosystem has matured over time, particularly in terms of its structure and responsiveness. Dr. Suri explained that the innovation lifecycle in such settings can be broadly categorized into four stages: interaction and sensitization of user requirements, prototyping the identified needs, induction of solutions into operational frameworks, and finally, scaling and replicating solutions for sustained impact. He acknowledged that while the first two stages have been effectively institutionalized—thanks to iDEX and associated agencies—the latter two stages still reveal structural gaps. Induction and seamless scaling remain challenges, and these "cracks in the wall," as he put it, must be addressed to realize the full potential of indigenous innovation.

Focusing on artificial intelligence, Dr. Suri described it as a foundational layer that will underpin almost all future technologies—from hardware systems to data processing. He highlighted that while the user community is increasingly seeking AI solutions, the emphasis has primarily been on achieving core functionality. However, once that threshold is met, the next step is integrating AI into operational reality, which requires a distinct shift in mindset. He urged

the defence community to invest in developing new tactics suited for probabilistic and stochastic technologies like AI, quantum, and cyber-technologies that demand strategies beyond traditional deterministic models.

To support this shift, Dr. Suri recommended the appointment of dedicated data experts or Chief Data Officers within the defence services to manage and provision data effectively. He also cautioned against the premature imposition of regulatory frameworks that might stifle innovation. While quality assurance and oversight are important, he stressed the need to first establish baseline capabilities before introducing stringent controls. These observations, he concluded, are vital for creating a vibrant and sustainable ecosystem for defence innovation, where agility, user awareness, and strategic thinking drive long-term national advancement.

Air Vice Marshal DV Khot posed a straightforward question to the panel from the services' side, inquiring how they are preparing to absorb the technologies expected to emerge from the successful execution of Mission Death Space. He asked how the services are gearing up to operationalize and benefit from these technologies, considering that a milestone has been reached and integration of these advancements is imminent. He sought clarity on where the services stand and what their plans are.

Col Kishore Yewale responded by emphasizing the spread of "space culture," referencing a previous discussion that highlighted its importance. Several measures and initiatives have been launched to foster this culture and create awareness within the military environment. While domain specialists present at such forums are generally informed about developments in space, ground-level soldiers and field personnel often lack this awareness. Initiatives to address this gap are being actively pursued.

He moved on to clarify that spreading awareness alone is insufficient. The Army is also focusing on revising Tactics, Techniques, and Procedures (TTPs). Referring to a point made by Professor Suri about the need for such revisions, Col. Yewale stated that steps are being taken at both policy and functional levels.



These revisions are underway, involving continuous deliberations. This constitutes a significant second measure being implemented. He added that initially, not all stakeholders within the Army were included in these discussions. Now, a broader spectrum of departments, including infantry, armoured units, and mechanized forces, are being informed and encouraged to think innovatively. These departments are now working on new problem statements that will aid in future developments. These, he stated, are among the key measures being undertaken.

Group Captain HS Prasanna then shared his perspective on service readiness to absorb new technology. He made three points, beginning with procurement reforms. While such reforms have started, he stressed that the pace of implementation must align with the services' ability to operationalize the new technologies. He suggested that the services should invest in test beds, simulation environments, and trial units to validate and adapt these technologies under real-world conditions. His second point focused on operational deployment in the space domain. He emphasized that such deployment should be preceded by structural war-gaming, development of standard operating procedures (SOPs), and end-user training.

AVM D V Khot then directed a question to the industry representatives. He wanted to understand how the private sector could better meet military requirements in the space domain. He sought suggestions on how the industry could scale its efforts to align with military needs.

Mr. Bharath Simha responded, stressing the importance of having clear visibility on technology readiness levels and realistic timelines for innovation from both industry and academia. He pointed out that discussions often start ambitiously but lack grounding in the actual duration needed for development.

Drawing from personal experience, Mr. Bharath mentioned that although officers involved in Feasibility Study Teams (FSTs) are committed, many of the panelists remain absent during key decision-making meetings. As a result, delays occur because pending queries from absent panelists halt progress. He questioned how this issue could be addressed.

He also discussed challenges with "Make" initiatives in the space sector, which often involve complex and expensive technologies. Many projects reach a certain stage before getting stuck. He expressed concern over the lack of transparency in the process, citing an instance where a project cleared the A1 stage without his knowledge. Months later, he was unexpectedly asked to participate further, but by then, his priorities had shifted due to a lack of updates. He noted that while the IDEX challenges are well-tracked and transparent, Make challenges often operate like a black box. He suggested that a tracking mechanism for Make challenges and their statuses would help move things in the right direction.

Prof. Manan Suri briefly echoed Mr. Bharath's concerns. He noted that while IDEX operates a digitized, portal-based system through all its stages (up to M5), other channels beyond IDEX are still reliant on paper-based systems. This creates visibility gaps for innovators. He recommended transitioning all such channels—whether ATB, ADB, or others—into a common ERP-based broadcast system that could involve all stakeholders simultaneously. He reiterated that IDEX remains the only channel with full end-to-end digitization.

AVM DV Khot then offered the final word to IDEX and asked Lt. Col. Sanjay Kumar Mahala if there were any existing or upcoming measures to address the issues highlighted by the previous speakers.

Lt. Col. Sanjay Kumar Mahala addressed the concerns raised. He began with the DAB (Defence Acquisition Board) issue. He stated that DAB was launched in 2020, amended in 2021 to include specific provisions for ITX, and further amended in 2024 to cover MPQ-related matters. Another amendment process is underway, which may include a separate chapter for IDEX. He addressed the open challenges, which have been intentionally capped at ₹1.5 crore. The rationale is to encourage single innovators to focus on technology development rather than product development. With more competitors working on a single technology, better outcomes are expected. Such technologies can then be upgraded to become future prime products. On the role of the services, Lt. Col. Mahala emphasized that the Defence Space Agency (DSA), rather than individual services, should play the major role in the space sector. Space technologies are inherently agnostic to specific



services-solutions developed for one can often serve others. Thus, DSA must take the lead, while services should focus on quickly exploiting prototypes and issuing orders. He highlighted the ITX philosophy: "make fast, fail fast, make faster," suggesting that services should embrace the idea of using services rather than owning physical assets. Startups could own the assets while services utilize them operationally.

Addressing the concern about clarity, he admitted it was a difficult perspective. Since technologies are niche and often untested, it's unrealistic to demand absolute clarity upfront. That's why they have adopted a flexible approach—if 70% of the requirement is met, orders may still be issued. Initially, only 20–30% success was expected, but recent developments show that 60% is achievable, and full completion of 75 goals could be within reach in a couple of months. He concluded by acknowledging the Make process is handled by a separate directorate, the DDP (Department of Defence Production). While he agreed that reforms are needed in the Make procedures, he admitted that the process remains long and cumbersome. He thanked Dr. Manan for his constructive remarks.

AVM D.V. Khot concluded his remarks by noting the remarkable progress that had been achieved within a relatively short span of time. He emphasized that in just a few months, some of the existing challenges would be fully addressed, with prototypes reaching completion and proving phases—an impressive pace by any measure.

At the same time, he acknowledged the multitude of challenges that lie ahead, stressing that while the road is long, even partial success is significant. He reminded the audience that just two and a half years ago, the initiative had started from ground zero. Therefore, achieving even 50% success over a ten-year horizon would be a tremendous leap forward. He affirmed that the team is on a strong trajectory, with promising results already emerging. However, he cautioned that the nature of these challenges requires a high degree of imagination and

adaptability. Quoting a former Defence Secretary, he stated that solutions will emerge as challenges surface—making this endeavour akin to walking into the fog, embracing uncertainty with courage. In doing so, he underscored the necessity of exercising a tolerance for ambiguity, making decisions despite incomplete information, and continuing to move forward. On this front, he commended the ongoing efforts and emphasized the need for enhanced funding, inter-agency integration, coordinated testing, and a seamless transition from prototype to scaled induction.

He raised pertinent questions about the "Make" scheme, suggesting that a review might be in order—or perhaps even a new model altogether. What brought him optimism, however, was the collective mood in the room: a healthy dissatisfaction and impatience shared by all present. These, he asserted, are powerful forces when directed inward toward self-improvement. He likened the needed transformation to a "leap made of small steps," highlighting the necessity of walking before running. He called for deeper introspection on how the Services intend to absorb these advancements into operational practice, a thought he had carried from the beginning. He stressed the importance of building internal structures for staffing, training, and adapting to systems driven by AI and ML, where traditional deterministic approaches would no longer suffice. He also emphasized the need for rethinking data management within the Service Headquarters, as future conflicts will be data-driven.





SESSION V: “INTERNATIONAL COOPERATION IN DEFENCE SPACE”

MODERATOR: Lt Gen Dushyant Singh, PVSM AVSM (Retd), DG CLAWS



Lt Gen Dushyant Singh, PVSM AVSM (Retd), DG CLAWS

Lt Gen Dushyant Singh (Retd), PVSM, AVSM, DG CLAWS, began the session by extending a warm good afternoon to all attendees. Acknowledging that the panel was positioned just before lunch, he assured the audience that they would strive to make the discussion as engaging as the previous one.

At the outset, he expressed his gratitude to ISpA for the opportunity to chair the session, and also extended thanks to his fellow panelists who would be contributing international perspectives on advancing space collaboration with India.

Before inviting the panelists to share their views, Lt Gen Singh highlighted a few pressing challenges. He pointed out that rapid technological advancements in the space domain are increasingly intersecting with complex geopolitical and security concerns. A dual trend was evident: while nationalism and sovereign interests were on the rise, these developments often clashed with the concept of

space as a global commons. He observed that although space had long been considered a shared domain, recent years had witnessed growing militarization and weaponization, elevating national security dependencies on space assets and thereby complicating international cooperation.

He emphasized the need to find collaborative solutions to this militarization and to address the issue of space traffic management. Noting the presence of approximately 7,500 active satellites and over 1.2 million trackable objects in orbit—with some estimates suggesting over 130 million pieces of debris—he called attention to the urgency of developing effective regulatory mechanisms for space congestion and debris management.

Lt Gen Singh highlighted the potential role of strategic international platforms such as QUAD, NATO, and the Artemis Accords, which emphasize transparency and rule-based, peaceful space



exploration, especially in lunar and deep space activities. He believed India's global partnerships, particularly with strategic allies, could be instrumental in addressing these global space governance challenges.

He then invited Mr Noel Ballot, EVP Sales & Marketing, SAFRAN Data Systems to share his opening thoughts on how international defence partnerships in space are evolving and the strategic advantages they offer in security and capability building.



Mr Noel Ballot, EVP Sales & Marketing, SAFRAN Data Systems:

Mr. Noel Ballot, Executive Vice President, Sales & Marketing at SAFRAN Data Systems, provided a concise overview of their key areas of collaboration in the space and defence sector, particularly focusing on *space domain awareness* and *space situational awareness*. He emphasized that with the increasing number of satellites in orbit, ensuring their protection is critical. SAFRAN is actively developing solutions in this domain and has been working closely with India, having recently participated in joint exercises in mid-March—events that proved highly relevant in the current international context. He highlighted the importance of utilizing diverse sensors for effective space situational awareness, as no single sensor can provide all necessary information. The real challenge lies in extracting actionable insights from the vast amount of data generated, making collaboration in artificial intelligence and machine learning for data processing a significant area of focus.

Mr. Ballot also underscored the vital role of international cooperation in the ground segment. Regardless of advancements in satellite communication—whether through optical or RF links—data must ultimately be collected on the

ground. Ensuring the integrity of this data demands robust cybersecurity measures. He pointed out that relying solely on ground stations within India presents challenges, such as limitations in real-time data refresh rates. To address this, a globally distributed network of ground stations is essential. While it is not necessary to own ground infrastructure in every country, the emergence of *ground segment-as-a-service* companies is proving crucial. Long-term, trustworthy collaboration among these international players is key. He noted that while many of the legacy operators were initially focused on GEO satellites, they have now expanded their networks to support LEO and MEO operations. He expressed hope that indigenous players will also scale up quickly, setting the stage for promising international collaborations.

Lt Gen Dushyant Singh, PVSM AVSM (Retd), Director General of CLAWS, acknowledged several critical aspects discussed by Mr. Noel Ballot, including space awareness, situational awareness, data processing, and cybersecurity. He pointed out, however, that ground station collaboration presents more complex challenges compared to space-based assets. He posed a key question regarding the mechanisms through which ground station collaboration could be enhanced, and the potential obstacles that might arise in this domain.

Mr. Noel Ballot, Executive Vice President, Sales & Marketing at SAFRAN Data Systems, responded by identifying the primary challenges as those related to the operational load of ground stations, the frequency and number of satellite passes they need to capture, and the associated data transmission demands. He stressed the importance of cybersecurity in this context. He also noted that while typical ground-segment-as-a-service providers are critical, they often leave coverage gaps that could be effectively addressed by local players—particularly in India. Given its strategic geographical location, alongside regions like South Africa and Australia, India is well-positioned to significantly contribute to comprehensive global ground station coverage.

Lt Gen Dushyant Singh, PVSM AVSM (Retd), Director General of CLAWS, then acknowledged the valuable insight provided by Mr. Ballot, particularly regarding India's potential role in ground



station collaboration—a point that merits further development. Transitioning to the next speaker, the Moderator invited Alexander, who brings extensive experience from the European space and defence sector, to discuss the European defence initiatives and commercial innovations aligned with frameworks such as NATO. The Moderator sought insights on how these international forums might be



leveraged **Mr. Alexander Jeuck, Senior Adviser at Novaspac**, delivered a compelling presentation during the Indian Defence Space Symposium, offering insights into the evolving landscape of space defence and security. He began by thanking ISpA for the opportunity and introduced his presentation titled “*Space Defence and Security Market Dynamics*”. Mr. Jeuck explained that this theme reflects the driving forces behind increasing international cooperation in defence-related space activities.

Representing Novaspac, a global consultancy formed through a joint venture between SpaceTec Partners and Euroconsult, he noted the organization's experience in conducting over ten defence consultancy missions in the past three years and serving around fifteen defence clients over five years. This background has provided Novaspac with a broad view of global trends in defence space investment. Mr. Jeuck emphasized that 93 organizations, including national governments and international bodies such as NATO and the European Union, are actively investing in space capabilities. He pointed out that while filings for space frequency usage are restricted to sovereign nations, organizations also play a significant role in collaborative frameworks. He noted that 52 entities are investing in space, and 15 countries have

established space commands in the last five years. Turning to budgets, he highlighted that only 2.6% of the global military budget currently supports space defence and security — a number expected to rise significantly. According to Mr. Jeuck, this underlines the importance of platforms like the Indian Defence Space Symposium, which brings together academia, users, startups, and industry giants to drive forward the agenda for a resilient and collaborative space ecosystem. From a market perspective, he shared that 84% of the global space economy is centered on services, with space defence and security contributing only 7%. Between 2014 and 2023, about 10,600 satellites were launched, of which just 5% were defence-related. By 2024, that number is expected to surge to 36,900, with 9% designated for defence use — a significant leap driven by international demand and partnerships.

India's launch capabilities position it uniquely in the global landscape, Mr. Jeuck noted, especially as many nations lack independent access to space. He projected the launch of around 250 defence and dual-use satellites in 2024, with primary focus areas including ISR, secure satellite communication, signals intelligence, and technology demonstrations. He emphasized the role of proof-of-concept demonstrations in accelerating capabilities and called for cross-sector cooperation — uniting industry, academia, and government stakeholders. He described space defence and security as a dynamic domain, constantly evolving with changing technologies and threats.

According to Mr. Jeuck, partnerships must carefully balance national priorities with shared global security interests. He identified two critical challenges:

1. The need for greater international collaboration.
2. The need for more streamlined public-private partnerships, especially with emerging industry players.

He cited examples of collaborative efforts such as NATO initiatives and the expanding role of the U.S. Space Force. He also referred to industry-led secure satellite constellations like WGS and Skynet, noting that similar collaborations would soon extend into ISR and positioning systems, with added focus on resilience and hardened designs. Offering a



European perspective, Mr. Jeuck underscored the importance of partnerships beyond EU boundaries, including with the UK, Canada, and Israel. A highlight was the IRIS² initiative — a European program designed to develop a resilient communications constellation using a blend of commercial and specialized technologies. This model seeks to complement national assets, not replace them.

In conclusion, Mr. Jeuck emphasized that while high-bandwidth communications are valuable, what matters most for soldiers and warfighters is consistent, tactical-level connectivity. Ensuring this reliability, he argued, will require thoughtful partnerships and integrated strategies across borders and sectors.

Lt Gen Dushyant Singh, PVSM, AVSM (Retd), Director General, CLAWS, offered a reflective and good-humored interjection following the presentation by Mr. Alexander Jeuck, acknowledging the time constraints of the session. Lt Gen Singh noted that although the session was tightly scheduled, the depth and importance of the insights shared made it difficult to remain within strict time limits. He graciously excused Mr. Jeuck for exceeding the allotted time, recognizing the value of the content presented.

He illustrated the challenge of concise communication with a humorous remark: *"If you give me a task to speak for five minutes, I might need two weeks to prepare. But if you ask me to speak for an hour, I'm ready now."* This was met with appreciation from the audience, offering a moment of levity amid an intense and insightful discussion.

Transitioning smoothly to the next topic, Lt Gen Singh invited **Col Baljinder Singh (Retd), Director for Aerospace & Defence, USISPF** to take the floor. He requested Col Baljinder Singh to highlight aspects of US-India cooperation in the space domain, with particular emphasis on interoperability. He emphasized that meaningful collaboration in the space sector could not be achieved without the ability to communicate effectively across systems and platforms, pointing out that interoperability remains a foundational requirement for strategic alignment and joint operations between partner nations. To enhance global space collaboration, Col. Baljinder Singh (Retd), Director for Aerospace &



Defence at the U.S.-India Strategic Partnership Forum (USISPF), began his remarks by expressing gratitude to Gen. Jan for the invitation to share his insights. He opened by underscoring the enduring wisdom behind an adage—that space is vast, abrasively demanding, and financially exhausting—emphasizing that no single nation can dominate this infinite frontier. In that light, he highlighted the importance of international collaboration in the space domain.

Col. Singh noted the historic contributions of the United States to India's early space program, particularly during the 1950s and 1960s. He cited the establishment of the Thumba Equatorial Rocket Launching Station as a pivotal example of U.S.-India cooperation, which significantly accelerated both India's space capabilities and broader economic development.

Reflecting on the present state of collaboration, Col. Singh observed that U.S.-India space relations have grown exponentially. He referenced Prime Minister Modi's recent visit to the United States in February, which reaffirmed the Indo-U.S. Comprehensive Global Strategic Partnership. The year 2025, he noted, is being hailed as a landmark year in civil space cooperation between the two countries. Key milestones include plans for a NASA-ISRO collaboration under the Gaganyaan mission, which is expected to involve a private astronaut mission and potentially send the first Indian astronaut, to the International Space Station. He further highlighted the successful launch of the NASA-ISRO Synthetic Aperture Radar (NISAR) mission—an earth observation satellite utilizing dual radars developed jointly by India and the U.S. This satellite is designed to track environmental and climatic changes such as glacial dynamics, biomass distribution, groundwater



reserves, and disaster patterns, making it a vital tool for climate resilience and disaster management globally. Col. Singh pointed out that the two nations are working closely on emerging areas like long-duration human spaceflight, planetary protection, space sustainability, space tourism, and advanced space manufacturing. He emphasized the growing private sector involvement and the potential for joint industrial missions. He also mentioned the significance of India's signing of the Artemis Accords, joining 53 other nations in promoting the peaceful use of outer space. He elaborated that the Accords, supported under both the Trump and Biden administrations, have served as an innovation bridge to enhance cooperation in critical and emerging technologies—including space.

Col. Singh shared insights from his participation in the INDUS-X dialogue held in the United States, where General Stephen Whiting, Commander of U.S. Space Command, expressed strong interest in collaborating with India in cyber and space sectors, areas seen as critical for future strategic alignment. Highlighting a notable bilateral initiative, Col. Singh referred to the joint challenge launched in November by the U.S. Defence Innovation Unit (DIU) and India's IDEX program, which focused on detecting and tracking spacecraft in contested Low Earth Orbit (LEO) environments. Selected companies from this challenge will collaborate with DRDO, the U.S. Department of Defence, and other agencies, gaining access to mentorship and market opportunities in both countries, including partnerships with major American defence contractors like Northrop Grumman, Raytheon, and Lockheed Martin.

He underlined the transformational potential for Indian companies accessing the U.S. defence and space markets, estimating possible annual revenues in the range of \$500 million to \$1 billion—a substantial opportunity for India's emerging space sector. Col. Singh concluded by referencing the TRUST initiative—Transforming Relations Utilizing Strategic Technologies—announced in the joint statement from February. He highlighted space as a major pillar of this initiative. During a recent visit, John Gibson, J5 from U.S. Space Command, showed keen interest in Indian startups and had productive engagements with them, signaling a promising future for continued bilateral cooperation in the space domain.

Lt Gen Dushyant Singh emphasized that India-US collaboration has reached remarkable depths, particularly in the defence sector, which now involves real-time information sharing. He noted this development as a significant step forward. While appreciating the robust Indo-US relationship, he expressed hope for a similar deepening of collaboration with European nations, especially in defence and space.

He also raised concern about the critical role of space in disaster management, referencing contemporary warnings about potential seismic disasters in India. He stressed that space-based systems could serve as early warning mechanisms, preventing large-scale damage. In this context, he posed a key question to the panel: *What role should private players play in international defence collaborations—particularly in areas such as debris tracking, satellite protection, and orientation communication systems?* He invited further reflections from the panel on this important issue.

Mr. Alexander Jeuck, Senior Adviser at Novaspace, began by expressing gratitude to ISpA for the opportunity to participate in the discussion. Reflecting on his own professional journey from defence to space, he remarked on how rapidly the space domain has evolved. He described the transformation of space from an exploration-driven activity in the 1950s and 60s, to a fully-fledged economy after the enactment of the US Space Act under President Obama, which allowed private entities to harness space resources—a turning point for space commercialization.

He further pointed out that in 2019, NATO officially recognized space as part of multi-domain warfare, marking its importance in global defence strategy. The emergence of new spacefaring nations and achievements—such as India's lunar mission success—highlight the changing geopolitical landscape and technological advancements that have simplified access to space.

In such a dynamic and increasingly congested domain, Jeuck argued that *international cooperation is essential*. He stressed that while nations operate under their own regulations on Earth, outer space necessitates a shared framework due to the growing volume of satellites and space debris.



From the industry perspective, he highlighted several priorities:

- **Standardization:** Companies across nations must adopt interoperable protocols to ensure seamless collaboration.
- **Technology Integration:** Private sector players must focus on rapid and effective deployment of advanced technologies such as AI, high-performance computing, blockchain, cloud systems, and autonomous satellite systems in the space domain.
- **Sustainability and Security:** Industry must play a central role in ensuring the long-term sustainability of space by advancing space debris mitigation and cleaning technologies. Additionally, the sector must uphold high standards of cyber and data security.

Mr. Jeuck concluded by underlining the balance between national sovereignty and international cooperation in the defence-space sector, reiterating that industry has a critical role to play in building secure, sustainable, and cooperative space ecosystems.

Lt Gen Dushyant acknowledged the optimistic outlook presented regarding the possibility of strengthening international collaboration in space, while still safeguarding sovereign interests. He pointed out that although sustainability and security are both vital, they often stand in contradiction to one another when viewed through a geopolitical lens—posing a real challenge in the pursuit of meaningful global cooperation. Gen. Singh noted that he would revisit these issues with more specific questions later if time permitted, and then invited the final panelist, Col. Gil Elmalem, Deputy Defence Attaché & DDR&D Attaché (MAFAT), Embassy of Israel, to share the Israeli perspective on bilateral versus multilateral collaboration in the space sector.



Col. Gil Elmalem, Deputy Defence Attaché & DDR&D Attaché (MAFAT), Embassy of Israel began by introducing the Directorate of Defence Research & Development (DDR&D), explaining that it functions as Israel's consolidated defence R&D body—playing roles similar to India's DRDO, IDEX, CSIR, and ISRO, all in one. Due to Israel's small geographic and demographic size—comparable to the Indian state of Kerala with a population of just 10 million—the country had no choice but to integrate its innovation and defence systems into a single operational entity.

The DDR&D does not operate its own laboratories or manufacturing units. Instead, it defines operational needs, manages government-funded programs, and contracts work to both state-owned and private-sector industries, including more than 300 startups through direct agreements. This model allows Israel to be agile and innovation-driven despite its constrained resources.

Focusing on Israel's space program, Col. Elmalem explained that it was launched in the 1980s, and due to geopolitical realities, Israel became self-reliant in developing and launching its own space assets. Notably, Israel is the only country that launches its satellites westward instead of eastward—a strategic decision shaped by regional threat perceptions. Although Israel has built significant in-house capability, Col. Elmalem candidly admitted that true self-reliance in space is not feasible in today's complex environment.

He emphasized that collaboration is not just a choice for Israel—it is a strategic necessity, particularly in the context of the nation currently engaging across six-and-a-half military fronts: Gaza, Lebanon, Syria, Iraq, Yemen, Iran, and partially the West Bank. Space-based surveillance and defence systems play a critical role in managing these multiple threats.

Col. Elmalem concluded by identifying two major gaps that require urgent attention: the technological gap and the operational gap—both of which, he said, can only be bridged through collaborative efforts with trusted international partners. He rejected the notion of waiting for a miracle ("*chamatkar*") and called for practical, sustained partnerships.

Gen. Dushyant Singh then thanked Col. Elmalem for his thoughtful remarks and highlighted key takeaways



for the Indian audience. Drawing a parallel to India's own strategic trajectory post-1947, he reflected on the Nehruvian model and its foundational vision for self-reliance. He acknowledged Israel's harsh regional security environment, pointing out that while India often discusses the threat of two or three fronts, Israel manages six-and-a-half.

Gen. Singh remarked that threats often act as a driver for innovation and adaptation. He concluded by referencing the growing complexity of global affairs, characterizing the modern geopolitical landscape using the acronym BANI—Brittle, Anxious, Nonlinear, and Incomprehensible—and emphasized that in such a world, collaboration, resilience, and innovation are not just desirable but indispensable.

During the discussion, Lt Gen Singh raised question regarding the "gray zone" in the space domain.

Mr Alexander Jeuck elaborated that gray zone threats primarily involve non-conventional, often non-attributable actions by major spacefaring nations that interfere with the missions of others. These threats are increasing in frequency and complexity, such as unconfirmed instances like satellite dogfights. Many existing space assets were not designed with such modern threats in mind, leading to a need for faster replacement cycles while still maintaining utility. Moreover, the threats are not limited to technology alone—they significantly involve trust, especially within constellations like the EU's IRIS².

Lt Gen Singh emphasized that space security now includes cyber hardening and the necessity for launch-on-demand capabilities to quickly replace downed satellites—especially when attribution of the threat is difficult. With war games highlighting this vulnerability, the focus shifted to increasing collaboration with Europe, particularly in the defence-space sector. India's new ₹1,000 crore venture capital fund aims to boost its space market to \$44 billion by 2033.

Mr Noel Ballot responded by underscoring the importance of sovereign access to space and pointed to increased collaboration between European and Indian private players. He cited examples like Safran's work with Skyroot and Agnikul and the rise of European startups like Sirius, Latitude, RFA, and Isar Aerospace. He also mentioned Europe's need for additional launch sites beyond Kourou, possibly including those in India.

Mr Alexander Jeuck added that financial resources and innovation are critical for space development. He highlighted that the true challenge is no longer access to space but the ability to establish high-performance computing capabilities in orbit. Leonardo, his company, is investing heavily in its own Earth observation constellation, designed with advanced technologies including onboard computing. He stressed that while government support is crucial, industrial partnerships and trust are key to progress.

Finally, when **Lt. Gen Singh** asked whether multilateral or bilateral forums are better suited for space regulation—especially with increasing near-Earth debris—**Col Baljinder Singh** emphasized the role of defence cooperation in global space traffic management, referencing policies like the US TRACSS. **Col. Gil Elmalem** concluded by highlighting that modern satellite constellations offer persistent, real-time intelligence, making international collaboration even more essential. Each country should identify its strengths and bridge gaps through global partnerships.





INDUSTRY SESSIONS



SatLeo Labs : Mr. Shravan Bhati, Founder & CEO of SatLeo Labs introduced SatLeo Labs as a space tech company focused on thermal data, noting that the company is the first in the world to work on dual-band thermal data, specifically in two key bands: MWIR (Mid-Wave Infrared) and LWIR (Long-Wave Infrared). The company's thermal data will have a resolution of less than 5 meters, and they will also incorporate a visible camera in their payload with a resolution of 3 meters. SatLeo Labs will fuse both data sets to provide high-quality RGB and dual-thermal data.

Mr. Bhati highlighted the Earth Observation (EO) data market, valued at approximately \$750 billion, which includes visible, thermal, and SAR (Synthetic Aperture Radar) data. While thermal data is not entirely absent from the market, existing data from satellites like Landsat only provides a resolution of 100 meters, which is downsampled to 30 meters. SatLeo Labs aims to provide much higher resolution data, enabling precise identification of temperatures and materials at specific locations. This capability is particularly valuable in defence applications, and the company intends to leverage AI and machine learning (ML) models to analyze the data and generate predictive models.

He emphasized that SatLeo Labs is the first company globally to focus on both MWIR and LWIR thermal data. The company plans to launch a constellation of over 12 to 15 satellites that will cover the entire globe twice a day. The thermal data will be available through an AI-based platform, with edge computing capabilities on the satellites to deliver specific, tailored information for individual customers. Mr. Bhati went on to explain the science behind thermal

data, describing how it captures heat emitted by objects. This ability makes thermal data essential for various applications, including defence, where it can detect hidden objects like underground hideouts or military barracks by identifying their unique thermal signatures. The real-time, precise nature of thermal data makes it far more effective in certain scenarios than visible data.

He also mentioned the competitive landscape, noting that while no Indian company currently works in the thermal data sector, there are companies based in Germany and the UK that are fulfilling similar needs. However, these companies mainly focus on a single thermal band for specific applications, such as LWIR for agriculture and MWIR for urban and defence-related applications. Mr. Bhati acknowledged the limited space tech skill set within India and commended ISRO as a key source of expertise for startups like SatLeo Labs. The company is working with renowned scientists who have contributed to missions like Chandrayaan. SatLeo Labs' roadmap includes launching their first prototype aboard an SSLV (Small Satellite Launch Vehicle) within 8 months and sending their first satellite into space within 18 months. They have already built a drone-based payload and captured initial data sets. Furthermore, they are collaborating with government agencies to tackle greenhouse gas emissions and identify sources of pollution.

To conclude, Mr. Bhati provided an example of the effectiveness of thermal data. While a heated pipe inside a building might be invisible in visible imagery, it would be easily detected using thermal imaging. Similarly, thermal data can identify which boilers are functioning, a task that would be difficult to achieve with visible data alone.

S M Creative Electronics: Mr. Rakesh Chand Jain, Vice President of S M Creative Electronics, began by introducing his company, which has been in operation since 1992, marking 33 years of supporting various satellite projects, particularly in the defence and space sectors. He highlighted that S M Creative Electronics specializes in providing customized power supply solutions, catering to the unique needs of the industry.



He went on to explain that the company has been a long-time supporter of ISRO, particularly in providing connectors, representing well-known companies like Positronic, COMIC, Diamond Semiconductors, Northern Government, CATS, IQE Corporation, and Kiko. Additionally, S M Creative Electronics offers spacecraft thermal solutions through advanced cooling technologies from the USA, which have already been used in large volumes by ISRO. The company also supplies thermal straps from Kika Corporation, Japan, and Technicio, Japan. Their expertise further extends to RF and microwave absorbers, complex waveguides, flexible waveguides, hexapods, optical encoders, and precision positioning systems from ISP France, all designed for payload integration. Furthermore, they provide passive components like hybrid capacitors that are small in size and have long Mean Time Between Failures (MTBF), suitable for storage in harsh conditions.

Mr. Jain specifically focused on Positronic, an American company for which S M Creative Electronics is the exclusive representative in the space industry for grid connectors. These connectors are approved by QPL and trusted across the military and space segments worldwide. The connectors provided by Positronic are designed to

withstand the harsh environments of space, offering a rugged and non-magnetic construction, along with built-in EMI and RFI shielding. They are also resistant to vibration and shock, and have undergone rigorous testing and earned certifications such as QPL, ESA, NASA, and MIL DTL 24308. The key areas of application for these connectors include space systems, satellites, spacecraft launch infrastructure, manned and unmanned space vehicles, and payload thermal control systems. Positronic's connectors are also used in electronic sensors, data storage, transfer infrastructure, and any other space segment requiring connectivity. Mr. Jain elaborated on the key features of these connectors, such as high voltage and signal handling capabilities in a single connector, solid machine contacts for durability, modular and expandable configurations, and various termination options, including solderable and crimping terminations. These connectors comply with all necessary military and space standards.

Positronic has a global presence, with offices in America, Europe, and Asia, including Singapore. Mr. Jain concluded by thanking the audience for their time and invited them to visit S M Creative Electronics' booth number four for sample testing and further inquiries.



SESSION VI: “SPACE DOMAIN AWARENESS: STRENGTHENING AND INDIA'S STRATEGIC EDGE”



This session, moderated by **Dr. AK Anil Kumar, Director, ISTRAC**, focused on the criticality of Space Domain Awareness (SDA) and Space Situational Awareness (SSA) for India's national security and space asset resilience.

Moderator's Opening: Dr. Anil Kumar highlighted the growing congestion and militarization of space, making effective surveillance, threat detection, mitigation, and strategic planning essential to safeguard national interests and maintain operational superiority. He anticipated discussion on surveillance technologies, debris management, threat detection, collaborations, India's current status, challenges, and defensive/offensive strategies.



Lt Gen Karanbir Singh Brar, AVSM, GOC, Dakshin Bharat Area, Indian Armed Forces emphasized his area's role as the hub of India's space ecosystem (ISRO, DRDO, startups). He stated that space is the fundamental enabler for multi-domain operations, arguing the Army has the greatest need due to its distributed nature. He stressed the importance of military leadership maneuvering technology



effectively and tailoring solutions to India-specific requirements rather than just copying global models. He identified space as the "centre of gravity" in modern warfare.

Air Marshal BR Krishna PVSM AVSM SC (Retd),



Former CISC, IDS HQ reflected on the growing importance of space, from early GPS trials to vital satcom use in disaster relief and its central role in Defence strategy formulated during his time at IDS/DSA. He underscored that space is for all humanity and requires a unified national effort.



Air Cmde Ashish Baduni, VSM, DSA positioned SSA not merely as a vertical but as the *foundation* for all military space activities. He pointed out the subtle but important difference between military SSA and general SSA requirements. He noted the inherently global nature of SSA data collection, achievable

through collaboration or space-based sensors, but strongly emphasized that core SSA capability, like air Defence, must be *sovereign* (hardware, software, data) and cannot be outsourced.

Mr. Marco Borghi, Senior Consultant, Novaspace



introduced Novaspace's work in space consulting and market intelligence, including specific reports on SSA/SDA. He highlighted the significant increase in global interest and prioritization of SSA/SDA over the last decade, viewing it as a key enabler for all space activities, much like launch, PNT, EO, and satcom.



Mr. Tanveer Ahmed, Co-founder & CTO, Digantara described Digantara's focus on building an end-to-end SSA solutions stack in India. He used an analogy of autonomous driving (Sensors -> Data Processing -> Analytics) to explain the SSA workflow. Digantara,



he stated, is developing and operating ground and space-based telescopes, processing the data into orbital information; and building analytical tools for decision-making.

Dr. Anil Kumar, Director, ISTRAC: Dr. Kumar provided insights from ISRO's perspective, noting SSA efforts began in 1996, primarily using US Space Command data (TLEs) for collision avoidance for India's 55+ space assets. He highlighted the changing space environment: the shift from debris

dominance (~90% pre-2020) to a growing proportion of operational satellites (~25% now, potentially 50% by 2030 with 60,000+ objects >10cm). This increases complexity, requiring operator-to-operator coordination for collision avoidance maneuvers, and even impacts launch schedules (citing a PSLV delay). He mentioned the challenge of many nations operating satellites without indigenous SSA capabilities, creating a market for SSA service providers.

KEY POINTS & CHALLENGES DISCUSSED DURING THE SESSION

(Lt Gen Brar) Need for SDA in Indian Context:

Given potential adversaries' strengths may lie in non-conventional domains (space, cyber), India's peaceful space assets (comms, banking infrastructure) are likely targets (jamming, spoofing, gray zone tactics). Effective SDA is paramount to know adversary satellite locations and intentions *before* employing any offensive or defensive capabilities (like ASAT, DEW, RPO, jamming). Knowing enemy satellite positions enables countermeasures and deception. SDA adds the crucial element of *intent* analysis to SSA's monitoring function.

(Air Marshal Krishna) Challenges & Limitations:

Challenges span technical, operational, environmental, and strategic domains. Key limitations include resource adequacy (sensors on ground/space), the need for a mix of indigenous capability and international cooperation, data quality (accuracy, resolution <10cm, standardized formats for fusion), identifying non-cataloged objects, and developing skilled human resources (operators, analysts, decision-makers).

(Mr. Marco Borghi) SDA Market Outlook:

The global SDA market is projected to be around 55–56 billion over the next decade (2024–2033). It is heavily government-dominated (55–56 billion over the next decade (2024–2033). It is heavily government-dominated (55–56 billion over the next decade (2024–2033). It is heavily government-dominated (53 B total, with \$47B Defence vs. 6 B civilian). The commercial market demand is 6B civilian). The commercial market demand is ~6B civilian). The commercial market demand is 3B. The US (>30B) and China (>30B) and China (~>30B) and China (10B) are the largest investors, followed by countries like France, India, Germany, and the UK (\$1-2B each). The trend involves more sensors (ground and space-based), data services, and software, driven primarily by Defence needs (anomaly detection, lifecycle analysis, early warning).

(Mr. Tanveer Ahmed) India-Specific Challenges:

Critical needs include generating *sovereign data at scale* to avoid reliance on potentially biased foreign sources, developing *independent cataloging capabilities* (as data processing is where manipulation can occur), and ensuring *analytics are*



relevant and actionable for commanders. Bridging the gap between technology developers and end-users is crucial.

(Air Cmde Baduni) Required Military SSA Capabilities: Specific needs include:

- **Sensors:** Ground-based passive RF receivers (for emitter identification/localization), IR/UV detectors, space weather sensors coupled with atmospheric calibration sensors. Space-based RF and Lidar for characterization.

- **Software:** Advanced data fusion algorithms (handling multi-sensor, geographically/temporally dispersed data), integrated software/networks for sensor tasking, synchronization, and crucially, prioritization/optimization (which can be contradictory in military contexts). Command and Control (C2) software for future countermeasures. Decision-support tools capable of handling massive data volumes and generating *actionable intelligence* (not just raw data). "What-if" analysis capabilities are essential given the predictive nature of SSA.

- **Sovereignty vs. Collaboration:** A debate arose on achieving full sovereign capability versus relying on collaboration. The consensus leaned towards needing indigenous capabilities, especially for sensitive data, but recognizing collaboration is necessary, particularly in the interim. Having sovereign data/capabilities provides leverage ("a seat at the

table") for meaningful collaboration and ensures co-dependency rather than just dependency (Air Cmde Baduni, Mr. Tanveer Ahmed). Air Marshal Krishna noted ISRO currently leverages free data but acknowledged its limitations.

- **Sustainability & Debris:** Dr. Anil Kumar elaborated on ISRO's IS4OM (SSA & Management) facility and Project NETRA. He confirmed active collision avoidance maneuvers (~20/year) and launch clearance checks. He highlighted ISRO's "Debris Free Space Missions by 2030" policy, committing to <5-year deorbit times and passivation, aligning with international guidelines (IADC, UN COPUOS LTS). While guidelines are non-binding, India adheres to them as a responsible nation.

- **Dedicated Space Force:** Air Cmde Baduni addressed a query about a separate space force, explaining it's an *evolutionary* process (Agency -> Command -> Force) that takes time, citing the decades-long development of the US Space Force.





Session VII: ADVANCED TECHNOLOGIES AND DEFENCE ECOSYSTEM: DRIVING FUTURE SPACE OPERATIONS”



Moderated by **AVM Rajiva Ranjan VM (Retd), Former ACIDS-ICT, IDS HQ**, this session explored cutting-edge technologies shaping future Defence space operations and the supporting industrial ecosystem.

AVM Ranjan framed the discussion by linking technological leadership (historically mechanization, electricity; now AI, space) to economic and global power. He positioned space as the ultimate high ground, critical for security and commerce, but noted its lack of established independent military doctrine compared to traditional domains. He emphasized the need for dedicated space strategy, technology, and mindset. He listed numerous future technologies (advanced propulsion, deep space comms/nav, space logistics like OMR,

manufacturing, rescue, habitation, mining) and stressed the convergence of space economy and warfighting. He questioned whether India aims to be a technology leader or follower and highlighted the need for investment, indigenization, and policy.

•Panelist Remarks & Technology Focus:



Mr. RC Jain, VP, SM Creative Electronics Ltd



Focused on the pivotal role of the sensor ecosystem for surveillance, secure communication, and missile Defence. He listed various required sensor types (optical, IR, SAR, HSI, MSI, mass sensors, RF/ELINT) for applications including debris management and power/thermal control. He emphasized dual-use applications but stressed the need for high security (encryption) for military uses. He mentioned SM Creative's contributions to ISRO (high-res cameras, CMOS/CCD sensors) under the Atmanirbhar Bharat initiative.



Mr. Sandro Panagini, VP Strategy- Space Division, Leonardo: Discussed the integration of space-based sensors with terrestrial and near-space systems within a multi-domain operations (MDO) framework. He stressed interoperability and secure communication (enabled by AI, cloud, HPC) across domains (land, sea, air, space, cyber). He highlighted the importance of the ground segment for data management (HPC, secure storage) and integrated sensor networks (including optical ISLs). Leonardo examples included the Meteosat Third Gen Lightning Imager (onboard processing), advanced high-resolution satellite imaging, precise atomic clocks (Galileo GNSS), and their proprietary multi-sensor constellation designed for responsiveness and data control. He advocated strongly for continued space exploration as a driver for technological advancement.



Mr. Shravan Singh Bhati, Founder & CEO, SatLeo Labs: Concentrated on AI and Edge Computing in space. He described the evolution from traditional ground-based processing (slow) to onboard edge computing (faster, resource-efficient – SatLeo's focus) and the future potential of in-space cloud data centers and space-based power transmission (beaming solar energy to ground), calling the latter a potential game-changer for remote Defence operations. He acknowledged Indian startups are currently tackling mid-level problems and require investment for more advanced concepts.



Mr. Ashok Saxena, Founder & CEO, SpaceTs: Covered a wide range, starting with the premise "Who controls space rules the modern world." He discussed threat analysis methodologies (Attack Trees, PASTA, STRIDE) and the role of AI/ML/DL in prediction. He detailed various threats (space weather, cyber, DEW, EW, ASAT, orbital attacks – kinetic, HPM, robotics, lasers, chemical sprayers, HANE). He touched upon missile Defence,



particularly against Hypersonic Glide Vehicles (HGVs), emphasizing the role of satellite constellations (LEO/GEO/Molniya IR sensors) and emerging HSI/UV sensors. He discussed miniaturization, resilient network architectures (Disaggregation, Distribution, Diversification, Proliferation, Protection), decoys (physical, electronic, cyber), camouflage, and concealment. He highlighted evolving operations like swarms, AI autonomy, RPO/Docking (areas Space Is works on), On-Orbit Servicing & Manufacturing (OSAM), international collaboration, and the importance of establishing norms of behavior in space.

Mr. SakthiKumar R., Founder & CEO, OrbitAID Aerospace: Focused on In-space Servicing, Assembly, and Manufacturing (ISAM) as foundational for India's space leadership. He highlighted OrbitAID's work in on-orbit refueling, including developing standardized interfaces and successful microgravity testing. He called for ISAM-specific policies and regulations in India (mirroring US OSAM strategy), mandating standard interfaces (like SPPIDER, Raft-i) for plug-and-play servicing. He stressed the need for indigenous development of ISAM subsystems (robotics, refueling tech, GNC, AI autonomy, docking ports), proposing a national roadmap involving all stakeholders (In-SPACe, ISRO, DRDO, MOD, DSA, industry), targeted funding (like IDEX), and technology transfer from ISRO. Regulatory clarity is needed for RPO licensing, STM, liability,

ownership transfer, and EOL disposal. He proposed a near-term roadmap including a national task force, prototype servicing satellite, policy papers, and university curricula.

Concluding Takeaways by AVM Ranjan: Beyond technology, critical needs include developing a skilled workforce (advocating for space-focused degrees, industry involvement in education/internships), establishing testing and certification protocols for novel technologies, increasing private R&D investment (moving beyond government dominance), potential tax incentives (like restoring Section 35 benefits), and leveraging technology spin-offs and duality (e.g., refueling tech for inspection). He concluded by emphasizing the need for domestic and international collaboration to establish India as a dominant and responsible space power.





Session VIII: “PROPULSION AND LAUNCH VEHICLES: ADVANCING INDIA'S SPACE CAPABILITIES”

This final session, moderated by **Mr. Raghavendra BM, Senior Deputy General Manager, L&T**, focused specifically on the engines and rockets enabling space access.

Mr. Raghavendra provided historical context from Goddard and Von Braun to India's Tipu Sultan and modern ISRO achievements. He highlighted the evolution of propulsion technologies (solid, liquid, cryogenic, electric) and the impact of commercial players globally. He noted ISRO's ongoing work (e.g., electric propulsion tests) and the potential of advanced propulsion (nuclear, new materials) for future exploration and cost reduction.

•Panelist Remarks:

Dr. Sudheer N, Former Director, CBPO, ISRO:



Underscored the foundational role of launch vehicles (7% of domain creating 100% business value). He traced ISRO's journey from overcoming technology denial to developing heavy-lift capabilities (GSLV MkIII). He stressed the need for India to anticipate future technologies (5+ years ahead) and leverage the startup ecosystem and incubation centers. He acknowledged the need for better commercialization mechanisms for ISRO's launch capabilities.



Prof. Arindrajit Chowdhury, CEO, InspeCity:

Explained the fundamental types of propulsion: chemical (solid/liquid for launch; different types for in-space), electric (high specific impulse/mileage but low thrust), and nuclear (future potential). He emphasized the importance of in-house development for flexibility. He introduced InspeCity's goal of building human habitats, pursued via enabling technologies like robotic servicing vehicles using their own chemical propulsion, robotics, and RPO systems. He noted the trend towards green chemical propellants (like Nitrous Oxide/Hydrocarbon mixes) for in-space applications due to safety and ease of handling.



Mr. Aakash Sinha, CEO, Omnipresent Robot Tech:

Shared his company's transition from terrestrial drones (precise mapping in India) to space



tech (Chandrayaan navigation, SAR development). He described their ambitious project to perform high-resolution (2cm GSD) mapping on the Moon using lunar-specific drones. This necessitates novel propulsion due to the lack of atmosphere, with ion and laser drives being explored. The goal is to precisely map resources like water ice. He linked India's current small global space market share partly to payload capacity limitations, which are being addressed.

Key Discussion Points & Challenges:

o Lunar Drone Feasibility (Mr. Aakash Sinha):

Addressed challenges like gravity anomalies and micrometeoroids, comparing the drone approach (flying low ~50m) with a very low-orbit satellite. The satellite option faces challenges with required camera speeds (>20k fps) and maintaining focus at high orbital velocities. While alternatives like 3D Flash Lidar exist, the drone approach leverages their terrestrial mapping experience. Ion propulsion is a key consideration for flight in the lunar vacuum.

o **India's Launch Market Share & Costs (Dr. Sudheer N & Mr. Raghavendra):** Dr. Sudheer argued that ISRO launch costs (e.g., PSLV) are internationally competitive when compared like-for-like (e.g., vs. Ariane, Atlas), dismissing comparisons with SpaceX's unique rideshare pricing model. He attributed low international uptake more to inadequate commercial marketing mechanisms rather than cost, expressing hope that reforms (NSIL, In-SPACe) and private participation (LVM3 production) will improve this. Mr. Raghavendra emphasized that scalability is the key to cost reduction, which private industry can bring

(citing L&T's K9 Vajra production). Higher launch frequency and larger vehicle production runs are needed to lower per-launch costs significantly.

o **Orbital Transfer Vehicles (OTVs) (Prof. Chowdhury):**

He described OTVs as potentially disruptive, enabling small satellites launched on large rockets to reach diverse orbits, potentially impacting the dedicated small satellite launch market. He favored faster chemical propulsion for OTVs, combined with refueling capabilities, over slower electric options.

o **Launch Infrastructure (Dr. Sudheer N):**

Expanding launch ports depends on demand and range safety constraints (finding uninhabited downrange zones is difficult in India). While Kulasekarapattinam offers advantages for SSO launches, multiple civilian ports are complex due to facility readiness requirements. For Defence, he suggested a need for mobile launchers (TEL - Transporter-Erector-Launcher concept) and strategically located, potentially hardened launch sites enabling rapid 'launch-on-demand' capabilities, similar to the SSLV's design goal.





DAY 2 OF THE INDIAN DEFSPACE SYMPOSIUM 2025: KEY TAKEAWAYS

INSIGHTS FROM THE EMINENT SPEAKERS

Opening Address: Lt Gen VG Khandare, Principal Adviser, MoD

Theme: Accelerating Indigenous Development

- Urged yearly discussions due to rapid tech-geopolitical convergence.
- Emphasised strategic autonomy amid rising “Trumpism” and global realignments.
- Recalled key policy shift from 21 Oct 2021: Startups interacting directly with PM, leading to privatisation momentum.
- Highlighted the mentorship of startups by retired specialists, with hubs growing beyond Bengaluru/Hyderabad to Pune.
- Stressed “jugaad” innovation and need to compress tech development timelines to <18 months.
- Called for actionable military applications of emerging tech like hyperspectral imaging.
- Identified cyber-space integration as vital for data security.
- Urged foreign firms to focus on JV models, not just service exports.
- It concludes with two national priorities: Semiconductor and space, which define India's future.

Keynote Address: Dr. Anupam Sharma, Director, Special Project, DRDO

Theme: Strategic Technology Vision

- Positioned startups and private industry as “uniformless soldiers.”
- Framed space as the 5th war domain, no longer a passive medium.
- Flagged urgent shift from observation to active space engagement.
- Noted major spending sectors: 30% national security, 24% SatCom, 21% AI/edge computing.
- AI/ML, quantum sensors, and GPS-independent systems highlighted as next-gen tools.
- Advocated small satellite constellations over large monoliths for ISR and resilience.
- Recognised India's cost-effective engineering: e.g., solar panels at 10% global cost.
- Supported integrated Space Innovation Hubs, linking academia, industry, DRDO.
- Identified gaps: space-grade chip ecosystem, space situational awareness (SSA), and slow funding cycles.

Guest of Honour: Vice Admiral SN Ghormade, Former Vice Chief of Naval Staff

Theme: Operationalising Private Sector Participation

- Emphasised transition from socio-economic to security-driven space policy.
- Noted India's \$44B space market potential by 2033.
- Encouraged models like “solution acquisition” over asset ownership.
- Called for space industrial corridors (like Florida's Space Coast).
- Emphasised indigenous maritime SatCom systems to reduce foreign dependence.
- Advocated for PLI schemes for space electronics and rideshare missions for startups.
- Stressed academic curriculum expansion and bilateral cooperation with NASA, ESA, etc.
- Cautioned against fragmented regulations; proposed a comprehensive Indian Space Law.



Guest of Honour: Lt Gen DS Rana, DG DIA

Theme: Geostrategic Realism and Threat Analysis

- Framed space as the “current frontier,” citing Russia–Ukraine war lessons.
- Highlighted China's rapid advances: PLA Aerospace Force, Beidou targeting in Pakistan, and SSA dominance.
- Pointed to China's ground stations in 17 nations and optical communication breakthroughs.
- Celebrated India's Chandrayaan and Gaganyaan, but urged pace and precision.
- Emphasised free-space optical communications, additive manufacturing, and quantum computing.
- Urged integrated orbital communication grids and near-space exploitation.
- Advocated software tools and AI-enabled analytics for space-derived data.

Special Address: Lt Gen N.S. Raja Subramani, Vice Chief of Army Staff

Theme: Army's Operational Needs in Space

- Explained battlefield scenarios: Israel–Hammas, Palantir, Russia–Ukraine (Starlink).
- Demanded day–night ISR, 15–minute imagery delivery, and persistent surveillance.
- Called for robust C4ISR, resistant to EW and cyber threats.
- Urged expansion of NavIC for precision strikes.
- Advocated real–time launch capability using miniaturized satellites and reusable rockets.
- Stressed need to protect Indian space assets from RPO, lasers, and hacking.

Vote of Thanks: Lt Gen A.K. Bhatt, DG, ISpA

- Reiterated “Semiconductors and Space” as India's dual imperatives.
- Applauded clarity from speakers on user needs and tech capability gaps.
- Recognized ISpA's role in bridging private sector–user community divide.
- Called for MoUs between industry and defence for seamless tech transition.

Session: Industry & Academia Collaboration

Dr. Ranjana Nallamalli, Director, DFTM, DRDO

- Reflected on post–2022 progress: 75 challenges from 2022 now showing results.
- TDF and iDEX hailed as translational bridges.
- Emphasised paper–based planning for 40% of the R&D cycle.
- Shared creation of the “Space Systems for Defence” vertical at IIT Hyderabad.
- DRDO's priorities: adaptive optics, regenerative transponders, deployable antennas, long–range radars.
- Advocated direct academia–industry ToT and tripartite MoUs (11 done).
- Warned against “reinventing the wheel”; instead, use mature design paths.

Session: Mission DefSpace Update

Gp Capt HS Prasanna, DSA

- Outlined challenge distribution: Payload (29), Satellite (28), Launch (7), Software (5), Ground (6).
- 45 under iDEX, 28 under DSA.
- ADITI 2.0 launched for space weather monitoring and AI fusion onboard.
- iDEX Prime challenges receive ₹10 crore funding; DISC remains ₹1.5 crore 50–50 cost share.
- Highlighted issue of lack of Minimum Order Quantities (MOQs) deterring investors.



Session: Industry Reflections & Gaps

Speakers: AVM DV Khot, Lt Col Sanjay Mahala, Col Kishore Yewale, Mr. Bharath Simha (Azista)

- AVM Khot acknowledged the long-term space reform trajectory (2001–2022).
- Lt. Mahala pointed to 60% challenges in the development stage, but Make projects are progressing more slowly.
- Lt. Kishore Yewale revealed the Army's learning curve, now preparing fresh DefSpace 2 challenges.
- **Mr. Bharath Simha urged:**
 - Inclusion of space in DAP 2020,
 - Dedicated DGQA for space,
 - More funding for ADITI,
 - Multiple officers per challenge to ensure project continuity.

Session: Industry Integration and Digitization

Dr. Manan Suri, CYRAN AI

- Highlighted AI as a foundational enabler across future space-tech.
- Four innovation phases: Sensitization → Prototyping → Induction → Scaling.
- Warned of “cracks in scaling and operationalization.”
- Advocated for dedicated Chief Data Officers and ERP-based ecosystem beyond iDEX.

Session: International Cooperation in Defence Space

Moderator: Lt Gen Dushyant Singh,

Panellists: USISPF, SAFRAN, Novaspace, MAFAT, Leonardo

- Lt Gen Singh noted that space is no longer a global common, increasing weaponisation, debris, and congestion.
- SAFRAN's Ballot emphasised space situational awareness + cybersecurity via a global ground-station network.
- Novaspace's Jeuck explained rising military interest: 9% of 2024's projected 36,900 satellite launches will be defence-driven.
- **USISPF's Col Singh:**
 - Recalled Indo-US legacy from Thumba to NISAR.
 - Emphasised Gaganyaan astronaut cooperation and joint DIU-iDEX challenges.
 - Hailed the Artemis Accords and INDUS-X dialogues for dual-use collaboration.



KEY TAKEAWAYS FROM THE SESSION

Strategic Focus Areas

- Semiconductors and Space are identified by India's EAM as the two most critical sectors for strategic growth over the next decade.
- Atmanirbharta (Self-reliance) goal: 90% in defence and space within 10 years (Dr. Samir V. Kamat).
- Civil-military fusion and indigenous dual-use technologies are central to future capability building. (Mr RC Jain, VP, Creative Electronics)
- Geopolitical shifts and rising "Trumpism" call for strategic autonomy through indigenous space capability. (Lt Gen VG Khandare)

Startups & Private Sector Role

- Explosion of space startups (200+ now) driven by iDex, IN-SPACe, 2023 Space Policy, and increased FDI. (Dr Anupam Sharma)
- Startups are praised for "Jugaad" innovation and rugged, cost-effective models, but urged to speed up delivery timelines. (Lt Gen VG Khandare)
- Mentorship from veterans and partnerships with legacy firms like L&T, Tata, and Godrej are strengthening the innovation ecosystem. (Lt Gen VG Khandare)
- Startups and R&D must operate as 'soldiers without uniforms' with civil-military tech fusion. (Dr. Anupam Sharma)
- Tripartite partnerships between DRDO, academia, and industry are bridging the 'valley of death'. (Dr. Ranjana Nallamalli)
- Industry must be treated as project partners, not vendors. (Vice Admiral SN Ghormade)

Technology & R&D Directions

- Hyperspectral imaging, AI for ISR, space robotics, quantum sensors, GPS-independent navigation, and cybersecurity are emphasised as frontier technology areas. (Lt Gen VG Khandare, Dr Anupam Sharma)
- Reusable launch vehicles, autonomous satellite management, miniaturised satellites, and space weather prediction systems were cited as urgent priorities. (Dr Anupam Sharma)
- Push for indigenous manufacturing of space-grade semiconductors, radiation-hardened electronics, and solar cells to reduce import dependence. (Dr Anupam Sharma)
- Need for space-based communication, adaptive optics, and cyber protection. (Dr. Ranjana Nallamalli)
- Development of compact maritime terminals, refuelling satellites, and inter-satellite links. (Vice Admiral SN Ghormade)

Defence Integration & Warfare Needs

- Space is now the fifth domain of warfare, essential for real-time ISR, precision targeting, and secure C4ISR. (Dr Anupam Sharma)
- Indian Army's core demand: Persistent ISR with real-time imagery, rapid data processing, and resilient satellite comms. (Lt Gen Raja Subramani)
- Space-based cybersecurity, electronic countermeasures, and space situational awareness are key to survivability. (Lt Gen Raja Subramani)



Policy & Structural Reforms

- Current fragmented space regulations must evolve into a unified Indian Space Law. (Vice Admiral SN Ghormade)
- Defence Acquisition Procedure (DAP) must formally incorporate space systems acquisition protocols. (Mr. Bharath Simha Reddy Pappula, Azista Industries Pvt. Ltd.)
- DGQA-like authority for space is proposed to ensure consistent quality standards across stakeholders. (Mr. Bharath Simha Reddy Pappula, Azista Industries Pvt. Ltd.)

Academia-Industry-Government Synergy

- DRDO launched 15 Defence Industry Academia Centres of Excellence, including a new "Space Systems for Defence" vertical at IIT Hyderabad. (Dr Ranjana Nallamalli)
- Strong push for tripartite MoUs and joint IP models to address the "valley of death" in translating R&D into deployable solutions. (Dr Ranjana Nallamalli)
- Emphasis on paper-based pre-project planning (up to 40%) before prototyping. (Dr Ranjana Nallamalli)

International Cooperation & Strategic Partnerships

- Global shift from "space as commons" to militarised and strategic asset, complicating cooperation. (Lt Gen Dushyant Singh, DG Claws)
- Importance of interoperability and ground station collaboration (esp. through cloud models). (Mr. Alexander Jeuck, Novaspace)
- US-India collaboration through NISAR, Gaganyaan, and joint DIU-IDEX challenges was highlighted as a model. (Col. Baljinder Singh, U.S.-India Strategic Partnership Forum)

Programmatic Progress (Mission DefSpace)

- 75 challenges issued; 45 under iDEX, 28 under DSA.
- 60% of iDEX challenges are in the development phase, ~20% in integration.
- New funding track: ADITI 2.0 launched for mid-scale high-tech projects (₹50 crore total per challenge).
- Challenges categorised under Payload & Comms, Satellite Systems, Launch, Ground, and Software domains. (Lt Col Sanjay Kumar Mahala (Retd), Program Director, iDEX-DIO)

Challenges Identified

- Delays due to personnel turnover, limited panellist availability, and non-digital tracking systems for the Make in India category. (Mr. Bharath Simha Reddy Pappula)
- Funding gaps and a lack of realistic GSD targets. (Mr. Bharath Simha Reddy Pappula)
- Need to revise Tactics, Techniques, and Procedures (TTPs) to integrate AI and probabilistic tech into military doctrine. (Col Kishore Yewale)

Cultural and Institutional Change

- Greater awareness campaigns across military ranks to instil a "space culture." (Col Kishore Yewale)
- Shift in Services' mindset: from scepticism to active participation and ownership of space-based initiatives. (Vice-Admiral SN Ghormade)
- Encouragement for "leap of small steps" approach – building long-term capacity while delivering near-term outcomes. (Air Vice Marshal DV Khot, Ex-DG, DSA)



APRIL 9, 2025

DAY 03 | THEME: “ADVANCING SPACE SECURITY & STRATEGIC CAPABILITIES”



Special Address: AVM Rahul Bhasin, ACAS (Ops) Space, Air HQ: Given the ever-increasing emphasis on multi-domain operations and the prime role that the space domain plays, he remarked that it is only fitting for professionals from this domain to regularly come together to collectively brainstorm the way forward.

He noted that the increasing dependence on space for both civilian and military applications has brought the strategic importance of the domain into sharp focus, making it critical for national security and defence. This dependence, he stated, spans a wide range of essential services and capabilities—from satellite communication and GNSS to space-based intelligence, surveillance, and reconnaissance (ISR). Focusing on the day's theme, "Advancing Space Security and Strategic Capabilities," he emphasized ISR as a critical and essential requirement for military operations, as it enhances informed decision-making capability. By concentrating on ISR, he also aimed to deconflict his talk from topics scheduled in the subsequent sessions.

Globally, ISR is widely used not only for military purposes but also for commercial and civil applications. For the military, ISR enhances decision-making, operational effectiveness, and the lethality of firepower. He highlighted that the all-important factors governing the efficacy of ISR include the speed, accuracy, and timing of the information provided. He explained that space-based ISR uses satellites and other space-based assets to gather, process, and disseminate information for military intelligence and other purposes.

The unique selling point of space-based ISR is its ability to provide near real-time and near-continuous coverage of activities of interest, ranging from troop movements and missile launches to environmental monitoring. He stated that space-based operations are critically reliant on sophisticated infrastructure, which includes upstream technologies like advanced sensors and payloads, as well as downstream technologies such as ground stations used for data dissemination and processing.

Over the past two decades, the importance of space-based ISR has been both realized and



acknowledged by the Government of India. This recognition led to the conception and execution of the country's space-based surveillance programs. He noted that those following industry updates may be aware that, towards the end of the previous year, the government sanctioned the next edition: SPS-3 which involves launching a significant number of new satellites.

Interestingly, he pointed out that these satellites will be a mix of those developed by government agencies and private industry. Along with ground and link segment requirements, this program is expected to give a major boost to the entire Indian space ecosystem.

AVM Bhasin emphasized that the latest trends in space-based ISR must be noted by planners, operators, and the industry alike, to ensure continuous capability upgrades that are both user-driven and product-driven. He enumerated key capabilities and requirements, including:

1. Moving towards constellations of smaller, more agile LEO satellites to enhance coverage and situational awareness.
2. Integrating artificial intelligence and advanced analytics into ISR platforms to improve information processing and exploitation for faster, more informed decision-making.

He further observed that global intelligence agencies and militaries are increasingly relying on space-based ISR. These assets are becoming more modular and scalable, allowing easier integration and adaptability. Cost-consciousness, he said, is pushing technology towards delivering effective, economical solutions.

An outcome of this trend is the adoption of dual- and multi-sensor satellites, which offer improved spatial, spectral, and temporal resolution at significantly lower costs.

However, alongside this rapid growth, challenges remain. These include risks across space, ground, and link segments; the hazards posed by space debris; and the competitive pressure to constantly innovate.

He advocated for a concerted effort by the entire Indian space ecosystem to overcome these challenges. The ultimate goal, he stressed, should be

to develop indigenous capabilities without prejudice to ownership or agency.

In conclusion, he reiterated that the Indian Air Force is fully committed to transforming itself into a credible aerospace power and will continue to collaborate wholeheartedly with all agencies and services to achieve the nation's required space capabilities.



Special Address by Lt Gen RS Raman, AVSM, YSM, Director General, Military Intelligence

Lt Gen RS Raman, AVSM, YSM, delivered a thought-provoking address emphasizing **India's increasing reliance on space-based Intelligence, Surveillance, and Reconnaissance (ISR) capabilities**. He noted that the Indian Army, and particularly Military Intelligence, is among the largest users of ISR data in the country—especially satellite imagery. Speaking from this user-oriented perspective, he provided a grounded view of the operational requirements and challenges in the defence-space domain.

He acknowledged the extensive discussions over the past two days on the unfolding vision for India's defence space ecosystem over the next 10 to 15 years. While India possesses robust technological capabilities through ISRO and other organizations, he identified a gap in effectively integrating these with defence requirements through streamlined processes and collaborative execution.

Reflecting on the progress made, Lt Gen Raman expressed optimism but also caution. He suggested the need for tangible planning with defined “waypoints” such as 2030 and 2035 to assess and recalibrate capabilities periodically. These milestones, he argued, help bring realism to otherwise conceptual discussions.



He contextualized the strategic environment by noting India's impending status as the world's fourth-largest economy by the end of 2024 and potentially the third-largest by 2031. This economic ascent, he predicted, would bring both opportunities and adversarial attention—both from the West and from neighbouring countries like Nepal, Bangladesh, and Myanmar. These developments necessitate enhanced surveillance capabilities, especially as military operations may be required beyond traditional borders.

Lt Gen Raman stressed that space capabilities, especially ISR assets, take time to develop and must be planned with foresight. He visualized a scenario by 2030 where the revisit time for satellite imagery could be reduced to four hours during the day—an improvement, but still insufficient for high-tempo operations. The Army's needs, he clarified, are distinct: it requires finer resolution imagery to detect small-scale activities such as trench formations and movement in concealed areas.

He advocated for a constellation of satellites providing near-real-time, high-resolution imagery with a sub-metric resolution and 30-minute revisit times. This would significantly enhance transparency and situational awareness, especially for tactical and combat group deployments. He also emphasized the need for real-time satellite communication systems capable of operating and controlling assets beyond the line of sight, supported by adequate bandwidth delivery to field units.

Highlighting the importance of proactive development, he urged for a focused effort to leap forward, not just catch up. He called for allocation of resources—both government and private sector—to meet the increasing demands of the defence sector. The role of private industry, he noted, is indispensable due to their faster, more adaptive procurement and innovation capabilities. Drawing from international examples like NASA's partnerships, he emphasized the need for public-private collaboration to accelerate progress.

Lt Gen Raman also suggested offloading assembly-line production to the private sector once technologies are matured, allowing elite institutions like ISRO to focus on innovation and new technology development rather than being burdened with routine manufacturing and administrative responsibilities.

He further recognized the growing ecosystem of startups in India's space sector. He advocated for active mentorship, handholding, and tolerance of initial failures—emphasizing that even a 60% success rate in research can instill confidence and build a foundation for future breakthroughs.

Concluding his address, Lt Gen RS Raman reiterated the necessity of strengthening ISR capabilities, fostering innovation through private partnerships, and strategically planning for a robust, forward-looking defence space ecosystem aligned with India's emerging geopolitical stature.



Special Address: Lt Gen Manish M Erry UYSM AVSM SM, DG SP

Lt Gen Manish M. Erry expressed his honor in being part of the prestigious third edition of the Indian DefSpace Symposium, organized by the Indian Space Association, which is leading the indigenous development of space technology in collaboration with private industry. Addressing a distinguished gathering of esteemed guests, scholars from academia, industry partners, and delegates, he emphasized the critical need to advance space security and strategic capabilities.

He began by acknowledging the operational requirements of the Indian Air Force and Indian Army in the ISR domain and stated his intent to focus his address on space security and capability development, specifically from the standpoint of the military and Ministry of Defence (MoD) working collaboratively with private industry. Recognizing the transformation of space from a domain of discovery



to one of strategic importance, he underlined that space is now vital for national security. Control of the space domain, he said, directly translates into strategic military advantages, and thus, countries are increasingly investing in building space-based capabilities. He lauded the policy reforms by the Government of India that have enabled deeper integration of private industry into national space efforts.

Lt Gen Erry defined space security as encompassing both the physical and operational security of space assets, including satellites, ground stations, communication networks, and the safe and sustainable use of outer space. He outlined threats such as cyber intrusions, jamming, spoofing, directed energy weapons, and kinetic anti-satellite systems. To counter these threats, he emphasized the need to strengthen national space programs, develop robust defences, enhance space situational awareness (SSA), and promote international cooperation.

He outlined several strategic areas requiring immediate attention: improving space domain awareness and SSA, building space defence and counterspace capabilities, creating resilient space systems, enhancing non-kinetic and cyber capabilities, managing space traffic and debris, and ensuring cybersecurity in the space domain. These, he said, are critical for national security, international relations, and economic progress.

Highlighting the role of the private sector, Lt Gen Erry stated that the military relies on space-based services for critical tasks such as surveillance, targeting, and weather monitoring. He stressed that the Indian military and MoD must develop strategies to integrate private sector solutions into national space architecture. Acknowledging that the private sector is driving innovation in India, he noted that its impact depends on effective integration into military operations during both peace and conflict.

He emphasized the need for robust collaborations where private players are not only engaged in satellite launches and space network development but are

also supported through scalable production, rapid technological refresh, and resilient systems. This, he noted, will enhance deterrence and secure India's interests in the space domain. He called attention to the advanced capabilities being developed by neighbouring countries, particularly the northern neighbour, necessitating India's acceleration in adopting resilient space-based capabilities.

Lt Gen Erry proposed four priority areas for collaborative action. First, he called for ensuring that private sector applications and solutions are readily available for defence use, suggesting that existing connections need strengthening and that contracts with the private sector should be streamlined and delegated more efficiently. Second, he advocated for the incorporation of space-based private solutions in daily military operations, not just during crises, to build seamless integration and readiness. Third, he highlighted the importance of enabling private industry to develop solutions that protect space assets, including establishing standards, norms, sharing threat intelligence, and providing financial support. **Lastly, he recommended stronger policy frameworks and contractual tools from the MoD to support private participation in innovation programs like IDEX and ADITI, aimed at producing mission-critical space solutions.**

In conclusion, Lt Gen Erry asserted that future military operations will be increasingly shaped by space capabilities. The militarization of space, while offering strategic advantages, also raises concerns about security and potential weaponization. He emphasized the urgent need for protocols and governance mechanisms to ensure that space remains a secure, stable, and sustainable domain, underlining that the future of defence and national security lies in effectively harnessing this new frontier.



Address by the Chief Guest: Air Marshal SP Dharkar, PVSM AVSM SM VSM, Vice Chief of the Air Staff, Indian Air Force

Air Marshal SP Dharkar expressed his honour and privilege to be present at the event. He noted that while policy developments and industrial contributions have been widely discussed, his focus would be on pragmatic steps that can be jointly taken by various stakeholders to advance India's progress in the space sector.

He highlighted the growing necessity for enhanced space capabilities, stressing the urgency to not fall behind in a domain that is becoming increasingly competitive, congested, and at times, contested. According to him, while aspirations in the space sector are natural and everyone desires a larger share of the "pie in the sky," timing and adequacy of efforts are crucial to safeguard national interests in terms of safety and security.

Air Marshal Dharkar pointed out the inherent cost-intensive nature of space activities—from design and development to manufacturing and satellite launches. He suggested that one viable path forward could be to start small, which allows the development of scalable capabilities. He noted that small beginnings often lead to success, and success, in turn, creates momentum.

He urged the industry to embrace new technologies such as miniaturization involving microelectronics and micromechanics, extensive use of artificial intelligence, cyber domain innovations including

cybersecurity, and advancements in quantum mechanics and quantum dynamics. These areas, he stated, could enable India to leapfrog ahead and remain competitive, rather than continuously playing catch-up with already proliferated technologies.

In terms of actionable pathways, he stressed the development of smaller, cost-effective satellites without compromising on capabilities. He emphasized the need for ground-based infrastructures that can fully exploit the potential of such satellites, calling for collaborative and more prolific use of existing assets. Technologies such as high-speed, high-throughput communications, efficient inter-satellite links, and rendezvous and proximity operations (RPO)—both for satellite maintenance and debris management—were suggested as critical areas for industry focus.

Air Marshal Dharkar proposed that progress in small, coordinated measures by different players in the industry could collectively create a significant impact. He concluded by reiterating that while the space domain is undoubtedly complex and costly, a strategy rooted in scalable innovation and collaboration can yield immediate capabilities and prepare the nation for future security and strategic needs.



**Special Address: AVM DV Khot, AVSM VM (Retd),
Principal Consultant, IN-SPACE**

Air Vice Marshal D.V. Khot (Retd), Principal Consultant at IN-SPACE, humorously acknowledged the presence of the Chief Guest, Air Marshal S.P. Dharkar, and fondly mentioned their longstanding association dating back 35 years, including their time as coursemates at the Staff College and collaborators during his tenure as DG DSA.

AVM Khot expressed his gratitude to the Indian Space Association (ISpA) for the opportunity to speak at the third edition of the Indian DefSpace Symposium. As a participant in all three editions, he highlighted the significant improvement in the quality of this year's event and complimented all the speakers and organizers for their outstanding contributions across various sessions. Reflecting on his participation in a panel the previous day reviewing the progress of the Mission DefSpace 75 challenges, he described the experience as heartening and encouraging in terms of the direction and growth being witnessed.

He shared how his career has granted him a unique perspective—first as a practitioner in uniform and now as an enabler in civilian attire. From this dual viewpoint, he emphasized that the strength of the military lies in the ecosystem that supports it. In times

of conflict, it is not just the armed forces that are tested, but the entire strategic capacity of a nation. Therefore, he asserted, industry must not merely be seen as a partner but as a sixth force of the nation—a critical strategic player in itself.

AVM Khot elaborated on the evolving role of the industry over the past 25 years, from being passive suppliers to defence PSUs to becoming active innovators, manufacturers, and even direct participants in crisis and conflict scenarios. He cited the example of Ukraine to underline the significance of this transformation. This, he suggested, calls for a new approach—constructing a framework that fully integrates industry into the national defence and strategic apparatus.

He proposed that the year 2025 be dedicated to achieving true civil-military fusion, not through theoretical documents or white papers, but by designing and implementing practical frameworks and mechanisms. He called upon all present—including the key decision-makers from the armed forces—to collaborate and ensure that by the time the next edition of the DefSpace Symposium takes place in 2026, tangible outcomes and operational structures reflecting this fusion are in place.

In conclusion, AVM Khot expressed his sincere thanks to ISpA and all stakeholders in the space ecosystem for organizing such a high-quality event. He extended his appreciation to the distinguished guests and panelists, especially acknowledging Air Marshal Dharkar and General Rakesh Basant for their presence and contributions to the inaugural session.

MoU Signing Ceremony:

- Chakra Dialogues Foundation
- Gujarat National Law University
- Vitti Research Foundation



SESSION - THE CHANGING WORLD & MAXAR

Welcome Address: Col Sai Arul, Head of Region SAARC, Maxar Intelligence



Col. Sai Arul, Head of Region SAARC at Maxar Intelligence, delivered the welcome address on behalf of Maxar during the session titled *"The Changing World & Maxar."* He began by extending his gratitude to all attendees and conveyed special thanks to General Bhatt and the Indian Space Association for organizing such an excellent and well-curated program.

He introduced Maxar as a global space technology company operating across two core verticals: space infrastructure and Earth observation. In the space infrastructure domain, Maxar builds spacecraft, satellites, robotics, and related technologies. The company also owns and operates a constellation of cutting-edge Earth observation satellites, known for their exceptionally high resolution.

Recently, Maxar launched the *WorldView Legion* constellation—a fleet of six satellites with 30 cm-class resolution, placed in a combination of mid-inclination and sun-synchronous orbits. This setup significantly enhances both capacity and revisit capabilities, allowing global coverage multiple times a day.

In addition to traditional satellite imaging, Maxar is working towards reconstructing the world in three dimensions with extremely high resolution and accuracy. This transformative 3D mapping capability opens new paradigms for applications in targeting, GPS navigation, and numerous other domains.

Col. Arul also highlighted Maxar's extensive international partnerships involving a wide range of sensors, including lower-resolution EO and SAR, ensuring comprehensive coverage across various terrains, times, and weather conditions.

These advanced capabilities are integrated into Maxar's solutions, many of which are actively deployed by defence and intelligence organizations around the globe. To showcase these innovations, Maxar had assembled a panel of experts—many of whom bring decades of defence experience, having previously served in armed forces worldwide.

He introduced the upcoming speaker for the session, **Mr Mike Small, Defence & Security Leader APAC & EMEA, Maxar Intelligence**, a British Armed Forces veteran and seasoned analyst, who has been with Maxar and the space industry for many years. Small would lead the session on *"Legion Live,"* exploring how the *WorldView Legion* constellation is set to redefine capabilities and address key challenges that have emerged from the discussions over the past few days.

As a transition to the speaker, a brief video was played to demonstrate Maxar's scope of work and technological prowess.



Legion Live-Leveraging Legion in your ISTAR Mission: Mr Mike Small, Defence & Security Leader APAC & EMEA, Maxar Intelligence

Mr. Mike Small, Defence & Security Leader for APAC & EMEA at Maxar Intelligence stated that Maxar, **with a long-standing heritage in commercial space support to defence dating back to the 1960s, has evolved significantly. From the launch of its early Earth observation satellites to the deployment of its latest Legion constellation- featuring high-resolution 30-34 cm satellites in both sun-synchronous and mid-inclination orbits-the company continues to lead in technological innovation.** These satellites form part of a broader virtual constellation that includes partnerships with operators of synthetic aperture radar and lower-resolution optical satellites, greatly enhancing the breadth and depth of data collection.

Throughout the session, Mr. Small emphasized Maxar's role not just in ISR but also in forward battlefield support, including target acquisition. He illustrated this with striking satellite imagery, such as detailed views of air defence sites in Syria and post-explosion assessments of ICBM silos in Russia, highlighting how Maxar imagery can detect subtle operational details and offer critical intelligence.

He also discussed the **broader ISTAR cycle, where Maxar excels in both the collection and the processing, exploitation, and dissemination (PED) of imagery. By integrating with widely-used systems like Palantir and BAE Systems' GXP, Maxar ensures that processed intelligence reaches commanders swiftly, aiding in timely decision-making and operational superiority.**

Further segments of the presentation covered how Maxar leverages high-resolution EO imagery in maritime domain awareness by tipping and cueing across sensor platforms, including UAVs and other airborne assets. They also showcased Maxar's proprietary tools such as the Precision 3D environment and MGP Pro, a desktop platform designed for analysts and commanders to access and manage the entire imagery chain- from historical archives to real-time tasking and fusion of multisource data using AI/ML techniques.

Mr. Small concluded by underlining the complementary nature of commercial and sovereign satellite systems. While sovereign systems provide wide area surveillance, commercial satellite operators like Maxar bring the advantage of agile, on-demand, concentrated coverage over critical areas of interest. He demonstrated this through a fictional North Korea scenario, highlighting how Maxar's operational model is already aligned with the needs of defence clients, offering scalable, mission-responsive ISR support. **He described how Maxar's advanced imaging capabilities are being utilized for strategic intelligence, particularly in high-stakes regions of North Korea. For instance, satellite imagery revealed the layout and structural details of tunnels, offering analysts valuable insights into their dimensions and possible military utility.** One notable example was a launch site, where indicators such as a rolled-out red carpet covered with blue tarpaulin signaled launch preparations- despite limitations in seeing within the facility itself.

The session emphasized **Maxar's operational philosophy of delivering "the right image at the right time, from the right angle."** Legion satellites, with their agility and wide field of view, allow for unprecedented flexibility. Unlike typical small satellites, Legion's one-meter diameter telescopic imaging systems can maneuver up to 60 degrees off-track, enhancing their ability to capture strategic moments from optimal angles. Through simulation, Small illustrated how each of the ten satellites in the Legion constellation is maneuvered precisely to monitor critical sites like North Korea's missile facilities.



Another highlight was the system's ability to provide Space Situational Awareness. For instance, Maxar captured images of a Russian satellite appearing to split in two, prompting questions about anti-satellite capabilities-only to determine that a large antenna had simply detached. This level of technical intelligence is critical for space command decisions.

Small detailed Maxar's dual-tasking capabilities: "headquarters tasking," where client-designated targets are uploaded and imaged on schedule, and "ground control terminal" operation, a unique feature where control is handed over to defence or intelligence clients. These clients operate terminals within their own secure facilities, controlling payloads and directly receiving data. This operational flexibility ensures real-time responsiveness and high operational security, even within forward battle spaces.

He underscored "mission agility"-the ability to capture intelligence minutes before or after critical operations such as airstrikes, assisting in both mission planning and battle damage assessments. This unique model allows clients to lease satellite time, offering autonomy and precision in image collection.

Maxar's Legion innovation includes both sun-synchronous and mid-inclination orbits. Four satellites operate in mid-inclination, enhancing image collection in critical zones between $\pm 45^\circ$, and enabling imaging at varying times of the day-a stark contrast to traditional systems. Taking the North Korean Sahel site example, the imaging opportunities increased dramatically-from 21 to over 219 in June with Legion, and even more when integrating data from Umbra, boosting revisit rates and enabling both day and night coverage.

The presentation concluded with high-resolution imagery showcasing the loading of a surface-to-surface missile onto a submarine, underscoring Legion's capability to not just detect military assets but also determine their armaments. This exemplifies the fusion of imagery, timing, and strategic relevance in modern ISTAR operations.

Precision3D: Processing and Exploiting Multi-Source Imagery Intelligence: Mr Mike Small, Defence & Security Leader APAC & EMEA, Maxar Intelligence



In his address, he provided an in-depth overview of how advanced 3D models and simulations are used in mission planning and rehearsal, focusing on real-world scenarios such as those observed in Ukraine. He explained how, using highly accurate 3D models of areas like Poland and Ukraine, military vehicles, including air defence systems and radar-equipped vehicles, can move through the battlefield undetected by the enemy. These models enable planners to assess the terrain's suitability for vehicles, ensuring that the paths taken are optimal, without requiring on-the-ground pre-positioning of assets. The accuracy of the models allows military personnel to anticipate how long it will take for vehicles to traverse the terrain, as well as their visibility and radar signature, all contributing to mission success.

Mr. Small highlighted how these 3D models help simulate the movement of vehicles, creating realistic scenarios that can be rehearsed repeatedly. Such detailed planning, using gaming engine technology,



allows for refining tactics to improve survivability during missions. Furthermore, the models enable the preparation of the battlefield by offering a pre-invasion 3D representation, which is then updated to reflect changes post-invasion, assisting in strategic planning for peace support operations.

He also discussed the integration of targeting imagery collected by various space-based sensors, with a focus on how accurate 3D models can enhance the precision of these images. By overlaying the 3D model onto the imagery, the accuracy of the coordinates is significantly improved, with the model providing an error margin as low as 1.82 meters. This ensures that military forces can make informed decisions with a clear understanding of both the target and the associated uncertainties.

Mr. Small concluded by emphasizing three key points: the unique ability of Maxar to control payloads and ensure secure, mission-specific imagery; the importance of an end-to-end solution that provides actionable intelligence rather than just raw imagery; and the significance of acquiring the right image at the right time to make informed operational decisions. He underscored that resolution matters when trying to understand an adversary's intent, with high-resolution imagery enabling the detection of individual vehicles and vessels, ultimately contributing to more accurate analysis and decision-making.



Mr. Matt Jackson, Engineering Senior Manager, Software Systems, Maxar Technologies continued the presentation following Mr. Mike's insights.

He focused on the second segment, specifically addressing how Maxar ingests other information sources into its system, with an emphasis on aerial video and its integration into precision 3D products.

Mr. Jackson introduced the audience to Maxar's new suite of products branded as Raptor, developed in response to operational challenges in GPS-denied environments caused by jamming, spoofing, or failures. The Raptor platform was designed to counter these threats using proprietary algorithms in conjunction with precision 3D to support vehicle and video positioning crucial for analysis, especially in high-stakes environments like battlespaces.

He emphasized, "If you're actually working and you want something from Amazon and the drone happens to be in the wrong spot, it's not really a problem. If you're out on a battle space and the coordinate you're getting out of that video is wrong, you have got a big problem."

Mr. Jackson explained that Raptor is a dual-use technology, serving both military and civilian sectors, which makes it not subject to high regulatory tunnels—an important factor when working with multiple clients.

The Raptor platform consists of three key components:

1. Raptor Guide – software integrated into aircraft or devices.
2. Raptor Sync – software for registering full-motion video to a 3D surface.
3. Raptor ACE – a hybrid tool enabling tactical commanders to extract accurate coordinates from full-motion video.

He shared performance benchmarks, stating, "We have most of the globe covered at 50 cm resolution. We have demonstrated the positioning of an unmanned vehicle to within 10 meters as it is flying and also pulled coordinates under 3 meters."

Describing Raptor Guide, Mr. Jackson noted it is distinct from Maxar's usual satellite image offerings. It



uses algorithms for generating and interacting with 3D data to solve the specific problem of navigation in the absence of GPS. He clarified, "We are not providing navigation—we provide positioning as part of the navigation system."

The system works by taking an initial position, registering a video frame, working backward to where that frame was taken from, and feeding the position into the navigation system, repeating this process at a 1 Hz refresh rate. This enables operation even on small single-board computers like a Raspberry Pi, making the technology scalable to compact UAVs.

He then explained Raptor Sync, which registers the incoming video feed onto Maxar's precision 3D surface, either in real-time or through post-processing. He illustrated how unregistered full-motion video lacks accuracy, whereas registered video "locks onto the ground," enabling the overlay of other visual data. "Everything becomes a stack of accurate imagery," he added, referencing its complementarity with satellite imagery.

Mr. Jackson also explained how Raptor Guide and Raptor Sync work together: Guide can correct the position and aid navigation, while Sync registers the video—either on the platform or later at a ground station.

Finally, he introduced Raptor ACE, developed in response to an urgent operational requirement. It allows operators to extract accurate coordinates from untrusted video feeds without modifying the capturing device. ACE runs on a commodity laptop connected to a drone controller, using the initial drone position and registering incoming video frames to extract precise targeting coordinates.

He demonstrated this using footage from the SOS Test Range in Sweden, where the registered video from a drone appears on the right and the operator interface on the left. The operator selects a frame, identifies a target (e.g., a vehicle), and captures its coordinates while the drone continues flying and

video keeps updating.

Mr. Jackson concluded by stating that Raptor's full-motion video processing integrates seamlessly with Maxar's TCP pipeline, complementing the registration of satellite imagery and further supporting battle space operations.



Maritime Surveillance, Detection, Identification and Establishing Intent: Mr Edward S. Lau, Director, Joint Engagement Team, Maxar Intelligence delivered an insightful presentation on advancements in maritime surveillance, detection, identification, and the ability to establish intent. He began by introducing Maxar's Synthetic Aperture Radar (SAR) capabilities, emphasizing their collaboration with Umbra, a company operating high-resolution SAR satellites offering imagery at resolutions between 25 to 100 cm. Maxar, which operates a constellation of 10 satellites including its new Legion series, combines its optical and SAR capabilities into a unified "virtual constellation" that provides all-weather, day-and-night imaging solutions.

Lau explained that the integration with Umbra allows Maxar to significantly enhance coverage beyond the standard 5x5 km footprint, extending it to approximately 50–75 km per scene through Maxar's proprietary SAR processor. This processor, refined over decades, not only increases scene coverage



but also enhances image clarity by reducing SAR imaging artifacts. Additionally, Maxar's partnerships with companies like Satellogic—operating a fleet of over 20 EO satellites—further bolster this comprehensive imaging network.

What sets Maxar apart, Lau noted, is the seamless integration of these imaging capabilities into a single platform. Users can switch between optical and SAR imaging modes based on weather and visibility conditions without the need for separate contracts or platforms. The Rapid Access Program enables users to quickly task satellites, download imagery, and access real-time visual intelligence.

Transitioning to maritime applications, Lau showcased Maxar's ability to detect and monitor naval activity, exemplified by images of Chinese Type 052D destroyers and Type 071 amphibious transport dock ships near Sri Lanka. The images captured not only large vessels but also smaller fast boats, illustrating the granularity and reach of Maxar's satellite assets.

He introduced Maxar's "Crow's Nest" tool as a pivotal operational intelligence system designed to provide a dynamic maritime situational picture. This system empowers users to define operational parameters—such as alerting for the presence of specific vessels—upon which satellites are tasked to collect, process, and deliver relevant data. The platform integrates seamlessly with sovereign sensors, ground-based radars, AIS data, and other intelligence streams, allowing for enhanced planning and decision-making.

The Crow's Nest platform is particularly valuable for wide-area surveillance, utilizing SAR imagery that can cover up to 200,000 km² in a single pass. This data is processed to detect vessels, correlate them with AIS data, and flag "dark ships" that are not broadcasting their positions. The system then enables further cues for high-resolution imaging and ultimately, optical confirmation—providing critical insight into activities such as illicit ship-to-ship oil transfers.

In conclusion, Lau highlighted the system's ability to fuse multiple sensor inputs, apply AI/ML-based vessel detection algorithms, and deliver actionable intelligence. This supports real-time maritime domain awareness and empowers decision-makers to respond effectively based on comprehensive, near-real-time data.

Mr. Edward S. Lau emphasizing the importance of understanding the value of satellites from first principles. He explained that satellites offer unparalleled access to the entire globe, including remote or restricted regions, such as North Korea, where traditional aerial methods like drones are not viable. Satellites in sun-synchronous orbits, traveling from pole to pole, can image every part of the Earth as it rotates beneath them, ensuring global coverage. He highlighted the impressive speed of satellites, which travel at approximately 8 kilometers per second, enabling them to cover vast areas, such as the entire U.S. coast, in just 90 seconds. Each satellite completes a full orbit of Earth in about 90 minutes, allowing for frequent imaging opportunities.

Mr. Lau then turned to Maxar's Legion constellation, expressing enthusiasm for its deployment. The first two satellites are in sun-synchronous orbits, while the next four are in mid-inclination orbits. This configuration allows for multiple revisits to the same location throughout the day. In some cases, up to 15 observations of a single location can be made daily. He illustrated this with a hypothetical scenario involving a maritime facility, showing how earlier constellations could only capture a single image per day, whereas the new Legion satellites provide multiple captures within the same day and across subsequent days.

He also discussed the role of SAR (Synthetic Aperture Radar) satellites, like those in the Umbra constellation. SAR sensors actively emit signals that reflect off objects, making them useful in low-visibility conditions such as nighttime or through cloud cover. While SAR provides strong signals from objects like ships, it lacks the resolution to identify vessel types, which is where Maxar's optical sensors complement SAR data.



Mr. Lau explained that combining high-resolution optical imagery with SAR data enhances maritime domain awareness. He gave an example related to suspected grain smuggling operations in Ukraine, where SAR detected ship activity, and optical imagery helped determine the nature and identity of the vessels involved.

He further addressed the importance of resolution in object detection. Internal Maxar testing showed that as image resolution decreased, the probability of accurately detecting objects dropped significantly. This underscored the critical role high-resolution imagery plays in successful detection and tracking.

One of the most exciting new capabilities he introduced was “vessel fingerprinting,” a feature in Maxar's Crow's Nest platform. He likened it to facial recognition for ships. Even when vessels do not transmit AIS signals, unique structural features such as bridge placement, helipad location, or lifeboat configuration allow Maxar to identify and track them across multiple observations. This feature, currently in beta, has been developed using over 1.3 million vessel detections from Maxar's Vessel Capture Record Database (VCRD), leveraging the company's unmatched image resolution and vast historical imagery archive.

Mr. Lau concluded by reiterating the significance of combining different sensor technologies and advanced analytics to provide reliable, timely intelligence across the globe.



(Mr. Partha Ghosh, Presales representative at Maxar Intelligence,) delivered an insightful overview of the Maxar Geospatial Platform (MGP) Pro, formerly known as SecureWatch.

He elaborated on the platform's evolution and emphasized its capabilities in accessing and analyzing high-resolution satellite imagery.

Key Features of MGP Pro (as presented by Mr. Ghosh):

- **Unified Access Platform:**

MGP Pro functions as a consolidated platform that provides access to Maxar's satellite imagery, integrating data from multiple satellite sources.

- **Extensive Archive:**

The platform offers view access to over 125 petabytes of archived imagery dating back to 1999. Approximately 3.8 million square kilometers of new imagery are added daily.

- **Global Coverage:**

MGP Pro delivers comprehensive global coverage, including high-resolution imagery up to 30 cm, even in restricted or denied areas.

- **Advanced Analytics:**

The platform is equipped with tools for creating time composites, seamless basemaps, precision 3D models, and performing change detection, among other analytical functions.

- **Flexible Access:**

Users can interact with the platform via a web interface, APIs, and SDKs, facilitating integration into a wide range of applications and workflows.



· Imagery Download and Tasking:

The platform allows users to download specific areas of interest and task new image acquisitions by specifying parameters such as date range, sensor type, and collection priority.

· Focal Points and Alerts:

MGP Pro highlights key areas of strategic interest and provides links to related news sources. Users can also set up alerts for updates on designated areas.

Mr. Ghosh demonstrated these capabilities through real-world examples, such as monitoring developments near **Pangong Lake** and tracking infrastructure changes. He showcased how the platform supports viewing, analysis, downloading, and tasking of imagery—all through a unified interface.

If the data is captured over 24 hours, then an image representing that 24-hour duration will be generated. In such cases, cloud coverage will not obstruct the imagery. Information about cloud presence will also be provided. This is part of the tasking process.

The platform offers view access to the complete archive imagery based on user requirements, and users can download the desired imagery accordingly. Additionally, users can initiate image tasking directly from their computers, offering significant flexibility through the NGP Pro platform.

NGP Pro also features a 3D capability, referred to as *NGP Pro 3D*. This is a web-based streaming service accessible via browsers like Google Chrome or Microsoft Edge. A live demonstration showcased an area near the border using this 3D streaming technology.

Users can view accurate 3D landscapes where even textual markings over hills and specific structural details are clearly visible. Coordinates including latitude, longitude, and altitude are displayed in the lower left corner for precise navigation.

Analytical tools like line-of-sight and view shed analysis are integrated. For instance, users can define an observer point and determine visible or non-visible zones from that location. These tools assist in simulating observational capabilities.

The 3D platform covers global terrains. Structures such as towers can be seen in high resolution, including details like height at the base and top of the structure.

In summary, NGP Pro provides access to:

- Archived and basemap imagery,
- Tasking capabilities,
- High-resolution 3D views,
- Analytical tools.

Additionally, NGP Pro is compatible with commercially available GIS platforms such as **Esri, QGIS**, and others. Plugins are available for integration. Imagery can also be accessed via raster or REST APIs and can be provided as orthorectified or atmospherically corrected and pan-sharpened imagery.

In terms of data types, a participant queried **whether military and non-military datasets could be integrated, especially since many environments now comprise both. The response clarified that the platform simply provides imagery. Though it has AI/ML capabilities to identify features such as aircraft, ships, or earth movers, it does not classify data specifically for military or civilian purposes. These detections are tools available for users to apply as needed.**

An additional offering called **Focal Points** was introduced, where a dedicated team monitors open sources for emerging events—such as natural disasters or social unrest—and prioritizes imagery tasking in those areas.

On the concern of sensitive information being derived from imagery, **it was acknowledged that historically, certain locations (like VAS or VBS areas) were smudged to prevent accurate targeting.** Today, the policy depends on governance and user agreements. The platform operates within local laws and space policies. For instance, before India's new space policy, such platforms were only accessible to defence organizations. However, the updated policy allows broader access to users up to a resolution of **30 cm**, beyond which restrictions still apply. Privately tasked imagery, collected by customers, remains confidential and is not released for general access.



In response to concerns regarding misuse—such as drones or imagery being used against friendly nations—it **was stated that the organization adheres to strict licensing and due diligence protocols to ensure responsible usage. Internal governance systems are in place to monitor and regulate access, and the platform is only provided to verified users. Imagery licensing and user verification are enforced to mitigate risks.**

In conclusion, while space governance remains a complex global issue, the platform complies with all relevant national and international frameworks, and efforts are ongoing to improve governance mechanisms collaboratively.

Special Address: Cyber Security in Space Operations AVM Dr. Devesh Vatsa, VSM, Advisor, DSCI Nasscom



(AVM) Dr. Devesh VSM, Advisor at DSCI, delivered a special address on the vital domain of cybersecurity in space operations.

AVM Dr. Devesh began by acknowledging the challenge of holding attention post-lunch, humorously noting his consistent assignment to this time slot over 15 years and the constant scrutiny from senior officers, now even including AI tracking. He transitioned to the core topic, stating that space, once a distant frontier, is now integral to daily life, powering global communication, navigation, scientific discovery, and national security. He cited the example of ATMs using satellite communication (Satcom) at 19.2 Kbps for transactions like mini statements, highlighting the dependency. AVM Dr. Devesh asserted that space is no longer just

imagination but a domain of operations and critical infrastructure underpinning the global economy and security.

With this advancement comes the responsibility to protect the domain from digital threats, driven by increasing digitization. AVM Dr. Devesh highlighted key ways digitization is changing the satellite business:

- Satellite Data Processing:** Leveraging cloud computing infrastructure for storing and processing vast amounts of data.

- Big Data & AI:** Using AI and Machine Learning to process and analyze the massive datasets generated by space missions, emphasizing the need for real-time processing, rapid detection, and agile response for immediate action.

- Autonomous Spacecraft:** Enabling automation and decision-making for navigational operations without real-time control from Earth.

- Digital Design & Manufacturing:** Utilizing additive manufacturing for custom part production on demand.

- Communication Networks & Connectivity:** Projecting the merger of terrestrial and satellite communication by 2035, making smartphones also satellite phones. He noted standards being defined and latency issues being addressed by 5G and eventually near-zero latency with 6G.

- IoT Sensors:** Increasing use to track spacecraft health and improve real-time data collection.

- Mission Software Tools:** Enabling simulation, planning, and optimization of mission phases.

- Collaboration Platforms:** Facilitating digital



collaboration through virtual platforms, cloud storage, and global computing.

·**Digital Twin Technology:** Creating virtual replicas of spacecraft, satellites, or entire stations for experimentation.

AVM Dr. Devesh stressed that space systems are not immune to terrestrial cyber threats and are, in fact, increasingly targeted. He noted that discussions on attacking satellites began immediately after the first launch due to their military value, leading to anti-satellite (ASAT) programs as early as 1958. Attacks have since expanded to target commercial and scientific capabilities, with cyber being the latest iteration of counter-space systems.

He grouped cyber security challenges into four main categories:

·**Legacy Systems:** Outdated hardware and the inability to modernize systems already in orbit.

·**Supply Chain Risks:** Embedded vulnerabilities and backdoor risks introduced during manufacturing or integration.

·**Regulatory Lags:** Outdated treaties and governance challenges struggling to keep pace with technology.

·**Geopolitical Tensions:** Strategic disruption risks and the potential for escalation.

AVM Dr. Devesh provided examples of cyber threats to space assets, mentioning the Turla attack (allegedly Russian, 2015) and the Viasat incident in 2022, where a ground segment attack impacted satellite internet services for 70,000 modems across multiple nations, similar to disruptions during the Ukraine conflict.

He argued that the growing danger stems less from increasing threat sophistication (though that is

occurring) and more from the space industry's progress: a historic number of active satellites (11,833 as of March 5, 2024, per Orbiting Now website) that are increasingly digital, interconnected, and essential. He detailed the distribution:

·84% in Low Earth Orbit (LEO)

·12% in Geostationary Orbit (GEO)

·4% in Medium Earth Orbit (MEO)

·Approximately 61.5% are small satellites (<500 kg).

·Most communication (80%) and technology development (79%) satellites have launch masses below 300 kg.

·Around 8,000 satellites are primarily for communication. AVM Dr. Devesh outlined the five segments of space systems, emphasizing that each presents potential entry points for cyber intrusions and requires clear understanding for effective cybersecurity:

·**Space Segment:** Vulnerable to command intrusion, payload control manipulation, Denial of Service (DoS), and malware.

·**Link Segment:** Susceptible to spoofing and jamming during ground-to-air and ground-to-ground communication.

·**Ground Segment:** Risks include intrusion into Telemetry, Tracking, and Control (TTC) systems. He cited an instance where hackers gained control and deliberately burned a satellite near the sun, creating dangerous debris. Insider threats are also a concern.

·**User Segment:** Includes GPS receivers, smartphones, satcom terminals used on aircraft, ships, cars, and by individuals.

·**Launch Segment:** Faces threats, especially with the advent of reusable rockets.

He emphasized the complexity of space missions relying on ground stations, communication links,



onboard computers, and data networks, making them vulnerable. He listed potential threats mirroring terrestrial ones: intentional jamming/spoofing, interception/data theft, malicious code injection, data corruption, ransomware, and hardware Trojans.

The consequences of a breach, AVM Dr. Devesh warned, could be severe: disrupted satellite orbits, compromised navigation (affecting financial markets, emergency services, military), compromised astronaut safety, or compromised national security. He stressed this is a present and growing risk, not science fiction. The unique space threat landscape involves limited physical access but boundless digital reach, allowing adversaries (nation-states, rogue organizations, individuals) to exploit vulnerabilities like outdated software, unencrypted links, RF signals, or the supply chain from afar. AI and quantum computing amplify both risks and defence potential.

He proposed treating cybersecurity not just as a technical challenge but as a strategic imperative, given the dependency on space infrastructure (projected >100,000 satellites by decade's end). Key solutions include:

- **Foundational Security:** Build systems secure by design with redundancy and resilience baked in; fortify ground stations, supply chains, and networks. Supply chain integrity is paramount.
 - **International Collaboration:** Establish common standards, share threat intelligence in real-time, and build collective defence for the shared domain.
 - **Invest in Talent:** Develop engineers, coders, and strategists proficient in both space physics and cyber tactics.
- Strategic approaches for the future include AI-driven defence systems, harmonizing space cybersecurity standards globally, prioritizing

security by design, boosting national regulatory oversight, and protecting critical space infrastructure.

AVM Dr. Devesh concluded by urging the audience to envision space as a domain of trust, cultivating a culture of vigilance among all stakeholders. He stressed that protecting space is a shared duty, necessary to prevent the final frontier from becoming a lawless battleground and to ensure a legacy of resilience, ingenuity, and unity.

Special Address: Quantum Communication Technology, Air Marshal GS Bedi, AVSMVM VSM (Retd), Vice President of Business Development



Air Marshal GS Bedi began by acknowledging the diverse audience and aimed to provide a concise ("Instagram reel" like) overview, covering academic, technological, and commercial aspects. He highlighted the severity of cyber threats, citing large-scale financial fraud in the BFSI sector and emphasizing the broader impact of threats on geopolitics, healthcare, transport, and power grids. He quoted DSI/ISB data indicating 702 potential security threats per minute in India.

He aimed to clarify common confusions surrounding quantum technology:

- **Quantum Cryptography (QC) vs. Post-Quantum Cryptography (PQC):** QC uses quantum physics to build new security (like a new lock needing a new door), while PQC uses new mathematical

Mr. Johri began by acknowledging the challenge of the post-lunch slot and paid respects to dignitaries present. He introduced IIFCL as a major lender and transaction advisor, notably advising In-SPACE and the Department of Space. Their task was to discuss



DAP 2020 and propose recommendations concerning space, UAVs, and deep tech. He quoted Field Marshal Manekshaw on the importance of continuous professional knowledge in a technologically advancing world.

He provided a brief overview of DAP 2020's aim (lifecycle management), scope (capital acquisitions for MOD/SHQ), and unique aspects (supplier constraints, tech complexity, cost). He then broke down the space sector into upstream (satellites, launch vehicles), infrastructure (launchpads, TT&C, ground support), and downstream (EO, Satcom, PNT, applications).

Mr. Johri reiterated AVM Dr. Vatsa's point that space is critical infrastructure. He outlined four capabilities essential for superpower status, which India possesses: Launch Vehicles (GSLV/LVM3, PSLV, SSLV - moving towards privatization), Communication Capabilities, Earth Observation (citing In-SPACe's PPP tender), and PNT (NavIC). He listed countries like the UK, Australia, EU, France, US, and Canada that have recognized space as critical infrastructure, arguing India should formally do the same.

He advocated for including space and related activities (launch vehicle/satellite manufacturing, data centers, ground stations) in the Ministry of Finance's Harmonized List of Infrastructure, citing strategic importance, economic dependencies (agriculture, logistics, telecom, banking - referencing SpaceX's success and satellite internet trends), vulnerability to cyber threats, and the need to foster Public-Private Partnerships (PPPs). He emphasized that defence should be a major buyer to stimulate the private industry, similar to US DoD/NRO support for companies like Maxar.

Mr. Johri discussed the interdependence of space and defence: space assets enhancing defence capabilities (ISR, Satcom, PNT) and defence creating demand for space products/services (citing SPS tender, IDEX, TDF).

Based on their study of DAP 2020, IIFCL proposed several recommendations:

•**Dedicated Space Chapter:** Similar to the existing chapter for Navy shipbuilding, to address space-specific procurement nuances and align with the National Space Policy 2023.

•**Reviewed Categorizations:** Tailor categories like Buy Indian-IDM, Buy Indian, etc., for the space context, focusing on reducing import dependency and incentivizing private sector indigenization.

•**Specific Funding Mechanisms:** Beyond TDF, proposed non-returnable grants (perhaps via ISRO/DRDO partnership, ~₹250 Cr/5 yrs) focused on indigenizing critical components (payloads, launch vehicles) and R&D, potentially alongside interest subvention schemes. He referenced international examples like ESA BIC, US SBIR/STTR, and NASA Tipping Point, and India's own In-SPACe TAF.

Special Address: Integrating Space Sector, UAVs and Deep Tech under DAP 2020, Mr. Rajat Kumar Singh, Associate General Manager, IIFCL, Projects



continued, focusing on UAVs, UUVs, and Deep Tech within the DAP context from a finance perspective. He highlighted the complexity of DAP 2020, particularly for startups unfamiliar with its processes, contrasting it with larger established players. He stressed the mismatch between rapid UAV technology cycles (2-3 years) and potentially decade-long DAP procurement cycles (using the MRFA tender as an analogy), leading to the acquisition of obsolete technology.

Mr. Singh described the hierarchical procurement categories (Buy Indian-IDM first, then Buy Indian, etc.) and the cumbersome justification process involving multiple agencies, causing delays critical for fast-moving tech like UAVs. He cited the pivotal role of UAVs in recent conflicts (Russia-Ukraine, Armenia-Azerbaijan).

He argued for a DAP overhaul for these sectors,



making it less lengthy, tedious, and complicated, especially for startups who are key innovators. He noted India is the second-largest arms importer with over 1000 defence startups, but procurement is dominated by slower DPSUs. He mentioned existing Indian UAV players (IdeaForge, etc.) but highlighted the import dependency for combat UAVs. He also touched upon the need for better HAPS capabilities compared to international standards (NAL's 8 hrs vs. Reaper's 50 hrs).

Regarding indigenization, Mr. Singh advocated for realism, citing the Turkish drone example with international components. He argued against insisting on 100% immediate indigenization, suggesting a phased approach allowing imports while building local design and assembly capabilities is crucial to avoid delays. He also pointed out financial hurdles for startups, like lengthy payment cycles and bank guarantee requirements, which need easing.

His key recommendation was for a separate, streamlined DAP chapter for UAVs and Deep Tech, similar to the space proposal, to facilitate easier entry for innovators. He also touched upon Deep Tech areas like Blockchain (beyond crypto, for secure ledgers) and the need to include these emerging technologies within the DAP framework.

Further general DAP recommendations included:

- Establishing a live committee for continuous updates, as technology evolves faster than 5-year revision cycles.
- Addressing HR churn in procurement roles and fostering exchange between defence and private sectors.
- Better integration of initiatives like the Technology Watch Tool and funding schemes (Aditi/IDEX) into the main DAP document to create a single, comprehensive resource.

Q&A and Discussion on DAP

The presentation was followed by a lively discussion:

- AVM Dr. Vatsa requested specific details on startup challenges for his report.
- A startup representative highlighted the "valley of death" for deep tech startups lacking "deep pockets," stressing the need for government support and shorter validation cycles.
- Mr. Johri agreed on the need for DAP flexibility and streamlining, suggesting stakeholder consultations

similar to SEBI's white paper process.

- AM BR Krishna questioned the rationale behind DAP's 50% Indian Content (IC) rule based purely on cost, urging a distinction between necessary imports and lack of local effort.

•Mr. Singh cautioned against simply adding more chapters to DAP, advocating instead for a radically simplified, principles-based document (referencing Mr. Parrikar's vision of a 90-page DAP) built on trust, and suggested channeling proposals through industry associations for better traction.

- AM BR Krishna clarified that DAP is currently under revision with stakeholder input, and a draft will be circulated.

•AVM Dr. Vatsa questioned the differing IC percentages for Buy Indian-IDM (50%) vs. Buy Indian (60%).

•Mr. Johri raised the issue of categorizing products designed/developed in India but manufactured abroad (like semiconductors) and reiterated the need for phased indigenization and specific incentives.

•Another startup representative shared a stark example of extreme price inflation from Indian suppliers compared to imports (PCB costing ₹2.5 Lakh locally vs. \$800/₹60k import), blaming an underdeveloped ecosystem and vendor "blackmail." They argued for developing a competitive supply chain first. Mr. Johri responded that economies of scale require PPPs and MOD acting as a demand creator, not micromanaging production. The startup also mentioned uncatalogued Chinese suppliers targeting Indian procurement.



**Fireside Chat: "LEADERSHIP IN THE AGE OF AI:
INDIA'S STRATEGIC SOVEREIGNTY IN SPACE,
DEFENCE AND ECONOMIC CORRIDORS"**

**Mr. Ravinder Pal Singh, Investor in Deep
Tech & Science,**



**Lt Gen AK Bhatt (Retd), PVSM UYSM AVSM SM VSM
(Retd) Director General of the Indian Space
Association (ISpA).** moderated fireside chat with Mr.
Ravinder Pal Singh, Investor in Deep Tech & Science.

Mr. Singh set the stage by reflecting on ISpA's journey, noting the rapid growth from <100 to >300 space startups in ~3.5 years and the increased availability of venture capital (challenging the narrative of funding scarcity for early-stage companies). He observed, however, that many VCs claim "deep tech" expertise without full understanding.

He argued the focus should shift from just seeding startups to addressing India's strategic needs, sovereignty, and particularly the quality of leadership in startups, especially post-Series B funding. He questioned the "patriotism" claims when VCs with foreign LPs sit on boards, influencing decisions. He stressed the importance of sovereignty in the context of data, AI, and supply chains, warning against over-reliance on foreign sources.

Mr. Singh cited examples of successful Indian deep tech (Lohum Cleantech) and foreign companies seeking JVs but not pivoting entirely to India (Tomorrow.io). He called for a realistic assessment of Indian startups' revenue generation versus funding received and the trend of pivoting overseas. He emphasized the need for business acumen, profitability, and leadership capable of navigating complex deep tech ventures, suggesting the current ecosystem has "froth."

He proposed future policies should be highly specific and sovereignty-focused, funding clearly strategic

areas and then allowing companies to become self-reliant. He questioned the strategic value of funding areas like launch vehicles if startups primarily use foreign launchers. He strongly advocated for encouraging ex-defence personnel into entrepreneurship (following the Israeli model) for their clarity, passion, and crucial domain knowledge. On AI, Mr. Singh lamented the lack of Indian companies building foundational models, questioning government support for ventures merely using existing open-source tools. He highlighted the data sovereignty issue with commercial aircraft data being processed abroad.

Lt Gen Bhatt shared his journey from the army to space, driven by recognizing technology's importance through experiences like convoy monitoring in Kashmir (where drones later proved vital) and the Doklam crisis (where SAR capability became essential due to cloud cover hindering optical surveillance). He contrasted military leadership ethos (nation first) with corporate focus (venture success), acknowledging the need to nurture young entrepreneurs driven by national goals, not just profit.

He agreed on the evolving definition of sovereignty (beyond borders to include data, AI, supply chains) and the need to focus policy there. Responding to Mr. Singh's points, he acknowledged the need for startups to generate revenue quickly and agreed AI is critical, recognizing India's current reliance on open-source but expressing confidence in India's talent to develop foundational AI with focused funding. He shared the positive example of Skyroot's launch success, emphasizing the crucial mentorship provided by ISRO and In-SPACe leadership.

During Q&A, an audience member praised Israel's planned approach to startup success with structured mentorship, suggesting India needs similar support systems. Mr. Singh agreed, highlighting Israel's clarity on strategic funding, the role of Venture Studios (lacking in India), and the significant contribution of ex-defence personnel in Israeli tech entrepreneurship, urging similar encouragement in India.



Industry Session:

Altem Technologies

Mr. Shubham Gupta, Altem Technologies, a 3D innovation platform company, outlined their offerings:

- 3D Scanning: Using partners like Artec 3D to convert real objects into virtual models for reverse engineering or quality inspection.
- 3D Printing (Prototyping): Using additive manufacturing (plastic or metal) for rapid prototyping (visual/functional), tooling, or creating end-use parts.

He showcased applications like replicating damaged components, creating custom tooling, drone development (including a topology-optimized metal frame), and ESD-safe enclosures.

Closing Keynote Address

Air Marshal BR Krishna

PVSM AVSM SC(Retd), Former CISC, IDS HQ



Air Marshal BR Krishna delivered the closing keynote. He thanked the attendees and organizers (DJI/ISpA). He summarized the symposium's three days:

- Day 1 focused on strengthening India's space defence foundation, emphasizing robust, secure, resilient, and integrated capabilities.
- Day 2 highlighted indigenous development and

competitiveness, aiming for strategic autonomy and global leadership through self-reliance and R&D.

- Day 3 advanced discussions on space security and strategic capabilities, underscoring the importance of sovereignty, leadership, proactive security measures (defensive/offensive), doctrines, and strategy.

He stressed the urgency of collaboration among defence agencies, research institutions, startups, and the private sector. He urged translating the symposium's insights into actionable strategies and policies ("walk the talk"), balancing technological advancement with peace and security to build deterrence. He thanked the ISpA team and encouraged continued dialogue, innovation, and collaboration for a stronger, safer India in space.

Vote of Thanks

Gp Capt. TH Anand Rao (Retd), Director at ISpA,



delivered the vote of thanks. He described the event as a successful "roller coaster" covering diverse topics intersecting defence and industry. He thanked the resilient participants ("real space-preneurs") for their engagement. He reiterated the symposium's goal of bringing stakeholders together to improve the ecosystem. He promised a summary report and thanked speakers, panelists, the audience, sponsors, contributors, ISpA mentors, and the hardworking ISpA team (naming individual members).



DAY 3 OF THE INDIAN DEFSPACE SYMPOSIUM 2025: KEY TAKEAWAYS

1: KEY TAKEAWAYS FROM THE EMINENT SPEAKERS

Opening Session

AVM Rahul Bhasin – ACAS (Ops) Space, Air HQ

- Emphasised the role of space-based ISR for military and civilian applications.
- India's SBS-3 program includes mixed government-private satellite constellations.
- Focus on smaller, agile LEO satellites, AI integration, and cost-effective multi-sensor platforms.
- Identified challenges like space debris and innovation pressure.

Lt Gen RS Raman – DG, Military Intelligence

- Called for high-resolution ISR with 30-min revisit times for tactical readiness.
- Stressed public-private collaboration and milestone-driven planning (2030, 2035).
- Recommended Focus Areas for Capability Development
 - Space Domain Awareness and Situational Awareness.
 - Counter-space capabilities (kinetic and non-kinetic).
 - Resilient space systems to withstand adversarial disruptions.
- Space Traffic Management and Space Asset Protection.
 - Policy and Operational Recommendations
 - Integrate private sector applications into defence workflows on a day-to-day basis, not just during crises.
 - Establish norms and standards for private participation in space defence.
 - Develop contractual mechanisms and funding structures to support rapid innovation and deployment.

Lt Gen Manish Erry – DG SP

- Outlined space threats, including cyberattacks, jamming, and kinetic weapons.
- Proposed a 4-point collaboration strategy to integrate the private sector into defence, emphasising the need for strategic partnerships, resilience, and innovation:
- Streamline the Availability of Private Sector Solutions for Defence
 - Ensure that private sector-developed space applications and services are readily accessible and usable by defence forces.
 - Strengthen the existing linkages between the private sector and military, particularly through efficient and decentralised contracting mechanisms.
 - Address the current gaps in procurement and enable faster onboarding of commercial capabilities.
- Incorporate Private Capabilities in Daily Military Operations
 - Move beyond using private solutions only in crises.
 - Embed private sector technologies into the day-to-day operations of the armed forces to foster familiarity, adaptability, and readiness.
 - Build trust and interoperability between public and private systems.



- Enable Private Industry to Secure Space Assets
 - Support private players in developing technologies to protect satellites and space systems.
 - This includes creating technical standards, sharing threat intelligence, and offering financial support.
 - Focus areas: cybersecurity, resilience, and space situational awareness (SSA) capabilities.
- Strengthen Policy & Contractual Tools for Innovation Programs
 - Develop and refine policy frameworks within the MoD that encourage private participation in defence innovation initiatives.
 - Support programs like IDEX (Innovations for Defence Excellence) and ADITI to foster mission-critical space technologies.
 - Ensure that contractual tools and processes are conducive to innovation and aligned with modern technological cycles.

Air Marshal SP Dharkar

- Advocated starting small but scaling fast with low-cost, advanced space tech.
 - Encouraged the Indian industry to actively invest in emerging technologies that can provide a competitive edge:
 - Miniaturisation: Microelectronics and micromechanics to reduce size and weight of systems.
 - Artificial Intelligence (AI): For autonomous decision-making, rapid data analysis, and predictive modelling.
 - Cybersecurity: As space assets are increasingly digital and interconnected, cyber defence becomes indispensable.
 - Quantum Mechanics & Dynamics: To advance both communication security and navigation systems for GPS-denied environments.
- These technologies are leapfrogging tools that allow India to jump ahead of legacy systems rather than play catch-up.

Maxar Intelligence Sessions

Legion Live – Mike Small

- Introduced WorldView Legion: high-resolution 30 cm satellites with rapid revisit.
- Virtual constellation integrates EO and SAR for ISTAR support.

Precision 3D & Raptor Platform – Matt Jackson

- Raptor platform supports GPS-denied navigation and UAV video positioning.
- Raptor ACE enables real-time coordinate extraction from full-motion video.

Maritime Surveillance – Edward Lau

- SAR and optical integration enhances dark ship detection and monitoring.
- Crow's Nest offers real-time maritime situational awareness and vessel tracking.

Geospatial Platform (MGP Pro) – Partha Ghosh

- Unified access to 125+ PB satellite archive with real-time imagery tasking.
- Features advanced 3D analytics, change detection, and data governance protocols.

Cybersecurity & Quantum Technology



AVM Dr. Devesh Vatsa – Cybersecurity

- Space systems face threats across five segments from cyber intrusions.
- Called for AI-driven defences, supply chain integrity, and global standards.

Air Marshal GS Bedi – Quantum Communication

- Explained Post-Quantum Cryptography (PQC) and Quantum Key Distribution (QKD).
- Urgency of Quantum Preparedness: Quantum computers will soon break current encryption; critical sectors must adopt quantum-resistant systems now to avoid major security risks.
- Post-Quantum Cryptography is Ready: PQC can run on classical systems and offers strong, future-proof protection through complex mathematical algorithms.
- India's Secure Tech Push: India is building indigenous, hybrid systems combining PQC and QKD to secure communication in defence, space, and critical sectors.
- Synergy Quantum is developing hybrid secure networks for critical sectors.

Policy, DAP 2020, and Deep Tech

IIFCL Session – Johri & Singh

- Recommended a dedicated DAP chapter for space and UAVs.
- Supported PPPs and phased indigenisation with realistic import tolerance.

Fireside Chat: Leadership in AI & Sovereignty

Key Themes

- Stressed AI leadership, strategic funding, and data sovereignty.
- Encouraged ex-defence personnel entrepreneurship and realistic deep tech policies.

Tech Showcase & Closing

Altem Technologies

- Demonstrated 3D scanning/printing for UAVs and tooling.

Closing Keynote – Air Marshal BR Krishna

- Summarised the symposium's focus on capabilities, indigenisation, and strategic readiness.
- Urged translation of insights into policy and actionable outcomes.



2: SUMMARY OF KEY TAKEAWAYS FROM DAY 3

Strategic Importance of Space

- Space is no longer the “next frontier” but the current battlefield, critical for national sovereignty and deterrence. (Lt Gen DS Rana)
- The fifth domain of warfare, alongside land, sea, air, and cyber. (Dr. Anupam Sharma)
- Geopolitical shifts and rising “Trumpism” call for strategic autonomy through indigenous space capability. (Lt Gen VG Khandare)

Indigenous Development & Innovation

- India must accelerate execution cycles and move beyond traditional “jugaad” to structured, scalable innovation. (Lt Gen VG Khandare)
- Over 200 space startups in India are innovating in sensors, payloads, and propulsion systems. (Dr. Anupam Sharma)
- Emphasis on Make-in-India satellites, terminals, and electronics to cut foreign dependency. (Vice Admiral SN Ghormade)

Civil-Military-Industry-Academia Synergy

- Startups, R&D, and the military must operate as 'soldiers without uniforms' with civil-military tech fusion. (Dr. Anupam Sharma)
- Tripartite partnerships between DRDO, academia, and industry are bridging the 'valley of death'. (Dr. Ranjana Nallamalli)
- Industry must be treated as project partners, not vendors. (Vice Admiral SN Ghormade)

ISR, C4ISR & Military Requirements

- Indian Army needs real-time ISR with 15-minute target detection windows. (Lt Gen N.S. Raja Subramani)
- Requires robust C4ISR systems, cyber resilience, and LEO SatCom coverage. (Lt Gen N.S. Raja Subramani)
- Persistent surveillance, rapid launch capability, and space domain awareness are operational necessities. (Lt Gen N.S. Raja Subramani)

Key Technologies & Emerging Domains

- Focus on AI/ML, quantum sensors, directed energy weapons, and hypersonic vehicles. (Dr. Anupam Sharma)
- Need for space-based communication, adaptive optics, and cyber protection. (Dr. Ranjana Nallamalli)
- Development of compact maritime terminals, refuelling satellites, and inter-satellite links. (Vice Admiral SN Ghormade)

Policy & Funding Reforms

Private industry involvement since the 2021 reforms has increased drastically. (Lt Gen VG Khandare)

Current funding caps under iDEX (₹1.5–₹10 cr) are insufficient for ambitious projects. (Lt. Col. Sanjay Mahala)

Suggested creation of Production-Linked Incentives (PLI) for space components. (Vice Admiral SN Ghormade)



Education, Talent & Awareness

India needs more space-focused academic programs, not just one IIST. (Vice Admiral SN Ghormade)

Importance of spreading space culture within the armed forces and TTP updates. (Col. Kishor Yewale)

Establishment of 15 Defence-Academia Centres of Excellence to drive research. (Dr. Ranjana Nallamalli)

International Cooperation

- India should pursue joint ventures with foreign players, not just service exports. (Lt Gen VG Khandare)

- Emphasised role of QUAD, NATO, and Artemis Accords in space governance & sustainability. (Lt Gen Dushyant Singh)

- India-US collaborations are growing via NISAR, Gaganyaan, and joint space challenges. (Col. Baljinder Singh)

Structural & Process Challenges

- Integration of multiple startup-led solutions in composite projects is slow. (Lt. Col. Sanjay Mahala)

- Make scheme lacks transparency; projects get stuck without updates. (Mr. Bharath Simha Reddy)

- Too few officers handling too many tech challenges leads to burnout. (Mr. Bharath Simha Reddy)

AI, Data, and Digital Readiness

- Need for Chief Data Officers in defence to manage and provision data for AI. (Dr. Manan Suri)

- Innovation must shift from prototype to scaling, which remains a weak link. (Dr. Manan Suri)

- AI is a core enabler across all future space tech—must be integrated beyond demos. (Dr. Manan Suri)



INDIAN DEFSPACE SYMPOSIUM 2025 – CRITICAL KEY TAKEAWAYS

- Finalise the Space Activities Bill & Institutional Reforms.
- Create a sovereign ISR through the integration of satellite-based intelligence with AI, edge computing, and digital twins.
- There is an urgent need for ground and space-based SSA infrastructure with predictive capability.
- Encourage Public-Private Partnership and Startup Integration.
- Integrate private sector applications into defence workflows on a day-to-day basis, not just during crises. Establish norms and standards for private participation in space defence. Develop contractual mechanisms and funding structures to support rapid innovation and deployment.
- Enable Inter-Agency and Inter-Domain Integration between DRDO, DSA, ISRO, IN-SPACE, and the Armed Forces.
- Respond to China's Strategic Space Advances, prioritise satellite resilience, ISR and satellite communication.
- Leverage emerging technologies like hyperspectral imaging, AI for ISR, space robotics, adaptive optics, quantum sensors, GPS-independent navigation, cybersecurity, quantum communication, 5G, and edge computing for space-based operations.
- Indian Army's core demand: Persistent ISR with real-time imagery, rapid data processing, and resilient satellite comms.
- Current fragmented space regulations must evolve into a unified Indian Space Law.
- Defence Acquisition Procedure (DAP) must formally incorporate space systems acquisition protocols.
- DGQA-like authority for space is proposed to ensure consistent quality standards across stakeholders.



SPEAKERS :
DAY 01 THEME: INAUGURAL SESSION



Mr Jayant Patil
Chairman ISpA



General Anil Chauhan
Chief of Defense Staff



AVM Pawan Kumar
VM DG, DSA



Amb Sujan R. Chinoy
Director General
MP-IDSA



Air Chief Marshal VR Chaudhari
PVSM
AVSM VM (Retd)



Lt Gen AK Bhatt
PVSM UYSM AVSM
SM VSM (Retd)

SESSION I: SPACE THREAT ANALYSIS: ADVERSARIES SPACE CAPABILITIES
AND CONSEQUENT GEOPOLITICAL THREATS



AVM Anil Golani (Retd)
Director General, CAPS



Brig Anshuman Narang (Retd)
Founder, Atmanirbhar Soch



Dr Ajey Lele
Deputy Director
General, MP-IDSA



Mr. Tanveer Ahmed
Co-Founder & CTO
Digantara



Mr Navneet Singh
Chief Executive Officer
Kepler Aerospace



SESSION II: COMMUNICATIONS: ENSURING SECURE AND RESILIENT DEFENCE NETWORKS



Mr Jitender Ahuja
Head Product & Solutions
NELCO



Cdr Vidyut Kak (Retd)
Chief Technology Officer
Hughes Communications



Mr Amrit Pal Singh
Managing Director
IPSTAR India



Mr Vikram Rathore
Regional Business
Head-Govt. SPSU
Bharti Airtel Ltd.



Mr Niladri Kundu
Director
Global Solutions Engineering
Kymeta Corp



Gp Capt Rahul Basoya
DSA

SESSION III : "BEYOND THE HORIZON: SPACE- BASED ISR FOR MULTI-DOMAIN OPERATIONS"



Ms Radha Devi
ADRIN



Lt Gen (Dr) AKS Chandele
PVSM AVSM (Retd)
President - Defence, Internal Security
& Public Safety, GWCC



Col HJ Singh
IAS - DIPAC



Mr Awais Ahmed
Founder & CEO
of Pixxel



Mr Krishanu Acharya
CEO and Founder
Suhora



Mr Suyash Singh
Founder & CEO
GalaxyEye



Mr Kalyan Boppinedi
Director of Business Development
Capella Space



DAY 02 | THEME: " INDIGENOUS DEVELOPMENT AND GLOBAL COMPETITIVENESS"

Inaugural Session



Lt Gen VG Khandare
PVSM AVSM SM (Retd)
Principal Adviser
Ministry of Defence



Dr Anupam Sharma
Director Special Project
DRDO



Vice Admiral S N Ghormade
PVSM AVSM NM (Retd)
Former Vice Chief of the Naval Staff
Indian Navy



Lt Gen DS Rana
AVSM YSM SM
DG DIA



Lt Gen N.S. Raja Subramani
PVSM AVSM SM VSM
Vice Chief of the Army Staff
Indian Army

SESSION IV: MISSION DefSpace UPDATE: PROGRESS, CHALLENGES AND FUTURE



Dr (Smt.) Ranjana Nallamalli
Director
Directorate of Futuristic
Technology Management
(DFTM), DRDO



AVM DV Khot
AVSM VM (Retd)
Principal Consultant
IN-SPACe



Lt Col Sanjay Kumar Mahala (Retd)
Program Director, iDEX DIO



Col Kishor Yewale
Col SP (Space)
Army HQ



Mr Bharath Simha Reddy
Pappula Assistant General Manager:
Space Systems, Azista Industries



Gp Capt HS Prasanna
DSA



Mr Tushar Jadhav
CEO & Director
Manastu Space



SESSION V: INTERNATIONAL COOPERATION IN DEFENCE SPACE



Lt Gen Dushyant Singh
PVSM AVSM (Retd)
DG CLAWS



Mr Noel Ballot
EVP Sales & Marketing
SAFRAN Data Systems



Col Baljinder Singh (Retd)
Director for Aerospace &
Defence, USISPF



Mr Alexander Jeuck
Senior Adviser
Novaspace



Mr Gianluca Baldassare
SVP International Marketing
& Strategy – Space Division
Leonardo



Col. Gil Elmalem
Deputy Defence Attaché
& DDR&D Attaché (MAFAT),
Embassy of Israel

SESSION VI: SPACE DOMAIN AWARENESS: STRENGTHENING
INDIA'S STRATEGIC EDGE



Dr. AK Anil Kumar
Director, ISTRAC



Air Marshal BR Krishna
PVSM AVSM SC (Retd)
Former CISC, IDS HQ



Lt Gen Karanbir Singh Brar
AVSM GOC
Dakshin Bharat Area
Indian Armed Forces



Mr Tanveer Ahmed
Co-Founder & CTO
Digantara



Air Cmde Ashish Baduni
VSM DSA



Mr Marco Borghi
Senior Consultant
Novaspace



SESSION VII: ADVANCED TECHNOLOGIES AND SENSOR ECOSYSTEM:
DRIVING FUTURE SPACE OPERATIONS



AVM Rajiva Ranjan
VM (Retd), Former
ACIDS-ICT, IDS HQ



Mr Sakthikumar R.
Founder & CEO,
OrbitAID Aerospace



Mr Sandro Panagini
VP Strategy & Innovation
Leonardo



Mr Ashok Saxena
Founder & CEO
SpaceTS



Mr R.C Jain VP
SM Creative Electronics Ltd



Mr. Shravan Singh Bhati
Founder & CEO
SatLeo Labs

SESSION VIII: PROPULSION & LAUNCH VEHICLES: ADVANCING INDIA'S
SPACE CAPABILITIES



Mr Raghavendra BM
Senior Deputy
General Manager, L&T



Dr Sudheer N
Former Director
CBPO, ISRO



Prof Arindrajit Chowdhury
CEO InspeCity



Mr. Aakash Sinha
CEO
Omnipresent Robot Tech

DAY 3 THEME: ADVANCING SPACE SECURITIES & STRATEGIC CAPABILITIES

Opening Session



AVM DV Khot
AVSM VM (Retd)
Principal Consultant
IN-SPACe



Lt Gen RS Raman
AVSM
YSM, DG MI



Lt Gen Manish M Erry
UYSM AVSM SM, DG SP



Air Marshal S P Dharkar
PVSM AVSM SM VSM
Vice Chief of the Air Staff
Indian Air Force



AVM Rahul Bhasin
ACAS (Ops) Space
Air HQ



SESSION: THE CHANGING WORLD & MAXAR



Col Sai Arul
Head of Region SAARC
Maxar Technologies



Mr Mike Small
Defence & Security Leader
APAC & EMEA
Maxar Intelligence



Mr. Matt Jackson
Engineering Senior Manager
Software Systems
Maxar Technologies



Mr Edward S. Lau
Director
Joint Engagement Team
Maxar Intelligence



Mr Partha Ghosh
Presales
Maxar Technologies

SPECIAL ADDRESSES

Cyber Security in
Space Operations



AVM Dr. Devesh Vatsa
VSM, Advisor
DSCI Nasscom

Quantum Communication
Technology



Air Marshal GS Bedi
AVSM VM VSM (Retd)
Vice President of
Business Development

Integrating Space Sector, UAVs and
Deep Tech under DAP 2020



Mr. Rajat Kumar Singh
Associate General Manager
IIFCL Projects



Mr. Akshat Johri
Assistant General Manager
IIFCL Projects

Fireside Chat: “leadership In The Age Of AI:
India's Strategic Sovereignty In Space,
Defence And Economic Corridors”



Mr. Ravinder Pal Singh
Investor in Deep
Tech & Science



Lt Gen AK Bhatt
PVSM UYSM AVSM
SM VSM (Retd)
DG ISpA



Air Marshal BR Krishna
PVSM AVSM SC (Retd)
Former CISC, IDS HQ



Gp Capt TH Anand Rao (Retd)
Director, ISpA

CLOSING SESSION

Technical Report prepared and Compiled By

THE KNOWLEDGE PARTNER



**AMITY
UNIVERSITY**



**INDIAN
SPACE
ASSOCIATION**