



# International Conference on Space 2023

# Expediting New Space in India

14-15 September 2023, Bengaluru



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#### Introduction

The International Conference on Space 2023, themed "Expediting NewSpace in India," held from 14<sup>th</sup> to 15<sup>th</sup> September in Bengaluru, marked a significant milestone in India's space journey. Organized by the Confederation of Indian Industry (CII) in collaboration with the Indian Space Research Organization (ISRO), Indian National Space Promotion and Authorization Centre (IN-SPACe), and NewSpace India Ltd (NSIL), the conference brought together a diverse array of stakeholders from government bodies, industry, startups, academia, and associations. The event aimed to deliberate on policy frameworks, regulatory reforms, and international collaborations to bolster India's position in the global space sector.

The conference celebrated India's growing prominence as a space power, exemplified by its successful satellite launches and its role in launching satellites for other nations. With a 2% share in the global space business, India demonstrated immense potential to become a hub for space commerce and manufacturing. The recent approval of the Indian Space Policy 2023 was hailed as a pivotal moment, ushering in an era of increased private sector involvement in the space industry. This policy framework set the stage for collaborations between ISRO, IN-SPACe, and private entities, heralding a new era for India's space endeavors.

CII's dedication to enhancing Indian industry's engagement in the space sector every year and fostering international partnerships was underscored. The organization has been playing a crucial role in driving India's vision for space exploration and development by providing a platform for connecting all the stakeholders.

The conference featured ten panel sessions, each comprising experts from various domains, including government bodies, startups, academia, and associations. These sessions addressed a wide spectrum of topics within the space sector, offering valuable insights and perspectives. Be it for business, industry knowledge, sector feedback and technological advancements, this conference served as a platform for all stakeholders. More than 600 people attended the conference with more than 80 speakers and guests from the industry stalwarts.

This year, the conference held special significance, coinciding with India's G20 Presidency and CII's role as a B20 Secretariat for the Government of India. This elevated the importance of discussions around space in the global context.

The success of the International Conference on Space 2023 owes much to the invaluable support and collaboration of our esteemed partners. The conference's success was attributed to the collaborative efforts of ISRO, IN-SPACe, NSIL, for their pivotal roles in catalyzing private sector engagement and regulatory reforms within the Indian space sector. Additionally, we would like to extend our sincere thanks to the Australian Consulate, whose presence and support as the guest country enriched the conference with diverse perspectives and insights.

The International Conference on Space 2023 served as a platform for meaningful discussions and collaborations that are poised to shape the future of India's space sector. With an enriched policy framework, heightened private sector involvement, and strategic international partnerships, India is well-positioned to accelerate its journey towards becoming a global leader in space exploration and commerce. The conference's impact will undoubtedly resonate in the years to come, fostering innovation, growth, imparting sectorial knowledge and collaboration in the Indian space ecosystem.



#### **Outline of Sessions: Discussion points & Key takeaways**

The following sessions were held with the sessions topics and respective moderators, panelists are listed here. For all the sessions, overall panel discussions overview, key takeaways from each speaker were noted and highlighted few actions from each session here in the following sections.

#### Overview of the conference sessions

Day 1: 14 <sup>th</sup> September 2023	
Inagural Sess	ion
Session 1	Expediting New Space in India: Current Scenario and challenges
Session 2	Driving India's Space Sector through favorable policies and demand creation
Session 3	Indian Space Industry moving towards AtmaNirbharata across the value chain
Session 4	Earth Observation: current trends, innovations, challenges and opportunities
	Day 2: 15 <sup>th</sup> September 2023
Session 5	Propelling India's Economy through Space start-ups
Session 6	Emerging Trends in SatCom: India's Perspective
Session 7	Human Spaceflight and Space Exploration Missions
Session 8	Enhancing International collaborations in space sector: Roadmap ahead
Session 9	Innovation & Emerging Technologies: The future of Space
Session 10	Earth Observation Data & Dissemination Platform: The Vision & Strategy

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### Day 1: 14<sup>th</sup> September, 2023

#### **Inaugural session**

List of Invitees	
Dr. Pawan Kumar Goenka	(IN-SPACe)
Ms. A S Kiran Kumar	Former Chairman, ISRO & Distinguished Indian scientist
Ms. Sarah Storey	Deputy High Commission Australian High Commission
Mr. Jayant Patil	Chairman, CII National Committee on Space
Mr. Apparao Mallavarapu	Co-chair, CII National Committee on Space
Mr. Kamal Bali	Chairman, CII Southern Region

#### Outline of the inaugural session

The outline of the inauguaral session covers the recent major achievements and developments in the Indian space sector, including the successful Chandrayaan-3 lunar landing, the new Indian Space Policy 2023, the growing private sector participation, investment and infrastructure development, and the opportunities and challenges going forward. There was excitement and optimism about the future growth of the Indian space economy to achieve the vision of \$44 billion by 2033. The key drivers highlighted were policy reforms, public-private partnerships, technology transfers, manufacturing capacity, startup ecosystem and global collaborations.

#### Key action Items

- CII to publish report on action points and follow-up plan after conference conclusions
- IN-SPACe to finalize implementation guidelines for Space Policy 2023
- ISRO to expedite additional technology transfers to industry
- Industry to submit feedback on Earth Observation policy consultation paper
- Startups to leverage emerging partnerships and tap into resources and platforms
- Stakeholders to collaborate on building skilled workforce for the space sector
- Government to actively engage with global space agencies for partnerships
- CII and IN-SPACe to plan next edition of the conference with participation goals

#### Key takeaways of the Inaugural session:

#### Major Recent Achievements

The successful soft landing of Chandrayaan-3 on the lunar south pole was a historic accomplishment that has made the nation proud and brought global recognition. The launch of 72 OneWeb satellites on the LVM-3 rocket demonstrated its commercial viability. The release of the new Indian Space Policy 2023 after extensive consultations was a major milestone.

#### Growth of Private Sector

There has been rapid progress by private sector players in launch vehicles, satellites, infrastructure, investments and collaborations, facilitated by reforms in policies, technology transfers and use of



ISRO facilities. Several private companies like Skyroot, Agnikul, Digantara, Pixxel etc. have raised significant funding.

#### Partnerships and Collaborations

Partnerships between industry, startups, academia and global collaboration are key enablers. The conference highlighted the close ties between India and Australia in the space sector. Several MOUs were exchanged between Indian and Australian organizations.

#### Future Roadmap and Challenges

The vision is to grow the Indian space economy from \$8 billion currently to \$44 billion by 2033, as per IN-SPACe. Realizing this ambitious target will require concerted efforts to build capacity, enable private investment, develop talent, enhance competitiveness, foster R&D and innovation, and collaborate globally. But there is confidence that the Indian space sector is poised for exponential growth.



## Day 1/ Session 1: Expediting New Space in India: Current scenario and Challenges

Moderator of the session	
Mr. Laxmesh BH	Vice President, L&T
Special Address	
Dr. Vinod Kumar	PD, IN-SPACe
List of Panelists	
Retd. Lt Gen Anil Kumar Bhatt	Director General, ISpA
Mr M.V. Reddy	Joint Managing Director, Astra Microwave Products Ltd
Mr. Maneck Behramkamdin	Assistant Vice President, Godrej Aerospace
Mr. Sanjay Nekkanti	Founder & CEO, Dhruva Space
Prof Satyanarayanan R Chakravarthy	Professor, IIT Madras
Mr. Yashas Karanam	CEO, Bellatrix Aerospace Private Limited
Mr. Anirudh Sharma	CEO, Digantara

#### Outline of the session 1

This session covered with discussions on the current scenario of the Indian space sector, existing challenges faced and the potential way forward. It highlights India's strength in space technologies like launch vehicles, spacecrafts and applications that benefit sectors like agriculture, education, health, etc. However, India lacks an ecosystem to support private space companies, faces challenges with regulations, access to technology and finance. The potential way forward discussed includes policy reforms, incentivizing R&D and private sector participation, capacity building and developing strategic technologies to reduce dependence on imports.

#### **Key Action Items**

- Finalize the space policy and guidelines for private sector participation.
- Provide financing support for private space companies through PLI schemes and soft loans.
- Build strategic technologies and technical capabilities through collaborations between industry, academia and government.
- Enable private access to ISRO's technical facilities to support capacity development.
- Undertake an analysis of the type of industries that would benefit from production linked incentives along the space value chain.
- Create institutional mechanisms to finance risky technology development and demonstrations.

#### Key takeaways of session 1

#### India's space strengths

India has developed launch vehicles, spacecrafts and applications that provide social and economic benefits. ISRO has built capabilities in upstream, midstream and downstream space technologies.

#### Challenges faced

The space sector faces regulatory challenges like the lack of a space activities bill yet, security concerns with private sector participation and spectrum allocation. There are also technological challenges with access to strategic technologies and cost of space access. The space sector also



faces financial challenges due to high upfront costs and risks associated with space technology development.

#### Potential way forward

The potential way forward for the space sector includes policy reforms to encourage private sector participation, incentivizing R&D and building strategic space technologies to reduce import dependence. Capacity building, skill development and enabling access to ISRO's technical facilities can support the growth of private space companies. FDI reform and financing instruments like PLI schemes, tax holidays etc,.

#### Highlights of the speakers discussion:

#### 1. Dr. Vinod Kumar, PD, IN-SPACe – Special address

Dr. Vinod Kumar, PD, IN-SPACe has presented a comprehensive overview of the speaker's session, covering various aspects of the current state, challenges, opportunities, and future prospects in the space and digital sectors.

- Current Scenario and Challenges: Discussion on current scenario, challenges, and the way forward. Emphasis on SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis for the current system.
- ISRO's Technological Advancements: Highlighted ISRO's state-of-the-art technologies across various verticals (upstream, downstream, and very streams). Mentioned ISRO's strengths in launch vehicles, satellites, and applications in different sectors.
- Applications for Governance: Discussed various applications for betterment of Main government and Micro governance initiatives.
- Digital Sector Leadership: India's leadership in digital transactions, especially through UPI, was emphasized.
- Global Currency Trends: Illustrated exponential growth in India's digital sector, aligning with international trends.
- Data and Proposals: Showcased data availability on the website and shared the number of received proposals (353).
- Challenges and Government Initiatives:Addressed regulatory, technological, and financial challenges in the space sector. Highlighted government initiatives such as the release of a comprehensive space policy.
- Cluster Mapping and Competitiveness: Discussed the importance of mapping factor input conditions and market demand conditions.
- New Space Approach: Advocated for an exponential growth approach in technology development, departing from traditional linear progress.



- Predictions and Growth Projections:Presented predictions of \$44 billion Indian space technology market by the 2033 from the current \$8 billion space economy. Mentioned detailed sector-wise studies which will be published soon.
- Opportunities for Digital Economy: Discussed revenue generation models of major tech companies like Apple, Google, and Amazon. Explored avenues in increasing digital penetration in India.
- Path to a \$1.5 Trillion Economy: Shared projections for the economy's growth towards becoming a \$1.5 trillion entity.
- Steps for Strengthening Space Sector: Emphasized the need to enhance technology, transport, facility utilization, export manpower, and more.
- Policy Framework and Institutional Investors: Highlighted the importance of a comprehensive space policy and attracting institutional investors.
- Space Data Opportunities: Discussed untapped potential in space data and applications, and the need to connect the unconnected.
- Mitigating Weaknesses and Threats:Addressed concerns about dependence on imports, policy framework for space spectrum, and development of cutting-edge technologies.



# Day 1/ Session 2: Driving India's space sector through favorable policies & demand creation

Moderator of the session		
Mr. Sreeram Ananthasayanam	Partner, Deloitte India	
List of Panelists		
Mr. Ganesh Mohan	Assistant Director, INSPACe	
Mr. Rohan Ganapathy	Director, Bellatrix Aerospace	
Mr. ATL Air Marshal GS Bedi	Director, Ananth Technologies	
Mr. Sunil Indurti	Director, Azista BST	
Mr. Venkatesh Kumaran	President, Astrome Technologies Pvt. Ltd	
Mr. Palava Bagla	Journalist, Science & Technology	
Mr. Ashok GV	Partner, Factum Law	

#### Outline of the session 2

The panel discussion covered various aspects of driving India's space sector growth through favorable policies and initiatives. Key points discussed were the need for a clear overarching space policy and implementation roadmap, addressing issues like liability frameworks, streamlining regulations, incentivizing private sector participation, boosting downstream applications, developing talent and ensuring sustainability. The recently released space policy was lauded as a good first step, but issues like conflict of interest and lack of liability framework were highlighted. Suggestions included separating the roles of regulator and implementer, having a consolidated legal framework, increasing access to data and clarifying government demand signals. Panelists emphasized the need to boost downstream applications to drive mass impact and highlighted areas like earth observation data analytics, satellite imaging and space debris mitigation as potential growth avenues. Overall, a clear long-term vision articulated through a national space policy white paper, along with coordinated efforts by all stakeholders was seen as crucial to unleash the potential of India's space sector.

#### **Key Action Items**

- Government to publish a national space policy white paper laying out long-term goals and vision for the sector.
- InSpace to separate regulatory and implementation roles to resolve conflict of interest.
- Constitute a joint committee for formulating an overarching space law addressing issues like liability, regulation, incentives.
- Set up platform to aggregate demand signals from various government agencies and clarify procurement norms.
- Launch programs to increase private sector access to space data and infrastructure like launch vehicles.
- Expand capacity building efforts to develop multidisciplinary space technology talent.

#### Key takeaways of session 2

- Key Takeaways from India's Space Policy
  - The space policy has defined stakeholders and laid out an implementation framework. But issues remain around conflict of interest, lack of liability framework and regulatory clarity.





#### Areas for Improvement

Suggestions included separating regulator and implementer roles, having a consolidated legal framework, boosting private sector incentives and increasing access to space data.

#### Boosting Downstream Applications

Panelists emphasized boosting downstream space applications in areas like earth observation, satellite imaging and space debris mitigation as huge growth opportunities.

#### Need for Coordinated Efforts

A clear long-term space vision white paper along with coordinated efforts by all stakeholders is crucial to realize India's space sector potential.



# Day 1/ Session 3: Indian Space Industry moving towards AtmaNirbharata across the value chain

Moderator of the session	
Mr. Vinod Chippalkatti	President, Centum Electronics
Special Address	
Dr. Rajiv Jyoti	Director, TD, IN-SPACe
List of Panelists	
Mr. SK Jha	CMD, MIDHANI
Mr. Chirag Doshi	MD & CEO, Walchandnagar Industries
Shri. N Balaji	Addl. General Manager, HAL
Mr. Ashtesh Kumar	Co-founder, Manastu Space
Ms. C.V.S.Kiran	R&D and Strategy. Skyroot Aerospace Private Limited
Mr. Mahadevan ATI	Senior Manager- Space, Dassault Systems

#### **Outline of the session 3**

This session discussed about the Indian space industry and its progress towards self-reliance. Key points included:- The Indian space industry has been an integral part of the space ecosystem for decades. It comprises large, medium, small industries and startups. There is excitement about the future growth of the sector. - The industry includes over 500 private suppliers and 150 startups. Major sectors are satellite manufacturing, ground systems, and launch vehicles. There is a need to scale up industry capabilities from subsystem to full system level.- For decades, ISRO has focused on self-reliance through R&D and technology development. Atmanirbharta is a continuation of this approach under new policy regime which enables private sector collaboration.- Opportunities exist in critical components, subsystems where volumes are higher for industry. Industry needs to invest in R&D and aim for complete systems, not just subsystems. They should target both domestic and export markets.- Spin-off benefits of space technology are evident in sectors like automobiles, telecom, medicine etc. Commercialization and export focus is important for growth.- Key challenges are availability of materials like composites, polymers, lack of standards for space-grade materials. Collaborative approach between ISRO, industry, academia is required to develop technologies, infrastructure, skilled manpower.- Companies like MIDHANI, HAL, L&T, Skyroot, Dassault highlighted their contributions. New space startups like Skyroot and Manasthu Space shared plans to develop launch vehicles, green propulsion etc. using ISRO base technologies. - Overall, self-reliance will lead to affordable space access and spin-off benefits for economy. But it requires holistic development of industry ecosystem with critical materials, aggressive commercial orientation and supportive policies. Self-reliance will lead to affordable space access and economy benefits but requires holistic development of industry ecosystem.

#### **Key Action Items**

- ISRO to identify and prioritize opportunities for industry to take up subsystem development and manufacturing especially where volumes are higher
- Industry players to set up capabilities for end-to-end realization of systems, invest in R&D and skilled manpower development
- ISRO, industry and academia to collaborate for developing standards for space-grade materials
- Government to provide supporting policies for easier access to capital and technology for private space startups
- Industry to adopt export-oriented approach to tap global launch services and satellite market



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ISRO to facilitate testing facilities for industry players to qualify space systems and components

#### Key takeaways of session 3

- Overview of Indian space industry and ecosystem
   The industry comprises established players as well as new startups across launch vehicles, satellites, ground systems etc. There is excitement about future growth led by private sector participation.

   ISRO's focus on self-reliance
- ISKU'S TOCUS ON SEIT-RELIANCE
   For decades, ISRO has invested in R&D and technology development for self-reliance.
   Atmanirbharta continues this approach under new policy regime and collaboration models.
- Opportunities for industry participation
   Opportunities exist in subsystems, components for industry to scale up. Commercial orientation for domestic and export markets are important.
- Challenges in scaling up industry ecosystem Critical materials, lack of standards, need for R&D and skilled manpower pose challenges. Collaborative approach can help overcome these.
- Contributions by industry players
   Companies like MIDHANI, HAL, L&T, Skyroot, Dassault highlighted their contributions. New startups shared plans leveraging ISRO technologies.



# Day 1/ Session 4: Earth Observation: current trends, innovations, challenges and opportunities

Moderator of the session	
Dr. K Sreenivas	DD, NRSC
Special Address	
Dr. Thomas JV	Director, EDPO, ISRO HQ
List of Panelists	
Mr. Arpan Sahoo	COO, KaleidEO
Mr. Krishna Rao TVB	ESRI India
Mr. Kishan Thakkar	VP Engineering, GalaxEye
Mr. Sathvik Shetty	Chief Commercials Officer, QL Space
Mr. Naveen Reddy	Head, South Asia, Planet

#### Outline of the session 4

The panel discussion covered various aspects of trends and opportunities in earth observation. Several speakers from various companies working in earth observation and geospatial technology share insights on the industry in India.

Key points discussed: There is huge untapped potential and market for ground observations and applications in India, with many new players entering the industry. ISRO is open and willing to engage private sector. Companies like SatSure, Kaleelio, and Galaxai are developing new satellite constellations and payloads optimized for analytics and fusion of datasets like SAR and multispectral. Goal is to provide actionable intelligence tailored to industry verticals. Need for higher downlink bandwidths, onboard processing, new algorithms, AI/ML to handle massive new datasets from multiple platforms. Building customized solutions.- Evolving with changing technology landscape crucial for companies like ESRI to remain leaders. Supporting startups and sharing revenue.- QL Space applying satellite data analytics with AI/ML for industries like wind farms and wildfire monitoring in Australia. Scope for Indo-Australian collaborations.- Planet Labs providing daily 3m satellite data coverage and has government and private customers in India. Partners help derive insights from data.- Key opportunities in building indigenous in-situ sensor networks to support calibration, validation and analytics. Building one-to-one dissemination platforms.

#### **Key Action Items**

- Engage with ISRO to better understand potential applications and user requirements for ground observation data
- Research market opportunities in various industry verticals for customized earth observation data products and analytics
- Explore partnerships with satellite data companies on building new optimized payloads and constellations
- Evaluate onboard processing, edge computing and AI/ML technologies for handling large volumes of satellite data
- Develop proof of concepts for using satellite data analytics in solving business problems for target industries.





- Research capabilities of companies like Planet Labs and ESRI as potential partners or data providers.
- Assess feasibility of developing indigenous solutions for in-situ sensor networks to aid analytics and insights from satellite data.

#### Key takeaways of session 4

# Untapped potential for ground observation applications Huge untapped market and potential exists in India for ground observation applications. Many new players entering the industry. ISRO open and willing to engage private sector.

- Innovations in satellites and data fusion
   Companies developing optimized satellites and payloads to provide fused datasets like SAR and multispectral images. Building customized solutions for industry verticals.
- Handling new data sources and volumes
   Need for more bandwidth, onboard processing, algorithms, AI/ML to handle massive new datasets from multiple platforms.
- Importance of adapting to changing technology
   Critical for companies to evolve with changing tech landscape through R&D, engaging startups, revenue sharing models.
- Satellite analytics use cases
   Companies like QL Space applying satellite data analytics with AI/ML for industries like wind farms and wildfire monitoring.
- Scope of Indo-Australian collaboration
   Opportunities exist for partnerships between the Indian and evolving Australian space industry ecosystems.
- Supporting calibration and validation
   Key opportunities in building indigenous in-situ sensor networks to support analytics and insights.



## DAY 2: 15<sup>TH</sup> SEPTEMBER, 2023

## Day 2/ Session 5: Propelling India's Economy through Space start-ups

Moderator of the session		
Shri. Sudheer N Kumar	Director- CBPO, ISRO	
List of Panelists		
Shri Brijesh Soni	Deputy Director PD, IN-SPACe	
Ms. Devleena Bhattacharjee	Founder & CEO, Numer8 Analytics Pvt. Ltd	
Mr. Vishesh Rajaram	Co-founder, Speciale Invest	
Mr. Govind Joshi	Executive Vice President, TransUnion CIBIL Limited	
Mr. Harshan V	Program Director (Principal), Mach33.Aero	
Mr. Ankit Bhateja	Founder & Director, Xovian Aerospace	
Mr. Navneet Singh	Chief Executive Officer, Kepler Aero	

#### **Outline of the session 5**

This session discussed about the potential of using space technologies to boost the Indian economy in various sectors including agriculture, finance and insurance. The speakers highlighted the challenges faced in building space-tech solutions and scaling up including lack of funding, limited access to market data and testing infrastructure as well as issues with the incubation system. They also suggested possible solutions such as developing dual-use technologies that can generate revenue, collaborating with larger companies and leveraging government support and CSR funds to build sustainable space-tech enterprises.

#### **Key Action Items**

- Develop dual-use technologies that can generate revenue in multiple sectors
- Collaborate with larger companies to access resources, testing infrastructure and markets
- Leverage government funding and CSR to support startups in their early stages
- Improve the incubation system by focusing on helping startups scale rather than taking equity
- Conduct research to better understand the Indian space sector and generate market data

#### Key takeaways of session 5

Using space tech in agriculture and finance

The speakers discussed how satellite data and imagery can be used by banks and insurance companies to assess farm productivity and risks, enabling better lending and underwriting decisions in the agriculture sector. Space-tech can help address challenges such as the informal and undigitized nature of the sector, the geographic spread of farms across India and the costs involved in on-ground assess

Challenges in building space-tech solutions

The speakers highlighted major challenges for startups including lack of funding, especially for commercial applications and venture capital's preference for proven technologies with shorter timeframes for generating returns. There is also limited access to market data on the Indian space



sector and testing infrastructure. The incubation system in India focuses more on equity rather than truly sup

#### Possible solutions and collaborations

The speakers suggested developing dual-use technologies that can be deployed in multiple sectors to generate revenue, collaborating with larger companies to access resources and the market as well as leveraging government support and corporate social responsibility funds to help startups during their ideation and prototyping stage.



## Day 2/ Session 6: Emerging Trends in SatCom: An India Perspective

Moderator of the session	
Mr. Praneet Kumar	Director, Deloitte India
Special Address	
Shri Hanumanth Rayappa	Director, Satcom PO, ISRO HQ
List of Panelists	
Shri Sumit Kumar	Chief Manager, NSIL
Mr. Vinod Sood	MD, Hughes Systique
Ms. Nishtha Kapoor	Director- Africa, South Asia, and India, OneWeb
Mr. Gautam Sharma	MD Inmarsat-UK
Ms. Madhu Radhakrishnan	Product Manager, SES

#### Outline of the session 6

This panel discussion covered various aspects related to emerging trends and opportunities in satellite communications from an Indian perspective. The key points discussed were:

1) Satellite communication has huge potential to provide broadband connectivity to rural and remote areas of India which lack terrestrial network coverage. This can help bridge the digital divide. India has only 29-30% rural broadband penetration compared to over 90% in urban areas.

2) Government's National Broadband Mission aims to provide broadband to every Indian village. Satellite broadband can play a key role in reaching the 10-15% of villages where terrestrial networks are not viable. Players like OneWeb with LEO constellations can address the connectivity gap.

3) Applications like e-governance, banking, direct benefit transfers are already using satellite connectivity in rural India. Areas like precision agriculture, renewable energy farms, healthcare, education can benefit from satellite broadband.

4) While India does not lack funds or technology for satellite communication, the main bottleneck is efficient project execution and implantation strategy. There are issues like supply chain problems, lack of components, delays in deploying infrastructure that need focus.

5) Regulatory uncertainties around spectrum allocation, licensing approachcreate uncertainty for industry players to make investments. A collaborative approach between government, ISRO and private players is required to create a favourable environment.

6) Emerging trends like HTS satellites, seamless integration of satellite broadband and 5G networks, use of IoT and sensors can open up many new applications in future like intelligent transportation, disaster management, telemedicine etc.

7) Satellite operators are also focused on mobility applications like maritime, aero in-flight connectivity. There is a surge in data consumption from thousands of onboard sensors that will require analysis.

8) Overall, satellite communications will continue to play a vital role in India's economic growth, achieving digital inclusion goals and national missions like Digital India and Make in India.













#### **Key Action Items**

- Ministry of Communications to engage with telecom operators, satellite companies and ISRO to create a joint taskforce for improving rural broadband connectivity using satellite technology.
- TRAI to provide recommendations on licensing framework, spectrum allocation policy for satellite communication by end of 2022 to create regulatory certainty.
- DoT to work with Ministry of Agriculture, Health, Education, Railways and State IT departments to identify key application areas where satellite broadband can be utilized under Digital India missions.
- ISRO to share technology roadmap on developing HTS satellites, ground infrastructure with capabilities to integrate 5G and IoT ecosystems by mid-2023.
- DoT to work with maritime and aviation ministries to promote use of satellite communications for emerging applications like maritime fleet analytics platforms, real-time ocean bed data sensors, aircraft cockpit and cabin connectivity solutions.

#### Key takeaways of session 6

- Importance and Potential of Satellite Communication
   Satellite communication can help provide broadband access to rural and remote areas in India to bridge the digital divide. It has a significant role to play in government's National Broadband Mission of connecting all villages.
- Key Applications Benefiting from Satellite Connectivity Areas like e-governance, banking, agriculture, education, healthcare etc are already benefiting from satellite broadband connectivity in rural India.

**Challenges and Opportunities** While technology and funds are available, focus needs to be on improving project execution through collaboration between government, ISRO and private players. Regulatory uncertainties need to be addressed.

#### Emerging Technology Trends Integration of 5G and satellite networks, use of

Integration of 5G and satellite networks, use of IoT, HTS satellites can enable many new applications and use cases, especially in sectors like transportation, disaster management, healthcare etc.

#### New Opportunities in Mobility

There are significant new opportunities in sectors like maritime and aviation connectivity. Managing data from thousands of on-board sensors will require use of satellite communication.



## Day 2/ Session 7: Human Spaceflight and Space Exploration Missions

Moderator of the session	
Shri. Imtiaz Ali Khan	Director, DHSP, ISRO HQ
Special Address	
Mr. R Hutton	Project Director, Gaganyaan
List of Panelists	
Gp Capt Amarendra Samal	Gp Capt Ops (Space) DTE of Ops (Space), Air HQ (VB)
Dr. R Kumar	Joint Director, Defence Food Research Laboratory (DFRL), DRDO
Mr. Vinod Chippalkatti	President, Centum Electronics
Mr. Aakash Porwal	Founder & CEO, Space Aura
Mr. Akshat Mohite	CEO, Astroborne Aerospace

#### Outline of the session 7

This panel session covered India's human spaceflight program Gaganyaan. Key points discussed:-Gaganyaan aims to send Indian astronauts to low Earth orbit for 3-7 days by 2024. The mission will use GSLV Mk III launch vehicle and will involve an orbital module with crew and service module. Key challenges are human-rating the launch vehicle, developing life support systems, and manufacturing large structures like the crew module. - Indian Air Force is closely involved in crew selection, training, spacesuit development, integrated drop tests etc. Crew have undergone extensive medical and psychological evaluations. Foreign collaborations utilized for training like parabolic flights. - Industry players like Centum Electronics, Space Aura, Astroborne are contributing to electronics, space tourism capsules, astronaut training facilities. They bring agility and innovation from private sector.- Key technologies needed from industry: large electron beam welders, space-grade components, life support systems, crew safety systems, heat shields, parachutes etc. Testing and quality requirements much more stringent than usual satellites due to crew safety factors.- Overall, the human spaceflight program is bringing great national pride. It inspires youth and expands India's capabilities in human-related fields like medicine and life sciences beyond engineering. The session showed growing ecosystem of government, industry, academia and startups coming together to make the mission a success.

#### **Key Action Items**

- Discuss with academic institutes on setting up microgravity and astronaut training facilities.
- Explore establishment of an electron beam welding facility for large structures.
- Evaluate feasibility of parabolic flight testing platform using existing aircraft in India.
- Discuss with ISRO expanded role of industry partners in providing key technologies like life support systems, crew safety systems, heat shields, parachutes, space-grade components etc.
- Set up working group to define roadmap for broader industry participation, including startups, in human spaceflight leading up to 2024 mission.
- Discuss potential collaboration with international players especially in areas like microgravity and parabolic flight testing platforms.

**Guest Country** 





#### Key takeaways of session 7

#### Overview of Gaganyaan Human Spaceflight Mission

Gaganyaan aims to send astronauts to low Earth orbit by 2024 using GSLV MkIII rocket and orbital module. Key challenges are human-rating systems, developing life support, manufacturing large crew module etc.

# Role of Indian Air Force in Crew Selection and Training IAF involved in crew selection, training, spacesuit development, integrated drop tests etc. Crew have undergone extensive evaluations and utilize foreign collaborations.

#### Contributions from Industry Players

Companies like Centum Electronics, Space Aura, Astroborne contributing in electronics, space tourism, astronaut training. Bringing agility and innovation.



# Day 2/ Session 8: Enhancing International collaborations in space sector: best practices and the roadmap ahead

Moderator of the session	
Ms. Anitha Nandini	Director, IC, DOS
Special Address	
Dr. Gowri Sankar	Director, OIIC, ISRO HQ
List of Panelists	
Mr. Dmitri Loskutov	Director General, JSC Glavkosmos
Ms. Naomi Kurahara	Founder & CEO, Infostellar Inc
Mr. Narayan Prasad	CEO, Satsearch
Group Captain Arvind	Senior Fellow, Geospatial Intelligence Professional, Centre for Air
Pandey	Power Studies (CAPS)
Prof Simon Ellingsen	Dean of School of Natural Sciences, University of Tasmania
Mr. Milind Pimprikar	Chairman, Caneus

#### **Outline of the session 8**

This panel discussed various aspects of international collaboration in the space sector. Key topics included technology transfer between space agencies, promoting startups and academic collaboration, engagement with industry, role of multilateral agencies, and space applications for development. The Indian Space Policy 2023 provides a framework for international collaboration, with a focus on using space for sustainable development goals and serving humanity. ISRO has over 250 agreements with 61 countries and 5 multinational bodies. Best practices include equal partnerships with space faring and aspiring nations, leveraging diplomatic channels, hosting UN centers, and academic partnerships. Priorities going forward include establishing regional space forums, forging commercial partnerships, creating a decadal plan, and leveraging Quad and other multilateral forums. Industry perspectives highlighted the need for transparent supply chains and a global tendering system to increase competitiveness and bring down costs. Recommendations for startups and academia included university collaborations on student satellite programs and exchange of talent. Applications in areas like agriculture, water resources and nanotechnology can be accelerated through international consortiums and funding models.

#### **Key Action Items**

- Explore establishing regional space forums for India to increase visibility of capabilities
- Create commercial partnerships with other space agencies through joint working groups
- Develop a decadal plan highlighting priority areas for international collaboration
- Increase private sector participation in multilateral forums like Quad
- Enable transparent space industry supply chains through a global tendering system
- Consolidate demand across countries for constrained supplies to improve negotiating leverage
- Promote university collaborations on student satellite programs for talent development
- Facilitate exchange programs for startup talent across countries
- Set up international consortiums and funding models for collaborative application development in agriculture, water and nanotechnology



#### Key takeaways of session 8

Overview of international collaboration priorities and best practices

The Indian Space Policy 2023 provides a framework for international collaboration focused on sustainable development goals and serving humanity. ISRO has extensive partnerships across 61 countries and 5 multinational bodies. Best practices include equal partnerships with advanced and emerging space nations, leveraging diplomatic channels, hosting UN centers in India, and academic partnerships.

#### Areas of focus for future international collaboration

Priorities going forward include establishing regional space forums for India, forging commercial partnerships through joint working groups, creating a decadal plan, and leveraging forums like Quad and other multilateral alliances. There is also a need to increase industry participation in these international platforms.

#### Perspectives on engaging industry internationally Industry experts highlighted the need for transportent space indu

Industry experts highlighted the need for transparent space industry supply chains and a global tendering system to increase competitiveness and bring down costs. Consolidating demand across countries can help improve negotiating power and access to constrained supplies.

 Recommendations for startups and academia
 For startups and academia, recommendations included university collaborations on student satellite programs which have been beneficial, and exchange of engineering talent across countries to help startups grow.

#### Applications focus for international collaboration

Key areas for collaborative applications include agriculture, water resources, and nanotechnology. Recommendations include creating international consortiums and funding models to accelerate development in these areas.



## Day 2/ Session 9: Innovation and Emerging Technologies: The future of Space

Moderator of the session	
Shri. Sudheer N Kumar	Director- CBPO, ISRO HQ
List of Panelists	
Ms. Mani Thiru	Head of Space & Satellite, AWS
Ms. Divya Sharma	Vice President, Satsure
Mr. Rajan Rajagopal	CEO, ZES Singapore
Dr. Debopam Bhattacherjee	Sr. Researcher, Microsoft Research
Col Sai Arul	Head- Region SAARC, Maxar Technologies
Mr. Phil Ridley	CEO, Quarsat
Mr. Terry Van Haren	Managing Director, LeoLabs Pty Ltd

#### **Outline of the session 9**

This session is presentations mode of discussion by industry experts covering various topics related to space technology and innovation in India.

Key points discussed were:-

- Israel's shift from routine operations to advanced R&D and focus areas like green propellants, robotic explorations, and in-space manufacturing. Innovations needed in areas like inflatable structures to achieve goals within constraints.
- AWS' collaboration with Israel on startups, digital engineering like simulations on cloud, edge computing in space, and use of generative AI in areas like image enhancement.
- SatSure's work in agriculture, infrastructure monitoring using EO data and AI/ML models, and need for better sensors and edge computing capabilities.
- Zidane's radiation hardened electronics like DC-DC converters and data integrity solutions to leverage COTS and reduce costs. 26 patents filed.
- Microsoft Azure's cloud offerings for space sector like Orbital Ground Station, and space research areas like LEO broadband and planetary computer.
- Maxar's innovations in space domain awareness, satellite data fusion, edge computing, maritime monitoring, high definition satellite imagery using AI/ML.
- Quasar's phase array antenna technology to tackle ground station capacity bottleneck, and space situational awareness using signals intelligence.
- LeoLabs' global space traffic management services using cloud computing, AI/ML and phased array radars. Tracking over 1M objects daily in LEO.

The panelists highlighted the need for advanced technologies like digital twins, edge computing, AI/ML, cloud analytics, phase array antennas, space domain awareness, and inter-disciplinary collaboration to tackle new challenges and opportunities in the fast-growing space sector.

#### **Key Action Items**

- Explore collaboration opportunities with Microsoft Planetary Computer platform for environmental analysis
- Evaluate AWS Orbital Ground Station service for our satellite data use case





- Connect with LeoLabs and Quasar for space situational awareness and spectrum monitoring solutions
- Discuss advanced satellite imagery analytics projects with Maxar and SatSure based on their experience
- Reach out to Zidane Systems to assess their radiation hardened electronics for our satellite subsystem

#### Key takeaways of session 9

- Israel's strategic shift to advanced R&D Israel is moving from routine operations to advanced R&D in areas like green propellants, robotic explorations, and in-space manufacturing to not just serve societal needs but also tap global opportunities.
- Potential of cloud computing and Al Cloud platforms from AWS, Microsoft and innovative Al solutions can accelerate space applications, reduce costs and enhance insights from space data.
- Importance of space situational awareness
   With congestion in space, capabilities like space domain awareness and space traffic management are critical for satellite operators and nations.

#### Highlights of the speaker presentations

#### Shri. Sudheer Kumar, Director, CBPO, ISRO HQ

- a. Speaking points summary
- The speaker begins by expressing gratitude and invites the audience to settle down for the second session of the conference.
- The speaker emphasizes the significance of the session, addressing a common question about ISRO's role in routine tasks versus future endeavors.
- ISRO's mandate, post-reforms, involves advancing research while routine tasks are delegated to the industry.
- The speaker highlights areas of heightened focus, including societal benefits, global market penetration, and adhering to the "Make in India" initiative.
- Various sectors within space exploration are discussed, such as energy systems, green propellants, planetary exploration, and space manufacturing.
- The importance of frugal innovations and working within constraints is emphasized, recognizing the contributions of startups in this regard.
- The speaker mentions ISRO's Izghan and its role in facilitating micro-gravity experiments, showcasing India's ingenuity in solving challenges.
- He acknowledges the role of startups in sending payloads to Poyak, underlining the benefits derived from such initiatives.
- The speaker expresses confidence in achieving significant progress without building large vehicles in the next decade.
- He lauds India's reputation for pushing the boundaries in space exploration and experiments within reachable limits.
- The speaker transitions to the panel discussion, urging panelists to discuss new technologies and their impact on space exploration and data sciences.







- b. Key takeaways:
- Diverse Focus Areas: The speaker highlighted the diverse areas of focus within the space sector, including energy systems, green propellants, planetary exploration, and space manufacturing. These areas are critical for the future of space exploration and development.
- Frugal Innovations: The discussion emphasized the importance of frugal innovations and working
  within constraints to achieve significant progress in space technology. Startups were recognized
  for their contributions in this regard.
- Micro-Gravity Experiments: The mention of ISRO's Izghan and its role in facilitating micro-gravity experiments showcased India's ingenuity in finding solutions to challenges, even without access to the ISS.
- Global Market and Making India: The government's clear focus on "Making India" and the
  potential to capture a share of the global space market were underscored. This indicates a strategic
  approach to positioning India as a significant player in the global space industry.

#### c. Quotes:

"India is very famous for such kind of human brains to explore and bring out new ideas and do experiments which are beyond our reach within the reachable limits."

#### Ms. Mani Thiru, Head of Space & Satellite, AWS

#### a. Speaking points summary

- Technology innovation is highlighted as a pivotal driver for national development, particularly in the domain of space technology.
- The speaker, Mani Tiru, leads Amazon Web Services' Space and Satellite Business across Asia Pacific. He commends the leadership in both the government and private sectors for propelling space technology development.
- AWS has made significant investments in India, including a commitment of 12.7 billion USD for data center expansion. The cloud and data sector infrastructure play vital roles in India's digital and space ecosystems.
- She emphasized AWS's mission to enable space builders and discusses the ways cloud computing is transforming the global space race.
- The speaker provided examples of how digital engineering, cloud-powered digital twins, and edge computing are reshaping traditional aerospace processes, significantly increasing productivity.
- She mentioned that generative AI as a powerful technology for the space industry, with applications in satellite imagery enhancement, data processing, and mission planning.
- Tiru concluded by expressing readiness for further discussions on how AWS supports the space industry.

#### b. Key takeaways

 Technology Innovation and Space Development: The speaker emphasizes the critical role of technology innovation in driving national development, particularly in the context of space technology.



- India's Leadership in Space Technology: The speaker commends India for having strong leadership in both the government and private sectors that are driving advancements in space technology.
- AWS Commitment to India: Amazon Web Services (AWS) has demonstrated a substantial commitment to India, including a significant financial investment and a focus on expanding data center infrastructure.
- Cloud Computing's Impact on Space Industry: Cloud computing, facilitated by AWS, is revolutionizing aerospace processes like design engineering, modeling, and simulation. This shift is enhancing productivity and efficiency in the industry.
- Digital Engineering and Cloud-powered Digital Twins: The integration of digital engineering and high-performance computing is leading to the development of cloud-powered digital twins, replicating real-world items and systems in the digital realm.
- Edge Computing in Space: AWS is pioneering edge computing, bringing cloud capabilities directly to data sources. This has practical applications for space operations, including onorbit cloud computing.
- Generative AI and Space Industry: Generative AI is identified as a transformational technology with potential applications in satellite imagery enhancement, data processing, and complex tasks like space mission planning.

#### c. Quotes:

- Generative AI is expected to accelerate growth in the space industry in remote sensing, spacecraft design and engineering, launch, flight and propulsion. So I believe that AI is the single most transformational technology of our time.
- One of the major findings to date is that with AWS AI/ML, you can reduce massive raw images and data files by 42%. That's a tremendous number. This helps speed up processing time and enables real -time insights. This is real -time insights that we can use to fight fires, to provide defense intelligence. And in a longer time series, of course things like climate change, agriculture, the several areas where real -time intelligence can be deployed. So the results of our experiments so far signal a very exciting era in space data management and satellite operations.

#### Ms. Divya Sharma, Vice President, Satsure

- The speaker expresses gratitude for the audience's belief in the unity of humanity and their collective power to shape a better future for the planet.
- An insightful quote is shared, highlighting the potential of observation in driving positive change.
- SatSure is introduced as a comprehensive SatEO (Satellite Earth Observation) company operating in both upstream and downstream aspects, focusing on sectors like agriculture, infrastructure, and utilities.
- The speaker delves into the evolution of satellite technology, emphasizing the improvements in spatial, spectral, and temporal resolutions, enabling more detailed and accurate data collection.
- Various applications of geospatial data are discussed, including agriculture, where SatSure's solutions are employed for precise monitoring throughout the crop lifecycle.





- Infrastructure monitoring, disaster response, and assessment are highlighted as critical areas where geospatial data plays a pivotal role.
- The utilization of regenerative AI is showcased as a means to overcome data barriers and enhance image quality and resolution.
- The importance of collaboration between industry and academia is emphasized, particularly in advancing hardware and sensing technologies to unlock new possibilities in geospatial data analysis.

#### b. Key takeaways

- Geospatial Data Revolution: The speaker highlights the transformative power of geospatial data in addressing various challenges across industries.
- Evolution of Satellite Technology: The speaker discusses the significant improvements in spatial, spectral, and temporal resolutions of satellites, enabling more precise data collection and analysis.
- Applications in Agriculture: SatSure's geospatial solutions are employed in agriculture for comprehensive monitoring of crop life cycles, aiding in decisions related to planting, harvesting, and land management.
- Infrastructure Monitoring: The technology is applied to monitor infrastructure, including power lines, to identify encroachment from vegetation, preventing potential hazards like wildfires.
- Disaster Response and Assessment: The speaker mentions how geospatial data and machine learning models are used to assess and respond to disasters, providing crucial information for timely interventions.
- Regenerative AI: The technology of regenerative AI is employed to bridge gaps in data quality, enhancing image resolution and quality for more accurate analysis.
- Industry-Academia Collaboration: The speaker emphasizes the need for collaboration between industry and academia to drive innovation in hardware and sensing technologies, pushing the boundaries of geospatial capabilities.

#### c. Quotes

"The one who has the ability to observe the world has the ability to change the world."

#### Mr. Rajan Rajagopal, CEO, ZES Singapore

- Zero Error Systems is a deep-tech company specializing in radiation-hardened electronics.
- They have developed a convergence solution that combines off-the-shelf semiconductor components (COTS ICs) with traditional space-grade ICs to create cost-effective space-grade components.
- This solution addresses the limitations of both types of components, offering low SEL and SEU while being more affordable than standard space-grade components. However, it may have a larger form factor and be more expensive than COTS alone.
- The company has a strong track record, with flight legacies on Japanese satellites and a growing portfolio of patented technologies.
- Their product portfolio covers latch-up detection, power management, data integrity, and radiation-hardened design cells, providing end-to-end solutions for addressing single event effects in space electronics.



#### b. Key takeaways

- New Space Age Trends: The speaker highlighted five major trends in the new space age, including the use of COTS components, the demand for edge computing in space, the importance of extending satellite lifetimes, the criticality of power reliability, and the focus on sustainability to reduce space debris.
- Rising Demand for Radiation Hardened Components: The increasing number of satellites being launched, along with the trends mentioned, has led to a growing demand for radiationhardened components, with an estimated market value of \$4.5 billion and an annual growth rate of 7%.
- Convergence of Semiconductor Components: The speaker introduced a solution by Zero Error Systems that converges off-the-shelf semiconductor components (COTS ICs) with traditional space-grade ICs to make COTS ICs space-grade. This solution addresses the limitations of both types of components.
- Zero Error Systems' Product Portfolio: Zero Error Systems offers a range of products, including latch-up detection and protection circuits, point-of-load circuits for power management, DC-to-DC converters, soft error-free voting circuits for data integrity, and radiation-hardened design library cells for digital circuit design.
- Cost-Effective Solutions: Zero Error Systems' approach, particularly in combining off-the-shelf components with their protection circuitry, can lead to a 50% reduction in costs for RAD-hard FPGAs, making their solutions highly cost-effective.

#### c. Quotes

 "There is a new space players who are putting up a business case to reduce the cost of each satellite that is produced using what are called cost components. These are commercially available off the shelf semiconductor components."

#### Dr. Debopam Bhattacherjee , Sr. Researcher, Microsoft Research

- Microsoft is actively involved in shaping the new space age and supporting space tech startups in India through initiatives like Microsoft Founders Hub.
- Azure Space is a suite of products and services designed to meet the specific needs of the space community, including the Azure Orbital Ground Station Platform, Earth observation data acceleration, and secure space application development.
- The Azure Orbital Ground Station Service allows seamless data download from satellites directly into Azure, enabling integration with various Azure services. It also offers a range of partner options for scheduling satellite contacts.
- The Azure Orbital Space SDK facilitates the creation and deployment of applications on orbit, enhancing the efficiency and value of space data.
- The Planetary Computer provides a platform for addressing global environmental issues by combining extensive environmental data with user-friendly APIs and scientific tools.
- FarmVibes, an AI-powered technology, captures intelligent data from drone-scouting flights and repurposes TV frequencies as Wi-Fi to create intelligent farm maps.



 The speaker's research at Microsoft Research Lab in Bangalore focuses on Leo Satellite Broadband, covering areas like constellation topology, trajectory design, and Leo network performance modeling and simulation.

#### b. Key takeaways

- Microsoft's Contribution to New Space Age: Microsoft is actively involved in shaping the new space age, with a particular focus on supporting space tech startups in India and providing essential tools, platforms, and mentoring.
- Introduction of Azure Space: Azure Space is a comprehensive suite of products and services designed in collaboration with key partners to cater to the needs of the space community. It includes the Azure Orbital Ground Station Platform for seamless satellite data download, Earth observation data acceleration, and secure space application development.
- Azure Orbital Ground Station Service: This service facilitates the download of satellite data directly into Azure for integration with various Azure services, such as storage, AI, and data analytics. It also provides access to a range of partner options for scheduling contacts with satellite systems.
- Azure Orbital Space SDK: This is a secure platform and toolkit enabling developers to create, deploy, and offer applications on orbit. It modernizes space-based applications, enhancing the efficiency and value of space data.
- Planetary Computer for Environmental Sustainability: The Planetary Computer combines extensive environmental data with user-friendly APIs and scientific tools to address global environmental issues. It provides applications for conservation stakeholders to leverage this data.
- FarmVibes and AI-powered Technology: FarmVibes utilizes intelligent data from drone-scouting flights and repurposes unused TV frequencies as Wi-Fi. It merges data from multiple sources, including satellites, to create intelligent farm maps, potentially revolutionizing agriculture.
- LEO Satellite Broadband Research: The speaker's research at Microsoft Research Lab in Bangalore focuses on LEO Satellite Broadband. They work on topics like constellation topology, trajectory design, LEO network performance modeling, and simulation for optimizing communication over dynamic LEO networks.

#### c. Quotes

 "Instead of tens of satellites in past deployments, we now have significantly larger deployments. Instead of a few missions like satellite telephony, the use cases are broader, and instead of geo height, satellites are now significantly closer to us."

#### Col Sai Arul, Head- Region SAARC, Maxar Technologies

- MAXAR, a satellite technology company, is actively involved in building and operating both commercial and earth observation satellites.
- The discussion highlighted the significance of Space Domain Awareness due to the increasing number of satellites and debris in space. This area is crucial for security and safety considerations.





- The integration of various technologies like electro-optics, star, multispectral, and RF data sources is essential for creating comprehensive outcomes from Earth observation.
- Edge computing, AI, and high-definition techniques are playing vital roles in advancing Earth observation capabilities.
- New service models, like satellite leasing, are providing cost-effective options for customers, especially for classified missions.
- The ability to create 3D representations from 2D sensors is an emerging area of innovation in Earth observation.
- The speaker provided concrete examples, including non-earth imaging for capturing space objects and fusion of SAR and EO data for high-resolution insights.

#### b. Key takeaways

- Space Domain Awareness: Recognizing the increasing number of satellites and debris in space, there's a growing emphasis on Space Domain Awareness for security and safety reasons.
- Data Fusion for Comprehensive Insights: The integration of various technologies like electro-optics, star, multispectral, and RF data sources is crucial for generating comprehensive outcomes from Earth observation.
- Emerging Technologies: Edge computing, AI, and high-definition techniques are playing significant roles in advancing Earth observation capabilities.
- Service Models and Leasing Options: New service models are emerging, offering options like leasing satellites instead of building them, which is particularly useful for classified customers.
- 3D Mapping from 2D Sensors: The ability to create 3D representations from 2D sensors is an emerging area of innovation in Earth observation.
- Application of Technologies: The speaker provided specific examples, such as non-earth imaging for capturing space objects, fusion of SAR and EO data for high-resolution insights, and the use of algorithms to enhance image clarity for improved machine learning outcomes.

#### c. Quotes

 "The ability to lease a satellite at a low cost and still achieve your operational security are areas of emerging outcomes that are coming about."

#### Mr. Phil Ridley, CEO, Quarsat

#### a. Key takeaways

- Space Industry Growth: The speaker emphasizes the rapid expansion of the space industry, particularly in satellite launches. The number of satellites in space is expected to increase significantly, with a conservative estimate of 50,000.
- Challenges in Ground Stations: Existing ground stations face limitations in their ability to communicate with multiple satellites simultaneously. Traditional parabolic antennas can only communicate with one satellite at a time, requiring constant movement.



- Importance of Space Domain Awareness: As space becomes more congested, maintaining control
  over assets in space and preventing collisions is crucial. The speaker highlights the significance of
  technologies like radar, optical, and their own technology (Petsivarev) for monitoring space activity.
- Phased Array Ground Stations: The speaker introduces a new technology phased array ground stations. These stations use electronically steered antennas, which can communicate with multiple satellites simultaneously. This technology has been under development for over a decade.
- Fully Digital Approach: The phased array technology presented is fully digital, allowing for scalability by adding more computing power. It enables the synthesis of multiple beams simultaneously and covers a wide area of the sky at once.
- Enhanced Sensitivity: Despite its compact size, the antenna developed by Quasar Satellite Technologies is more sensitive than larger antennas. This achievement is attributed to advancements in materials, science, and physics.

#### b. Quotes

There's obviously a lot of stuff up there, there's going to be a lot more satellites, there's over a million pieces of track space jump, the space where they're up there. So it's getting congested and it's getting congested. A lot of satellite operators get up to a dozen conjunctional loads a day saying there's a chance it might hit something. So it's very very important for all satellite operators and all southern nations to have control over their assets in space and know what's going on.

#### Mr. Terry van Haren, Managing Director, LeoLabs Pty Ltd

#### a. Key takeaways

- LeoLabs and Space Traffic Management: LeoLabs, a spin-off from the Stamping Research Institute in 2016, is now a major player in space traffic management. They provide services for over 60% of satellites in lower Earth orbit, including prominent companies like Starlink, Maxar, and Planet.
- Superior Information Delivery: LeoLabs prides itself on delivering superior information in a rapidly changing space environment. They outperform the US government's space surveillance network in terms of data collection, measurements, and speed of processing, ensuring information is relevant and up-to-date.
- Technological Stack and Services: LeoLabs integrates various technologies like computing, machine learning, artificial intelligence, and radar systems to offer a range of products. They serve commercial space companies, space agencies, defense ministries, and even provide unique solutions for insurance companies.
- Cloud System: This cloud-based computing system is a key technology for Leal Labs, enabling them to track activities in low Earth orbit. It is complemented by their radar systems, creating a comprehensive solution.
- Software as a Service (SAAS) Model: LeoLabs offers their services through a SAS model, likened to platforms like Netflix. This approach helps distribute costs and make their products accessible to organizations worldwide.
- Expanding Scope: While LeoLabs primarily focuses on low Earth orbit, they collaborate with ExoAvaleatics for activities in Near Earth Orbit (Neo) and Geostationary Orbit (Geo). Their radar network is integral to supporting these endeavors.



- Radar Technology Development: LeoLabs boasts a rich history in radar technology, with lead designers having over 30 years of experience. They've developed a suite of radar systems, including one-dimensional, phased array, UHF, and S-band radars, each tailored for specific applications.
- Innovation and Future Plans: The company remains highly innovative, constantly upgrading their radar systems based on the latest commercial technologies. Their future plans involve further advancements in S-band radar capabilities, positioning them as a world leader in radar technology.

#### b. Quotes

 "One of the big problems of the world at the moment is no one is cataloging below 10 centimeters. So there are hundreds of thousands of degree items between two and 10 centimeters that we are aiming to slowly start to use a catalog on with a network of S -band radars."



# Day 2/ Session 10: Earth Observation Data & Dissemination Platform: The Vision & Strategy

Moderator of the session	
Ms. Nivedita Bhattacharjee	Journalist, Reuter
Special Address	· · · · ·
Dr. Pawan Kumar Goenka	Chairman, Indian National Space Promotion and Authorization Center (IN-SPACe)
List of Panelists	
Mr. Prakash Chauhan	Director, NRSC
Dr. Rajiv Jyoti	Director, TD, IN-SPACe
Dr. Jayaprakash V. Thomas	Director, EPDO, ISRO HQ
Mr. Sanjay Nekkanti	Founder & CEO, Dhruva Space
Dr. Sai Prasad	CTO IoT & DE, TCS

#### Outline of the session 10

This panel session discussed about the current state and future plans for Earth observation data in India. It covers topics like the satellites currently in orbit, the ground systems for receiving and processing data, data dissemination policies, and priorities for improving spatial and temporal resolution of data. Some key points are:- ISRO currently operates over 20 Earth observation satellites, providing data for applications in agriculture, disaster management, infrastructure planning etc. The ground station network receives over 1TB of data per day.- Data is made available via the Bhuvan geoportal and other portals like VEDAS. New space policy will enable free open access to IRS data above 5m resolution. - Demand for EO data is increasing from government users as well as private sector. Priorities are to improve spatial resolution to 1m/30cm and temporal resolution to daily/weekly for applications like urban planning.- 9 new EO satellites are planned including microwave and hyperspectral satellites. Private sector participation is sought in building satellites and also using data for new applications.- Models like PPP, service contracts from government can help accelerate private sector growth. Building an end-to-end capability spanning satellites, ground systems and applications is key.

#### **Key Action Items**

- Set up coordination mechanism between ISRO, government and private sector for EO mission planning
- Implement open access to IRS data above 5m resolution via Bhuvan portal by Q1 2023
- Identify government service contracts that can be opened up for bidding by private companies by Q2 2023
- Explore PPP models for new hyperspectral and microwave satellites by Q3 2023
- Develop consolidated plan for private sector partnerships in EO domain covering satellites, ground systems, data utilization by Q4 2023



#### Key takeaways of session 10

#### Current Earth observation capabilities

ISRO has launched over 40 satellites so far including Cartosat, Resourcesat, Oceansat series in optical and microwave bands. Daily 1 TB of data is received via extensive ground station network. Bhuvan portal provides access to data archives and ordering.

#### Future satellite plans

9 new satellites planned including microwave, hyperspectral and high resolution optical satellites. Will improve spatial resolution to 1m/30cm and revisit time to daily/weekly. Satellites will be funded by user ministries based on requirements.

#### Policy changes to enable private sector

New space policy will provide open access to IRS data above 5m resolution. Sub-5m and value added data will be commercially priced. This will open up opportunity for private companies to utilize data for applications.

#### Priorities for increasing private participation

PPP models, service contracts from government, consortium approaches suggested to build initial user base and revenue certainty for private sector. Building end-to-end capability and global customer base also important.



**Glimpses of the Conference** 



[L-R] Shri Sudheer Kumar N, Director, CBPO, ISRO, HQ; Mr Apparao Mallavarapu, Co-chair, Cll National Committee on Space; Ms. Sarah Storey, Deputy High Commission, Australian High Commission; Dr. Pawan K Goenka, Chairman, INSPACe, Shri A S Kiran Kumar, Former Chairman, ISRO & Distinguished Indian scientist, Mr. Jayant Patil, Chairman, Cll National Committee on Space



Exchange of MoU between INSPACe & NIIFL for collaborating on Programs, targeted for support from global investors for making investments in the Indian space sector, at CII International Conference on Space, in Inaugural Session on 14 Sep 2023.





Release of Release of 'Catalogue of Indian Standards for Space Industry, developed by INSPACe & BIS' at CII International Conference on Space, in Inaugural Session on 14 Sep 2023.



Release of CII- Deloitte report on 'NewSpace: India Perspective'

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