

# spacepreneur

A Space Explore Edition...

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**INDIAN SPACE ASSOCIATION (ISPA)**

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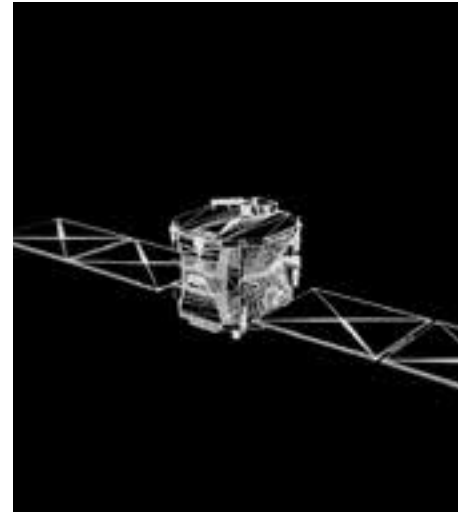
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**B. KARTIKEYA**

Hello my dear readers,

The leading publication covering news on astronomy, space exploration, and technological advancements is called Spacepreneur. It documents (and celebrates) humanity's ongoing investigation of the ultimate frontier. By providing our readers with accessible, thorough coverage of the most recent news and discoveries, we take them around the solar system and beyond. In this episode of space exploration, the latest news from the farthest reaches of the vast universe is presented to you.

In the Global News section, you may read about X-Bow Systems' selection for a \$60 million STRATFI Award and the latest developments about the ispace HAKUTO-R Mission 1 Lunar Lander. The latest military satellite from Boeing also features an Anti-Jam Payload for improved communication on the front lines. To support mission-critical DoD communications, Hughes has developed Smart Network Edge Software. You can learn more about how NASA's Voyager will conduct more science with its new power strategy in the magazine's Jet Propulsion section.

Watch interview with Lt. Gen. AK Bhatt, Director General of the Indian Space Association (ISpA), where they discuss the prospects and problems facing the Indian space sector. Additionally, the co-founders of DHRUVA SPACE are interviewed in the second interview, which discusses Dhruva Space's history. Wonderful Conversation with Dr.Srimathy Kesan Founder of Space Kidz India (SKI) will take you through the immense potential lying in the space education.

Space Industry is now stealing the show with their applications, which are only limited by human creativity. The Space Quiz, which questions Indian astronomers and their contributions to astronomy, is the best opportunity to test your knowledge.

Travelling through space is as much about the process as the final destination. Therefore, you'll find something extraordinary every month in Spacepreneur, from skywatching tips and breathtaking night sky photographs to rocket launches and breaking news about robotic missions exploring distant planets.

*Kartikeya*

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## ViaSat-3 Americas Successfully Launched

Viasat Inc. a global communications company announced the successful launch of ViaSat-3 Americas aboard a SpaceX Falcon Heavy from Launch Complex 39A (LC-39A) at NASA's Kennedy Space Center in Florida.

ViaSat-3 lifted off yesterday at 8:26 pm EDT, and approximately four hours and thirty two minutes after liftoff, the satellite separated from the launch vehicle. First signals from the satellite were acquired approximately 15 minutes later through a ground station in South Korea. In the coming days, ViaSat-3 will deploy its solar arrays and drift to its final orbital location. Viasat expects it will take less than three weeks for ViaSat-3 to reach its final orbital destination, located at 88.9° west longitude.



Today's successful launch of ViaSat-3 Americas opens a new chapter in Viasat's growth. This first Americas satellite will multiply our available bandwidth, and enable faster speeds and more coverage - especially for our mobility customers. It's not just a new satellite, it's a new way to build broadband satellites. Thanks so much to all our people, and our partners, for their commitment and dedication to getting this done.



**Mark Dankberg, Viasat's chairman and CEO**



## LVM3 M3/OneWeb India-2 mission accomplished successfully

ISRO's LVM3 launch vehicle, in its sixth consecutive successful flight placed 36 satellites belonging to OneWeb Group Company into their intended 450 km circular orbit with an inclination of 87.4 degrees. With this, NSIL has successfully executed its contract to launch 72 satellites of OneWeb to Low Earth Orbit.

The vehicle took off with a total payload of 5,805 kg at 09:00:20 hours local time from the second launch pad at SDSC-SHAR, Sriharikota. It gained the required altitude of 450 km in about nine minutes of flight, achieved satellite injection conditions in the eighteenth minute, and began injecting the satellites in the twentieth minute. The C25 stage performed a sophisticated maneuver to repeatedly orient itself in orthogonal directions and inject satellites into precise orbits with defined time-gaps to avoid collision of the satellites. 36 satellites were separated in 9 phases, in a batch of 4. OneWeb confirmed the acquisition of signals from all 36 satellites.

This mission marked OneWeb's second satellite deployment from India, highlighting the strong partnership with NSIL and ISRO. It was OneWeb's 18th launch bringing the total of OneWeb's constellation to 618 satellites.

Shri Somanath S, Secretary, Department of Space and Chairman, ISRO congratulated ISRO, NSIL, and OneWeb on the successful mission. He expressed happiness over the consecutive successful flight of LVM3, the opportunity provided by NSIL and the confidence OneWeb team has in ISRO. He thanked the Government for the support and approvals for the missions for the commercial launches that have enhanced the confidence in LVM3. He was delighted to mention that this mission had the upgraded S200 motors with enhanced margins suitable for the upcoming Gaganyaan mission and the motors performed very well.

Shri Radhakrishnan D, Chairman-cum-Managing Director, NewSpace India Limited congratulated ISRO for successful and repeatable performance. Terming the event as momentous, he recalled the challenge of this complex mission in terms of maneuverability.



# ROGERS SIGNS AGREEMENT WITH SPACEX TO BRING SATELLITE-TO-PHONE COVERAGE TO CANADA

Rogers Communications Inc. and SpaceX announced the companies have agreed to bring satellite-to-phone coverage nation-wide to ensure Canadians stay connected in areas beyond the limits of traditional wireless networks.

Rogers and SpaceX will offer satellite-to-phone technology in Canada using SpaceX's Starlink low earth orbit satellites and Rogers national wireless spectrum. The companies plan to start with satellite coverage for SMS text and will eventually provide voice and data across the country's most remote wilderness, national parks and rural highways that are unconnected today.

"As the country's biggest investor in 5G spectrum with Canada's largest

5G network, Rogers is proud to work with SpaceX to expand wireless coverage across all of Canada, from coast to coast, to keep Canadians connected and safe," said Tony Staffieri, President and CEO, Rogers. "In the future, these investments will deliver wireless connectivity, including access to 911, to even the most remote areas."

Once commercially available, satellite-to-phone coverage will work with all 5G and 4G smartphones. The coverage will support SMS and MMS text, and help all Canadians reach 911 as first responders and emergency services upgrade their systems for emergency SMS texting.

Rogers is committed to improving public safety through its national network investments. This includes the company's

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"As a Canadian, I'm excited that SpaceX is collaborating with Rogers to bring SpaceX's Direct to Cell service to Canadians. I'm proud of the impact this will have across the country wherever Canadians may work, play or travel," said Sara Spangelo, co-lead for Direct to Cell at SpaceX.

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commitment to bring wireless service and 911 access throughout the entire Toronto subway system for all TTC riders and extend wireless coverage along Canada's remote highways.

Today's announcement builds on the company's investment to bring Canadians the largest 5G wireless network covering more than 2,000 communities. Through its transformative merger with Shaw, Rogers now brings Canadians a national coast to coast wireline network with fibre-powered internet available to nearly 70% of Canadian households.



## X-Bow Systems Announces Selection for \$60 million STRATFI Award

X-Bow Systems Inc (X-Bow) announced that the innovation engine for the Department of the Air Force, AFWERX, has selected the company for a Strategic Funding Increase (STRATFI) award. The award secures up to \$60 million between government funding, private investment, and matching Small Business Innovation Research (SBIR) funds. The funding will extend X-Bow's previous and existing work with the U.S. Air Force Research Lab (AFRL) at Edwards Air Force Base. The work will focus on rapidly produced, low-cost solid rocket motors (SRMs) using X-Bow's proprietary advanced manufacturing technology and culminate in a flight test series.

X-Bow is a new, non-traditional, small business producer and supplier of SRMs, suborbital and orbital launch services and defense technologies. It further leads the market with patent-pending innovations of Additively Manufactured Solid Propellants (AMSP) for solid rocket motors.

Recent reports have noted a consolidation in the solid rocket motor industry from six to just two domestic manufacturers. This has created significant cost and lead time increases, along with an inability to deliver SRMs in the quantities needed to support industry plans and national defense needs. X-Bow's market entry and STRATFI selection is well timed to fill this domestic manufacturing and national security need.



"We are thrilled to be selected and funded for this STRATFI award. We further see the award as a strong signal from our U.S. Government partners for the need of X-Bow's solid rocket technology and SRM production capabilities in both the DoD and commercial industry," says X-Bow Systems' Chief Revenue Officer, Maureen Gannon.



## Exotrail electric propulsion systems selected by Korean satellite manufacturer Satrec Initiative

Exotrail unveils a new contract with the satellite manufacturer Satrec Initiative, to embark a spaceware™ electric propulsion system for a Korean governmental mission. Satrec Initiative is a Korea based world-leading Earth observation solution provider. They have selected Exotrail's spaceware™ product to meet the space mobility needs of an Earth observation satellite which will be used for a Korean governmental R&D mission.

Within a year, Exotrail will deliver a spaceware™ - micro XL propulsion system engineering model, as well as a flight model for a proof-of-concept mission for an innovative earth observation service aiming to validate the use of Satrec Initiative's Earth observation platform in Low Earth Orbit (LEO). The LEO mission will allow Satrec Initiative to significantly increase the performance of its Earth observation service; a breakthrough in Earth observation made possible by Satrec Initiative's cutting edge satellite platform design paired with Exotrail's unparalleled high thrust spaceware™ propulsion system.

spaceware™, and its nano, micro, mini and cluster product configurations, is Exotrail's space-proven Hall-Effect electric propulsion system for satellites ranging from 10 to 1,000 kg. Spaceware™ - micro is a 150W propulsion system delivering more than 7mN of thrust for missions up to 60kNs and more. It provides an unrivalled trade-off between thrust compared to mass and volume efficiency. Thanks to its high level of thrust and modularity, spaceware™ drastically improves satellite deployment, increases service performance, and contributes to the reduction of space pollution.

The inking of this contract by a French company and a Korean company, both in strong leadership positions in their respective markets, is announced at the occasion of the visit of Mr. Jean-Noël Barrot, French Minister for Digital Transformation and Telecommunications, and in attendance of Mr. Cho Joo Hyun, Korean Vice-Minister of SMEs and startups. This first commercial contract of Exotrail in South-Korea proves the relevance of its propulsion system product portfolio for both small satellite constellations, and the dynamic Asian market.

On this occasion, Satrec Initiative's CEO Ee-Eul Kim expressed his excitement about the partnership, stating:

Exotrail's CEO and cofounder Jean-Luc Maria, added: "We are extremely thankful to Satrec Initiative for this mark of confidence, emphasizing the fact that our spaceware™ product is a true asset for the constellation market, notably for Earth observation satellites. Additionally, we are proud to sign this contract fueling a positive dynamic between France and South-Korea, one of the leading space nations in Asia."



"We are thrilled to be working with Exotrail for our upcoming LEO mission. This partnership will enable us to deliver breakthrough Earth observation services with increased performance, while contributing to the reduction of space pollution."





## STATUS UPDATE ON ISPACE HAKUTO-R MISSION 1 LUNAR LANDER

ispace, inc., (ispace) a global lunar exploration company, issued an update on the status of the HAKUTO-R Mission 1 Lunar Lander. The HAKUTO-R Mission 1 Lunar Lander was scheduled to touchdown on the surface of the Moon at approximately 1:40 a.m. JST. As of 8:00 a.m. JST, April 26, 2023, the communication between the lander and the Mission Control Center was lost, although it was expected even after the touchdown, and it has been determined that Success 9 of the Mission Milestones is not achievable.

Based on the currently available data, the HAKUTO-R Mission Control Center in Nihonbashi, Tokyo, confirmed that the lander was in a vertical position as it carried out the final approach to the lunar surface. Shortly after the scheduled landing time, no data was received indicating a touchdown. ispace engineers monitored the estimated remaining propellant reached at the low-

er threshold and shortly afterward the descent speed rapidly increased. After that, the communication loss happened. Based on this, it has been determined that there is a high probability that the lander eventually made a hard landing on the Moon's surface.

To find the root cause of this situation, ispace engineers are currently working on a detailed analysis of the telemetry data acquired until the end of landing sequence and will clarify the details after completing the analysis.

For Mission 1, it has been determined that Success 9 of the Mission 1 Milestones, successfully landing on the Moon and establishing communications, is no longer achievable. Despite this, the mission has already achieved Success 1 through Success 8. In addition, while attempting the completion of Success 9, the Mission Control Center was able to acquire valuable data and know-how

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Although we do not expect to complete the lunar landing at this time, we believe that we have fully accomplished the significance of this mission, having acquired a great deal of data and experience by being able to execute the landing phase. What is important is to feed this knowledge and learning back to Mission 2 and beyond so that we can make the most of this experience,” said Takeshi Hakamada, Founder and CEO of ispace. “To this end, we are already developing Mission 2 and Mission 3 concurrently and have prepared a foundation that can maintain this continuity. I would like to thank once again all the employees who have contributed to this mission from its inception to the present, all the families who have continued to support it, and all the shareholders, HAKUTO-R partners, customers, suppliers, and many others who have continued to believe in ispace’s vision. We will keep moving forward.”

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from the beginning to nearly the end of the landing sequence, which will enable a future successful lunar landing mission. It is strongly believed that this is a great leap forward to future lunar exploration and an important milestone to advance space development by the private sector toward the next level not only in Japan but also the world.

ispace will continue to make the most of the data and know-how acquired during the operation through Success 8, and landing sequence including aspects of Success 9, aiming to dramatically improve the technological maturity of Mission 2 in 2024 and Mission 3 in 2025.

“Today, ispace’s HAKUTO-R” Mission 1 became the first private company to attempt to land on the Moon, but unfortunately, the landing could not be realized, said Hiroshi Yamakawa, President of the Japan Aerospace Exploration Agency (JAXA). “As a fellow Japanese space en-



enthusiast, I am proud of ispace's challenge and respect the efforts of everyone involved. ispace will analyze the data obtained from this mission and use it as a foundation for the next mission. JAXA will continue to make steady progress together with ispace, the industry and organizations challenging space, and our international partners, and will contribute not only to space exploration activities but also to the sustainable development of human society."

"The Mission underpins the successful cooperation between ESA and ispace. Such collaboration schemes between new space companies and space agencies open up exciting opportunities for the future of lunar exploration and other domains. Accounting for new space approaches is also a central element of ESA's agenda 2025. I'm con-

vinced that the HAKUTO-R Mission 1 is only the beginning of many fascinating projects and activities to come," said Josef Aschbacher, Director General of the European Space Agency.

"ispace has already accomplished a tremendous feat by entering lunar orbit and attempting a first landing. What they are trying to do is so complex and at the cutting edge of technology that success is not guaranteed at the first attempt. The experience and unique expertise gained by the team will help make the next mission a success," said Martin Sion, CEO of ArianeGroup.

Draper released the following statement: "The historic maiden commercial mission of ispace inc.'s M1 HAKUTO-R achieved numerous significant first-time achievements, but ultimately fell short of its goal of landing safely on the Moon. M1 HAKUTO-R experienced an anomaly, ending the mission prematurely. Though the mission did not achieve its ultimate goal, by successfully reaching

cislunar space and orbiting the Moon, the mission represents an important step forward for the international space economy. Draper serves on ispace's team for the M1 HAKUTO-R mission and will collaborate on missions M2 and M3. We look forward to our ongoing partnership with ispace, both now and in the future."

## Mission 1 Milestones

For Mission 1, ispace set 10 milestones between launch and landing, and aimed to achieve the success criteria established for each of these milestones. Recognizing the possibility of an anomaly during the mission, the results will be weighed and evaluated against the criteria and incorporated into future missions already in development between now and 2025. Mission 2 and Mission 3, which also will contribute to NASA's Artemis Program, will further improve the maturity of ispace's technology and business model. Future announcements on progress of milestone achievement are expected to be released once attained.

**ispace**  
Mission 1 Milestones

We have set 10 milestones, which we aim to achieve during the Mission 1. Each of the milestones has separate success criteria.

- Success 1**  
**Completion of Launch Preparations**
  - Complete all launch preparation processes of the lunar lander before flight operations
  - Control and prepare launch vehicle, and complete integration of lunar lander into the launch vehicle
- Success 2**  
**Completion of Launch and Deployment**
  - Complete successful separation of the lunar lander from the launch vehicle
  - Prove that the lander's structure is capable of withstanding the launch conditions during launch, including the jolts and gathering information towards future design improvements and missions
- Success 3**  
**Establishment of a Steady Operation State**  
*(Pre-lunar Critical Operation Period)*
  - Establish communication link between the lander and Mission Control Center, confirm a stable attitude, as well as start stable generation of electrical power in orbit. The completion of this step verifies the integrity of lander core systems and customer payload.
- Success 4**  
**Completion of first orbital control maneuver**
  - Complete the first orbital control maneuver, steering the lander on a course towards the Moon and verifying operation of the main propulsion system, as well as related guidance, control, and navigation system
- Success 5**  
**Completion of stable deep-space flight operations for one month**
  - Prove that the lander is capable of steady deep-space flight by completing a number of coast and attitude control maneuvers over a 1-month period
- Success 6**  
**Completion of all deep space orbital control maneuvers before LOI**
  - Complete all planned deep space orbital control maneuvers by proving gravity assist effects and successfully target the first lunar orbit insertion trajectory. This step proves the ability of the lander's deep space maneuverability, as well as the validity of orbital control planning
- Success 7**  
**Reaching the lunar gravitational field / lunar orbit**
  - Complete the first lunar orbit insertion maneuver and confirm the lander is in a lunar orbit, verifying the ability of power to perform operations and commands and maintain lunar orbit
- Success 8**  
**Completion of all orbit control maneuvers in lunar orbit**
  - Complete all planned lunar orbit control maneuvers before the landing sequence
  - Confirm the lander is ready to start the landing sequence
- Success 9**  
**Completion of lunar landing**
  - Complete the landing sequence, including the landing on the lunar surface
- Success 10**  
**Establishment of a steady system state after lunar landing**
  - Establish a steady communication and power supply on the lunar surface after landing to support systems operation, surface operations

**HAKUTO-R**



## CONTROLLED RE-ENTRY EXPERIMENT OF MEGHA-TROPIQUES-1

ISRO is gearing up for a challenging experiment of controlled re-entry of a decommissioned low Earth orbiting satellite, namely Megha-Tropiques-1 (MT1), on March 7, 2023. MT1 was launched on October 12, 2011, as a joint satellite venture of ISRO and the French space agency, CNES for tropical weather and climate studies. Although the mission life of the satellite originally was to 3 years, the satellite continued to provide valuable data services for more than a decade supporting regional and global climate models till 2021.

UN/IADC space debris mitigation guidelines recommend deorbiting a LEO (Low Earth Orbit) object at its end-of-life, preferably through controlled re-entry to a safe impact zone, or by bringing it to an orbit where the orbital lifetime is less than 25 years. It is also recommended to carry out “passivation” of on-board energy sources to minimise the risk of any post-mission accidental break-up.

The orbital lifetime of MT1, weighing about 1000 kg, would have been more than 100 years in its 20 deg inclined operational orbit of 867 km altitude. About 125 kg on-board fuel remained unutilised at its end-of-mission that could pose risks for accidental break-up. This left-over fuel was estimated to be sufficient to

achieve a fully controlled atmospheric re-entry to impact an uninhabited location in the Pacific Ocean. Controlled re-entries involve deorbiting to very low altitudes to ensure impact occurs within a targeted safe zone. Usually, large satellites/rocket bodies which are likely to survive aero-thermal fragmentation upon re-entry are made to undergo controlled re-entry to limit ground casualty risk. However, all such satellites are specifically designed to undergo controlled re-entry at end-of-life. MT1 was not designed for EOL operations through controlled re-entry which made the entire exercise extremely challenging. Furthermore, the on-board constraints of the aged satellite, where several systems had lost redundancy and showed degraded performance, and maintaining subsystems under harsher environmental conditions at much lower than originally designed orbital altitude added to the operational complexities. Innovative workarounds were implemented by the operations team based on the study, deliberations, and exchanges among the mission, operations, flight dynamics, aerodynamics, propulsion, controls, navigation, thermal, and other sub-system design teams across the ISRO centres, who worked in synergy to surmount these challenges.

An uninhabited area in the Pacific Ocean

between 5°S to 14°S latitude and 119°W to 100°W longitude was identified as the targeted re-entry zone for MT1. Since Aug 2022, 18 orbit manoeuvres were performed to progressively lower the orbit. In between the de-orbiting, aero-braking studies at different solar panel orientations were also carried out to gain better insights into the physical process of atmospheric drag affecting the orbital decay of the satellite. The final de-boost strategy has been designed after taking into consideration several constraints, including visibility of the re-entry trace over ground stations, ground impact within the targeted zone, and allowable operating conditions of subsystems, especially the maximum deliverable thrust and the maximum firing duration of the thrusters. The final two de-boost burns followed by the ground impact are expected to take place between 16:30 IST to 19:30 IST on March 7, 2023. Aero-thermal simulations show that no large fragments of the satellites are likely to survive the aero-thermal heating during the re-entry.

As a responsible space agency committed to safe and sustainable operations in outer space, ISRO proactively takes efforts for better compliance with the UN/IADC space debris mitigation guidelines on post-mission disposal of LEO objects. The re-entry experiment of MT1 has been undertaken as a part of the ongoing efforts as this satellite with sufficient left-over fuel presented a unique opportunity to test the relevant methodologies and understand the associated operational nuances of post mission disposal by direct re-entry into the Earth's atmosphere.



## VIASAT DEBUTS MERCURY EXPEDITIONARY FREE SPACE OPTICAL COMMUNICATIONS TERMINAL

Viasat Inc. announced that it debuted its new Mercury Free Space Optical Communications (FSOC) terminal during the U.S. Special Operations Command (SOCOM) Technical Experimentation (TE) event on March 21, 2023 in Avon Park, Florida. SOCOM conducts TE events across the United States with participation from government, academia, and private industry organizations, providing a unique opportunity for technology developers to interact with the Special Operations Forces community. The new free space optics (FSO) solution was designed to support terrestrial, expeditionary applications, including SOCOM use cases.

The Viasat Mercury solution is an expeditionary, high-capacity FSOC link with an automated pointing, acquisition, and tracking (PAT) system,

offering military operators lower signature communications at the quick-halt. Mercury is based upon advanced commercial-off-the-shelf technology, leveraging substantial industry investment towards bringing a high-performance, resilient, and cost-effective capability to better support warfighting operations at the edge.

The Mercury terminal integrates state-of-the-art optical terminal technology with an industry-leading PAT gimbal and user-oriented control and management interface to offer a FSOC system that will offer substantially higher range and throughput than other solutions in the tactical environment. The Viasat FSOC solution will deliver data rates up to 40 Gigabits per second (Gbps), have a range of up to 70 Kilometers (km) for terrestrial applications,

“

We are very excited about the debut of the Mercury FSOC terminal during the SOCOM TE event and sharing the unique capability it can bring to edge communications. Free Space Optics offers the benefits of fiber optic cable communications without the need to run the cable,” said Craig Miller, president of Viasat Government Systems. “As the U.S. Department of Defense (DoD) seeks to gain an advantage through increasingly reliable and low detection communications, we are investing in FSO as part of a resilient multi-transport network. The Mercury terminal is designed as a high-capacity and low-cost solution for the DoD, and this is the first platform for terrestrial use as we continue to invest in comms-on-the-move capabilities across sea, air and space.

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and be highly resistant to jamming, spoofing and electro-magnetic interference when compared to RF systems. By leveraging a dual-stage continuous active line-of-sight tracking system, Mercury will be deployable to support multiple expeditionary communications environments including Ground-to-Ground, Ground-to-Air, Ship-to-Ship, and Ship-to-Shore.

Viasat developed the Mercury terminal to address DoD requests for FSO capabilities that will enable warfighters to operate high-bandwidth links across significant distances in an LPI/LPD environment. Modern electronic warfare effects can disrupt radio frequency communications in contested near-peer environments, but FSO offers a communications pathway outside the RF spectrum.



enhanced brightening at the center of the cap. The sensitivity and longer wavelengths of Webb’s NIRCам may be why we can see this enhanced Uranus polar feature when it has not been seen as clearly with other powerful telescopes like the Hubble Space Telescope and Keck Observatory.

At the edge of the polar cap lies a bright cloud as well as a few fainter extended features just beyond the cap’s edge, and a second very bright cloud is seen at the planet’s left limb. Such clouds are typical for Uranus in infrared wavelengths, and likely are connected to storm activity.

This planet is characterized as an ice giant due to the chemical make-up of its interior. Most of its mass is thought to be a hot, dense fluid of “icy” materials – water, methane, and ammonia – above a small rocky core.

Uranus has 13 known rings and 11 of them are visible in this Webb image. Some of these rings are so bright with Webb that when they are close together, they appear to merge into a larger ring. Nine are classed as the main rings of the planet, and two are the fainter dusty rings (such as the diffuse zeta ring closest to the planet) that weren’t discovered until the 1986 flyby by Voyager 2. Scientists expect that future Webb images of Uranus will reveal the two faint outer rings that were discovered with Hubble during the 2007 ring-plane crossing.

Webb also captured many of Uranus’ 27 known moons (most of which are too small and faint to be seen here); the six brightest are identified in the wide-view image. This was only a short, 12-minute exposure image of Uranus with just two filters. It is just the tip of the iceberg of what Webb can do when observing this mysterious planet. In 2022, the National Academies of Sciences, Engineering, and Medicine identified Uranus science as a priority in its 2023-2033 Planetary Science and Astrobiology decadal survey. Additional studies of Uranus are happening now, and more are planned in Webb’s first year of science operations.

The James Webb Space Telescope is the world’s premier space science observatory. Webb will solve mysteries in our solar system, look beyond to distant worlds around other stars, and probe the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and the Canadian Space Agency.

# NASA’S WEBB SCORES ANOTHER RINGED WORLD WITH NEW IMAGE OF URANUS

Following in the footsteps of the Neptune image released in 2022, NASA’s James Webb Space Telescope has taken a stunning image of the solar system’s other ice giant, the planet Uranus. The new image features dramatic rings as well as bright features in the planet’s atmosphere. The Webb data demonstrates the observatory’s unprecedented sensitivity for the faintest dusty rings, which have only ever been imaged by two other facilities: the Voyager 2 spacecraft as it flew past the planet in 1986, and the Keck Observatory with advanced adaptive optics.

The seventh planet from the Sun, Uranus is unique: It rotates on its side, at roughly a 90-degree angle from the plane of its orbit. This causes extreme seasons since the planet’s poles experience many years of constant sunlight followed by an equal number of years of complete darkness. (Uranus takes 84 years to orbit the Sun.) Currently, it is late spring for the northern pole, which is visible here; Uranus’ northern summer will be in 2028. In contrast, when Voyager 2 visited Uranus

it was summer at the South Pole. The South Pole is now on the ‘dark side’ of the planet, out of view and facing the darkness of space.

This infrared image from Webb’s Near-Infrared Camera (NIRCам) combines data from two filters at 1.4 and 3.0 microns, which are shown here in blue and orange, respectively. The planet displays a blue hue in the resulting representative-color image.

When Voyager 2 looked at Uranus, its camera showed an almost featureless blue-green ball in visible wavelengths. With the infrared wavelengths and extra sensitivity of Webb we see more detail, showing how dynamic the atmosphere of Uranus really is.

On the right side of the planet there’s an area of brightening at the pole facing the Sun, known as a polar cap. This polar cap is unique to Uranus – it seems to appear when the pole enters direct sunlight in the summer and vanish in the fall; these Webb data will help scientists understand the currently mysterious mechanism. Webb revealed a surprising aspect of the polar cap: a subtle



Spacepreneur Magazine Editor  
Kartikeya Bethireddy  
in conversation with

## **Co-Founders of DHRUVA SPACE**

**Q** Before we talk about business, how best can you describe the journey of Dhruva Space since its humble beginnings to where it is now?

**A** **Sanjay Nekkanti, CEO:** "Dhruva Space was established in 2012 with a vision to pioneer the privatization of the space industry in India. We have come a really long way since we started the company to being the

first awardees of the National Startup Award from the Govt of India.

The opening up of the private sector has seen Dhruva Space completing three Space missions in less than a year with more in planning and production phases currently – all as part of our vision to make Space accessible frequently and cost-effectively on a reliable basis. We have also taken our indigenously-developed

Space products to the global market where we've had fruitful interactions with the multiple stakeholders in the UAE, Finland, USA, and, most recently, France and Singapore."

**Chaitanya Dora Surapureddy, Chief Financial Officer:**

The Company's first revenue-generating financial year was 2021, where it generated turnover of INR 50 lakh. In a year, we went from a 3,000 square-foot facility to a 10,000 square-foot facility in Hyderabad; we hope to grow to about INR 100 Crores by FY 24, by which time we aim to have our own AIT facility up and running.

Till date, the company has raised close to US\$9 million from prominent investors such as Indian Angel Network Fund, Blue Ashva Capital and Big Capital. In the context of our Space missions,

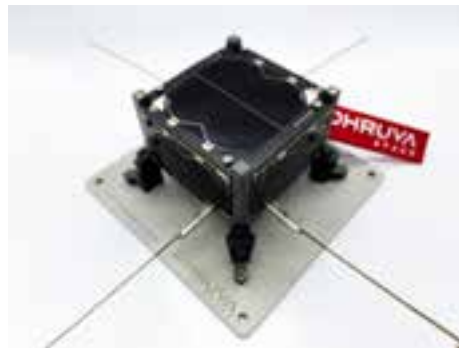
## FOCUS ON STARTUP



we Space-qualified our 1U Satellite Orbital Deployer (DSOD-1U) onboard ISRO's PSLV-C53; we launched and successfully deployed two CubeSats – Thybolt-1 and Thybolt-2 – onboard PSLV-C54; and more recently, we Space-qualified our 3U and 6U Satellite Orbital Deployers (DSOD-3U and DSOD-6U, respectively), and our Orbital Link (DSOL) for satellite-based data relay applications onboard PSLV-C55.

Dhruva Space has also earned recognition from the Government of India through the 2020 National Startup Award for work in Space & Satellite Technology, and the 2022 Pandit Deendayal Upadhyaya Telecom Skill Excellence Award for work in Satellite Communications. Other prestigious awards include the 2022 Innovation for India Awards from Marico Innovation Foundation as well as 'Best Startup - Silver' at the 2022 Telangana State Industry Awards.

Dhruva Space has roughly 60 full-time employees – across engineering, business development, legal and regulatory, and marketing roles – including the four co-founders and consultants, and we are working on growing our team as part of our scaling-up as a whole."



**Q** What are the various Products & solutions currently offered by Dhruva space?

**A** Krishna Teja Penamakuru, COO: "Any Space Mission requires three pillars essential to its success:

- **the Space segment:** manufacturing of the spacecraft and its subsystems, integrating the same with the payload;
- **the Launch segment:** manufacturing of separation systems for the deployment of the spacecraft;
- **and the Ground segment:** manufacturing and on-site assembly of the Earth Stations, along with the setup to operate the spacecraft in orbit including downlink of data

Keeping in mind the aforementioned, Dhruva Space has merged these three pillars together for the realization of our full-stack solutions in order to build, launch and operate satellites. That said, we indigenously design, develop and test our products: Satellite Platforms & Sub-systems (including space-grade solar arrays), Satellite Orbital Deployers and Satellite Earth stations."

**Q** What are the challenges & opportunities you see in the space industry?

**A** Sanjay Nekkanti, CEO: "It is extremely important to speak about the challenges being faced across the Space industry so that entities in the industry can collectively work together to increase India's presence in the global Space economy.

For a long time, India's space industry was State- or Government-run; now, we observe the Government of India empowering the privatization of the Sector with ISRO being the torchbearers of the industry.

There are three factors contributing to the growth in participation of private firms in the Space sector: policy, access to capital and growth in the general ecosystem to serve markets outside of India. All this is fuelled by the tremendous growth of requirements for satellites globally. A key to commercial success in the Space industry is the flight heritage of the systems. It helps that India is known for its thriving IT industry and its Space programme, the latter for which 400 ISRO-vetted MSMEs have demonstrated active and continual support over the last five to six decades. The current Government has been very forthcoming in bringing about an interesting revolution where private players experience a level playing field in trying to support not just local requirements but also global requirements too. This is reflected in the recently-published Indian

## FOCUS ON STARTUP



Space Policy 2023 in which the roles of Department of Space, ISRO, IN-SPACe, and NSIL are clearly defined.

Just look at the infusion of capital into the Private Space Sector from 2012 till 2022; it comes to US\$50-60 million and this figure has increased, signalling that investors are interested. Additionally, the Central Government has earmarked US\$137 billion for the Department of Space in the Union Budget 2022-23, which is a good sign of things to come. Considering Space is very close to Defence, the Government has a lot of push power towards Make-in-India which is all adding up to people foraying into this Sector.

The timing of the vitalisation of the Private Space Sector has been integral, considering there are many small satellite requirements globally. The projections are estimated to be in the tens of thousands in number; in order to meet any of those demands, the global supply chain needs to be robust and strong. These startups that exist in the ecosystem along with 400-odd companies that build small components for the Indian Space Programme are gearing up to benefit from this sudden 'Space Rush'.

All three of these factors work symbiotically. We are already seeing private companies raising



substantial capital, leveraging a greater degree of autonomy in making decisions while working with regulatory bodies such as IN-SPACe to maintain a certain level of accountability, and engaging the public in a more detailed dialogue around Space and Satellite Technologies. Such support will inexorably boost participation not just across startups but also investors and stakeholders, as well as progressive collaborations."

**Q** Are you seeking any support from the government for upcoming missions?

**A** Sanjay Nekkanti, CEO: "The Government of India has been very supportive of all three of Dhruva Space's missions, as well as the missions of many other NGPEs

(Non-Governmental Private Entities) to enhance the diffusion of Space technology and to boost space economy within India. Hence ISRO has been complementing the Department of Space in its objective of opening up the Space sector to private industries; we have seen this through the commercial undertakings at NSIL; promotion and authorisation activities at IN-SPACe, as well as the capacity-building efforts at ISRO.

Furthermore, given Dhruva Space's payload-agnostic technologies, we are already in detailed discussions with various Ministries within the Government of India for potential projects."

**Q** Can you talk about the small satellite-launch market? What does it mean for players like you?

**A** Chaitanya Dora Surapureddy, CFO: The market is seeing a 'small satellite manufacturing Zeitgeist', both in India and globally, due to lower costs for developing and launching satellites. The figures speak for themselves in that the global small satellite market size is projected to grow to US\$ 12.02 billion by 2029. Furthermore, it is predicted that by 2025, the 'Make in India' satellite manufacturing segment will be the second fastest growing in the Indian Space economy, and we are very excited for this! It is fortuitous that existing significant launcher organisations, including ISRO, have announced intentions to increase the number of launches in the coming years, anticipating large volumes of satellite launches, which, for us, paves a yellow brick road towards our vision of rapid constellation deployment missions.

Two of Dhruva Space's satellite platform segments are nanosatellite and microsatellite classes. We've noticed the increasing market demand for missions around these satellite

## FOCUS ON STARTUP



classes over the past year: the nanosatellite segment will witness significant growth owing to increasing usage for Earth observation, while the microsatellite segment will see decent growth due to increasing use of CubeSat for Space exploration and scientific applications. As a full-stack company, we've also been told we do 'too much', but we believe in this model that has boded well for us, till date."

**Q** **Would you associate with government projects, including in the defence sector? What are the advantages of such an association?**

**A** **Abhay Egoor, CTO:** "Government projects are certainly a boon for any private player in the Indian Space industry. There is a growing use of satellites by institutions of strategic importance in communications, navigation, Earth observation, experimentation and demonstration of new and emerging technologies and a lot more. The government segment will see notable growth as an increasing number of solutions are now being enabled by space technologies. This also has a notable impact on Public Procurements, which is a key

contributor to commercial sustainability for the emerging private sector.

We also see that promotion of dual-use technologies is often hastened by use and adoption in the defence sector. Government projects are certainly a key driver in our commercial and technical success.

At Dhruva Space, one of our offerings is that we manufacture satellite platforms and their subsystems including Space-grade Solar Arrays. It is worth noting there are less than 10 companies in the world that can design and manufacture Space-grade Solar Arrays and we are one of them. Dhruva Space is one of the first private Indian companies to secure an end-to-end design-and-development order for Space-grade Solar Arrays for a strategic customer in India."

**Q** **What is your message to youngsters who wish to become a 'spacepreneur'?**

**A** **Sanjay Nekkanti, CEO:** "I always say 'dream big'. You must have an unrelenting passion for the field and the vision of your company. There will be hardships along the way and, many times, you may feel like there may not be much progress or success, but never give up on the dream that

got you here in the first place."

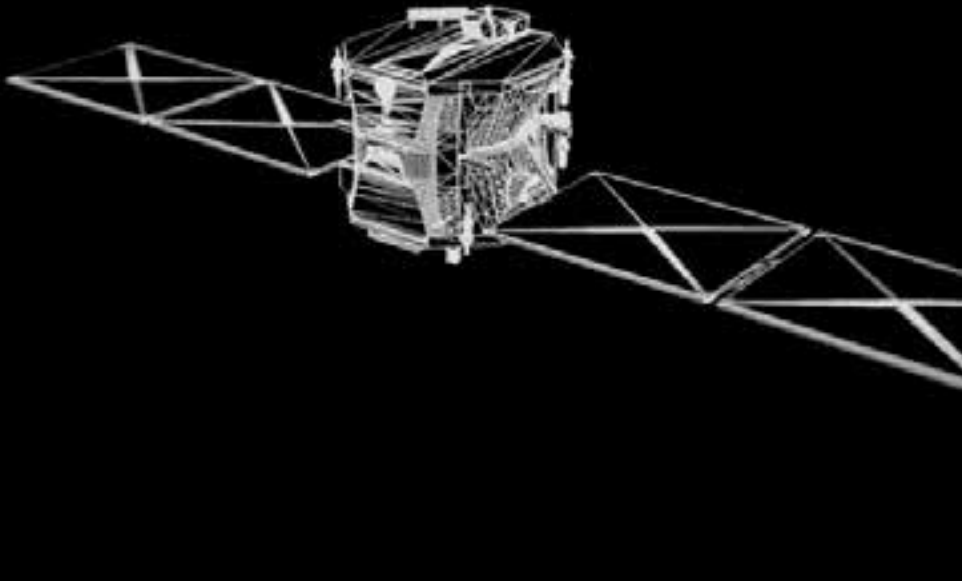
**Abhay Egoor, CTO:** "The type of team you have is the biggest and most important factor in overcoming most challenges you may encounter in the early phases of your business. They're the ones who will be with you through the whole execution phase of the idea; ideation is one part but to make that idea a reality it is a different ball game! For example, we develop satellites, but one person will not have all the skill-sets. The team should have varying yet complementary skill-sets. I have an Electronics Engineering background and my co-founder Krishna Teja has a Software background while Sanjay has a Space & Telecommunications background. But one range of skills that does not get due importance is actually of the non-technical variety, such as running the company effectively, marketing and commercialising your products and services, and regulatory and legal affairs. If you do not have this in your core team, you'll start seeing problems sooner than you think!"

**Q** **What is your ultimate goal in the next 5-10 years?**

**A** **Chaitanya Dora Surapureddy, CFO:**

"We hope to grow to about INR 100 Crores by FY24, by which time we aim to have our own AIT facility up and running in Telangana. We are in the planning phases of this AIT facility which would be a Spacecraft Manufacturing Facility that would be integral in Dhruva Space's scale-up road map, as we take on more commercial projects. We also intend to fly on every ISRO PSLV, launching either our own or our customers' payloads. And, of course, we also aim to have a much larger team, contributing a great deal to our R&D and the overall exciting culture at Dhruva Space."





## TRUE ANOMALY EMERGES FROM STEALTH TO REVOLUTIONIZE SPACE SECURITY, STABILITY, AND SUSTAINABILITY

**T** rue Anomaly, Inc., the company revolutionizing space security, stability, and sustainability, announced it has come out of stealth and raised \$30M in funding to date, including its recent \$17M Series A led by Eclipse in partnership with Riot Ventures, Champion Hill Ventures, Space VC, and Narya.

Founded in early 2022, True Anomaly's team is composed of former military operators and engineers focused on building spacecraft and software solutions designed to secure U.S. commercial and military interests in space and train ready and credible forces. The company has created a fully-integrated platform with seamless satellite, navigation, and data-capture technologies designed to provide unparalleled security and training for the rapidly evolving space market. In under a year, the company designed its first spacecraft, the Jackal Autonomous Orbital Vehicle, opened a 35,000 square foot fac-

tory in Denver, and hired 57 employees. With this most recent round of funding, True Anomaly will validate the technical abilities and operational capabilities of the Jackal and make the necessary investments to scale production later this year.

Our commercial and military Space assets are vulnerable to attacks

As the world faces intense geopolitical conflicts and a constant stream of climate events and natural disasters, space systems have never been more critical to ensuring economic prosperity and global security. However, today's systems are outdated and highly vulnerable to both physical and cyber threats. With launch costs significantly down and space technology rapidly evolving, those threats are rising exponentially.

Bringing decades of U.S. government and military experience, the True Anomaly team has a deep understanding of these increasing international risks and the ur-

gency with which they need to be mitigated. By building an integrated technology stack, True Anomaly will enable the U.S. and its allies to understand activity in the space domain, deploy resilient systems, train combat-ready forces, and compete responsibly.

"Space-based technologies have played a pivotal role in enabling the U.S. to employ instruments of national power, and it's imperative that we invest in upgrading and protecting those technologies," said True Anomaly Co-Founder and CEO, Even Rogers. "We need to address the capability asymmetry that has emerged in the space domain in the last two decades as the U.S. and its allies have focused military efforts primarily on Counterinsurgency Operations. If we don't act quickly and with a sense of urgency, our nation and its allies will be at an increased risk of geopolitical conflict and escalation of conflict that extends into space, which could lead to potentially catastrophic debris-generating outcomes as a result of attacks on our spacecraft."

The private and public sectors must join forces to enact meaningful, pivotal change to overcome intense national security space challenges and must do so dramatically faster than the 7-10 years currently consumed by legacy military space programs. Congress and the Department of Defense (DoD) continue to prioritize space resilience and responsible competition with the creation of a new military branch, the Space Force in 2019, and year-over-year USSF budget increases. True Anomaly plans to match the government's commitment by applying the team's collective expertise in space operations doctrine, tactics, and technology to build the solutions needed to enable continued U.S. military advantage in space and protect the burgeoning private sector space economy.

"The U.S. terrestrial military advantage has been enabled by superior capabilities in the space domain," said Seth Winterroth, Partner at Eclipse. "This advantage is quickly waning and as a result, the U.S. and our Allies face risks and challenges. True Anomaly is the purpose-built team with the tactical, technological, and defense procurement expertise to develop the necessary capabilities to regain our military advantages in space and ultimately, bolster national security."



## Rocket-Powered Spaceplane Takes Flight

**D**awn Aerospace, a space transportation company with operations in New Zealand, the Netherlands, and the United States announced the successful completion of the first rocket-powered flight campaign of its spaceplane, the Mk-II Aurora. The flights occurred at Glentanner Aerodrome on 29, 30, and 31 March.

Dawn is already the fastest-growing supplier of green in-space propulsion, with over 15 customers in Europe, Asia, and the USA and hardware on 11 operational satellites. The accomplishment announced today signifies a major milestone in the company's mission to revolutionize space access as well, and thus provide end-to-end space transportation.

The Mk-II Aurora had previously been tested using surrogate jet engines, while last week's campaign was the first conducted under rocket power. All test objectives were achieved.

The Mk-II Aurora is designed for aircraft-like operations and is capable of flying multiple times a day. Unlike traditional rock-

ets, Dawn vehicles take off and land horizontally on a runway and do not require a dedicated launch pad.

Dawn CEO Stefan Powell said, "To have demonstrated rapid reusability in the first tests is proof of our core philosophy, and confirmation that rocket-powered vehicles can be operated just like commercial jet aircraft. This fact allows us to rapidly test now, but in the future, it will completely revolutionize the economics of space access."

The flights aimed to validate key systems and capabilities, such as the rocket engine, rather than striving for maximum speed or altitude. Future tests will gradually increase speed and altitude in a 'build-up' approach. During commercial operations, the Mk-II Aurora will fly to 100 km altitude and aims to become the first vehicle capable of such flights twice in a day, laying the foundation for a fully and rapidly reusable first-stage booster.

Initial flights reached altitudes and speeds similar to those demonstrated in previous test flights under jet power, approximately 6,000 feet and 170 knots.

Upon the successful completion of the Mk-II Aurora program, Dawn Aerospace plans to develop the Mk-III, a two-stage orbital vehicle capable of carrying over 1 ton on a suborbital flight or delivering a 250 kg satellite to LEO with an expendable second stage.

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"These flights were a monumental achievement for Dawn Aerospace, and the result of years of hard work from the team. After conducting three tests in three days, we believe Mk-II is the most rapidly reusable rocket-powered aircraft in operation," he said.

"The vast majority of our industry's carbon footprint is created in the manufacturing of rockets, not the fuel efficiency. Our orbital vehicle, Mk-III, is designed to be 96% reusable. This is key to delivering on our vision of a sustainable and future-proof space industry," said

Powell.

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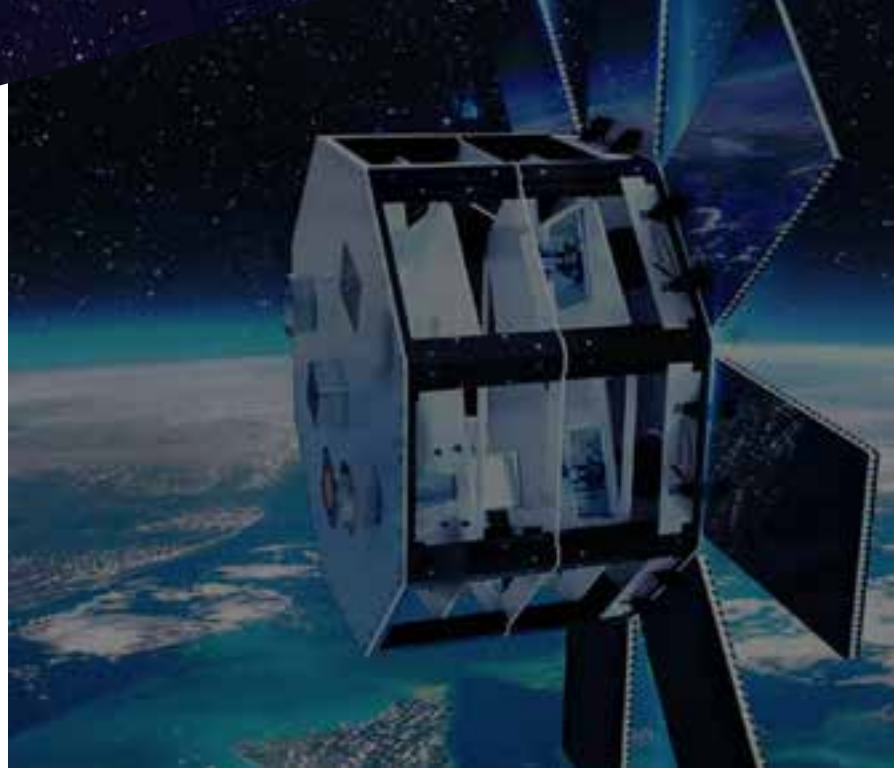
## Virgin Orbit Announces Receipt of Nasdaq Delisting Notice

Virgin Orbit Holdings, Inc a responsive space launch provider, announced that it was notified by the Listing Qualifications Department of The Nasdaq Stock Market LLC (“Nasdaq”) that Nasdaq had determined to commence proceedings to delist the Company’s common stock and warrants to purchase common stock as a result of the Company’s commencement of voluntary proceedings under Chapter 11 of the United States Bankruptcy Code. Nasdaq also asserted that the Company is not compliant with Listing Rule 5250(c)(1) because it has not yet filed its Annual Report on Form 10-K for the fiscal year ended December 31, 2022.

Nasdaq informed the Company that trading in the Company’s common stock and warrants would be suspended at the opening of business on April 13, 2023.

The Company intends to appeal Nasdaq’s decision to delist the common stock and warrants, but pursuant to Nasdaq’s listing rules, such appeal will not impact the upcoming suspension of trading in the common stock and warrants, and such suspension will remain in effect unless Nasdaq determines to reinstate the securities as part of the Company’s appeal. The Company can provide no assurance that its appeal will be successful.

If the appeal is unsuccessful, it is expected that Nasdaq would file a Form 25 with the Securities and Exchange Commission (the “SEC”), which would remove the Company’s common stock and warrants from listing and registration on Nasdaq.



## Sidus Space and L3Harris Team for the Department of Defense Mentor-Protégé Program

Sidus Space, Inc. a Space-as-a-Service company focused on commercial satellite design, manufacture, launch, and data collection, is teaming with L3Harris Technologies for the Department of Defense Mentor-Protégé Program (MPP). The DoD program helps businesses expand their footprint in the defense industrial base by supporting their partnering efforts with larger companies, such as L3Harris.

The MPP is designed to enhance Sidus’ capabilities to operate more effectively within the DoD supplier base, enabling the company to more efficiently reach its vision of making space data accessible and actionable to a broad range of customers. The DoD program is the oldest continuously operating federal MPP in existence. Over the past five years, this dynamic program has supported more than 190 businesses in their mission to fill unique niches within the military’s supply chain ecosystem. The Sidus-L3Harris MPP agreement runs from April 1, 2023 to March 31, 2024.

“We look forward to capitalizing on opportunities for process improvements as we work with L3Harris on various assessments and benchmarking initiatives, gaining valuable large company perspective that will benefit our team as we scale operations in the quarters and years ahead,” said Carol Craig, Founder and CEO of Sidus Space. “In addition to expanding our supplier relationship with L3Harris, this agreement will strengthen our ability to provide global customers, including the Department of Defense and other defense agencies, with a range of Space-as-a-Service solutions such as satellite services and space-based data offerings.”



# Hubble Unexpectedly Finds Double Quasar in Distant Universe

The early universe was a rambunctious place where galaxies often bumped into each other and even merged together. Using NASA's Hubble Space Telescope and other space and ground-based observatories, astronomers investigating these developments have made an unexpected and rare discovery: a pair of gravitationally bound quasars, both blazing away inside two merging galaxies. They existed when the universe was just 3 billion years old.

Quasars are bright objects powered by voracious, supermassive black holes blasting out ferocious fountains of energy as they engorge themselves on gas, dust, and anything else within their gravitational grasp.

"We don't see a lot of double quasars at this early time in the universe. And that's why this discovery is so exciting," said graduate student Yu-Ching Chen of the University of Illinois at Urbana-Champaign, lead author of this study.

Finding close binary quasars is a relatively new area of research that has just developed in the past 10 to 15 years. Today's powerful new observatories have allowed astronomers to identify instances where two quasars are active at the same time and are close enough that they will eventually merge.

There is increasing evidence that large galaxies are built up through mergers. Smaller systems come together to form bigger systems and ever larger structures. During that process there should be pairs of supermassive black holes formed within the merging galaxies. "Knowing about the progenitor population of black holes will eventually tell us about the emergence of supermassive black holes in the early universe, and how frequent those mergers could be," said Chen.

Finding close binary quasars is a



"We're starting to unveil this tip of the iceberg of the early binary quasar population," said Xin Liu of the University of Illinois at Urbana-Champaign. "This is the uniqueness of this study. It is actually telling us that this population exists, and now we have a method to identify double quasars that are separated by less than the size of a single galaxy."



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This was a needle-in-haystack search that required the combined power of NASA’s Hubble Space Telescope and the W.M. Keck Observatories in Hawaii. Multi-wavelength observations from the International Gemini Observatory in Hawaii, NSF’s Karl G. Jansky Very Large Array in New Mexico, and NASA’s Chandra X-ray Observatory also contributed to understanding the dynamic duo. And, ESA (European Space Agency)’s Gaia space observatory helped identify this double quasar in the first place.

“Hubble’s sensitivity and resolution provided pictures that allow us to rule out other possibilities for what we are seeing,” said Chen. Hubble shows, unequivocally, that this is indeed a genuine

pair of supermassive black holes, rather than two images of the same quasar created by a foreground gravitational lens. And, Hubble shows a tidal feature from the merging of two galaxies, where gravity distorts the shape of the galaxies forming two tails of stars.

However, Hubble’s sharp resolution alone isn’t good enough to go looking for these dual light beacons. The researchers enlisted Gaia, which launched in 2013, to pinpoint potential double-quasar candidates. Gaia measures the positions, distances, and motions of nearby celestial objects very precisely. But in a novel technique, it can be used to explore the distant universe. Gaia’s huge database can be used to search for quasars that mimic the apparent motion of nearby stars. The quasars appear as single objects in the Gaia data because they are so close together. However, Gaia can pick up a subtle, unexpected “jiggle” that mimics an apparent change in position of some of the quasars it observes.

In reality, the quasars aren’t moving through space in any measurable way. Instead, their jiggle could be evidence of random fluctuations of light as each member of the quasar pair varies in brightness on timescales of days to months, depending on their black hole’s feeding schedule. This alternating brightness between the quasar pair is similar to seeing a railroad crossing signal from a distance. As the lights on both sides of

the stationary signal alternately flash, the sign gives the illusion of “jiggling.”

Another challenge is that because gravity warps space like a funhouse mirror, a foreground galaxy could split the image of a distant quasar into two, creating the illusion it was really a binary pair. The Keck telescope was used to make sure there’s no lensing galaxy in between us and the suspected double quasar.

Because Hubble peers into the distant past, this double quasar no longer exists. Over the intervening 10 billion years, their host galaxies have likely settled into a giant elliptical galaxy, like the ones seen in the local universe today. And, the quasars have merged to become a gargantuan, supermassive black hole at its center. The nearby giant elliptical galaxy, M87, has a monstrous black hole weighing 6.5 billion times the mass of our Sun. Perhaps this black hole was grown from one or more galaxy mergers over the past billions of years.

The upcoming NASA Nancy Grace Roman Space Telescope, having the same visual acuity as Hubble, is ideal for binary quasar hunting. Hubble has been used to painstakingly take data for individual targets. But Roman’s very wide-angle infrared view of the universe is 200 times larger than Hubble’s. “A lot of quasars out there could be binary systems. The Roman telescope can do huge improvements in this research area,” said Liu.



## Sierra Space Expands VORTEX® Product Line with New 1,500 lbf Hypergolic Engine

Sierra Space, a leading, pureplay commercial space company building the first end-to-end business and technology platform in space, announced it successfully completed a hot-fire test campaign of a new hypergolic engine.

The Sierra Space VORTEX® VRM1500-H produces 1,500 pounds of force (lbf) thrust and achieved high thrust efficiency during recent testing. VORTEX technology will serve a critical industry need for engines that can support in-space propulsion for spacecraft orbital maneuvering and extraterrestrial landers.

The VRM1500-H is rooted in Sierra Space's patented VORTEX engine design technology, which promotes efficient, stable combustion. A vortex injector utilizes a unique swirling propellant flow to naturally cool the combustion chamber. Depending on mission requirements, both pressure-fed and electric pump-fed variants will be available. The new engine relies on additive manufacturing to reduce part count and simplify manufacturing.

Coupled with the unique VORTEX technology, this results in a robust, lightweight and cost-efficient rocket engine system. A video of the recent testing can be found [here](#).

Sierra Space, which is building the Dream Chaser® spaceplane and inflatable LIFE™ habitat, is reimagining rocket fuels and their engines at a 200-acre propulsion test facility outside Baraboo, Wisconsin. The company is also developing a larger, 35,000 lbf thrust upper-stage engine, the VORTEX VR35K-A, in conjunction with the Air Force Research Laboratory. With VORTEX, robust design margins deliver extremely high durability, reliability and reusability in engines that are inexpensive to manufacture and maintain.

The VORTEX VRM1500-H uses hypergolic propellants, which have long-term storability in space and spontaneously ignite upon mixing, thereby improving reliability and removing the complexity of a traditional ignition system. Use of hypergolic propellants allows the VRM1500-H to easily and reliably

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Commercial companies and government entities sometimes require a high thrust, high efficiency propulsion solution that provides a large payload with the ability to move to a new orbit rapidly,” said Rusty Thomas, Senior Vice President and General Manager of Space Applications at Sierra Space. “Our VORTEX engine technology couples high performance with reliability in a small package. This recent successful hot-fire test program brings us one step closer to another dynamic addition to our family of engines to propel us in building and growing an accessible commercial space economy.”

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ignite and reignite multiple times, as needed. Sierra Space began development and initial testing of the VRM1500-H in 2021. After optimizing the design, a second test campaign commenced in 2022, with the VRM1500-H ultimately achieving the high performance of 1,500 lbf thrust in vacuum. The next design and testing cycle of the VRM1500-H will address the industry's need for cost-efficient solutions using design for manufacturing best practices.



## Viasat Real-Time Earth Antennas Integrated on Microsoft Azure Orbital

Viasat Inc. announced through a collaboration with Microsoft Azure Orbital, the global Viasat Real-Time Earth (RTE) ground service is now accessible through the Azure marketplace. Five RTE sites will be equipped with high-speed connectivity directly to the Azure cloud platform.

Satellite operators are able to schedule passes on RTE antenna systems and will soon be able to rely on secure end-to-end connectivity with Azure over the private Microsoft WAN. This solution is ideal for commercial satellite operators seeking high throughput, low latency connectivity with their spacecraft, coupled with the security and resiliency of the cloud.

“Viasat Real-Time Earth is enabling remote sensing satellite operators who are pushing the envelope of high-rate downlinks,” said John Williams, vice president

Viasat Real-Time Earth. “Our strong relationship with Microsoft enables those same customers, through increased access to our ground service, Azure Orbital, and a dependable, high-speed terrestrial network, to reduce the time it takes to downlink and deliver massive amounts of data.”

Commercial satellite operators are moving towards higher and higher downlink rates, which brings down the cost of delivering data from space to the ground. To achieve this, many satellite operators have moved to Ka-band, which provides over three times more bandwidth than the traditional, and crowded, X-band spectrum for remote sensing missions. With Viasat, satellite operators flying electro-optical, Synthetic Aperture Radar (SAR), and hyperspectral payloads, gain access to an already established global network of Ka-band antennas for remote

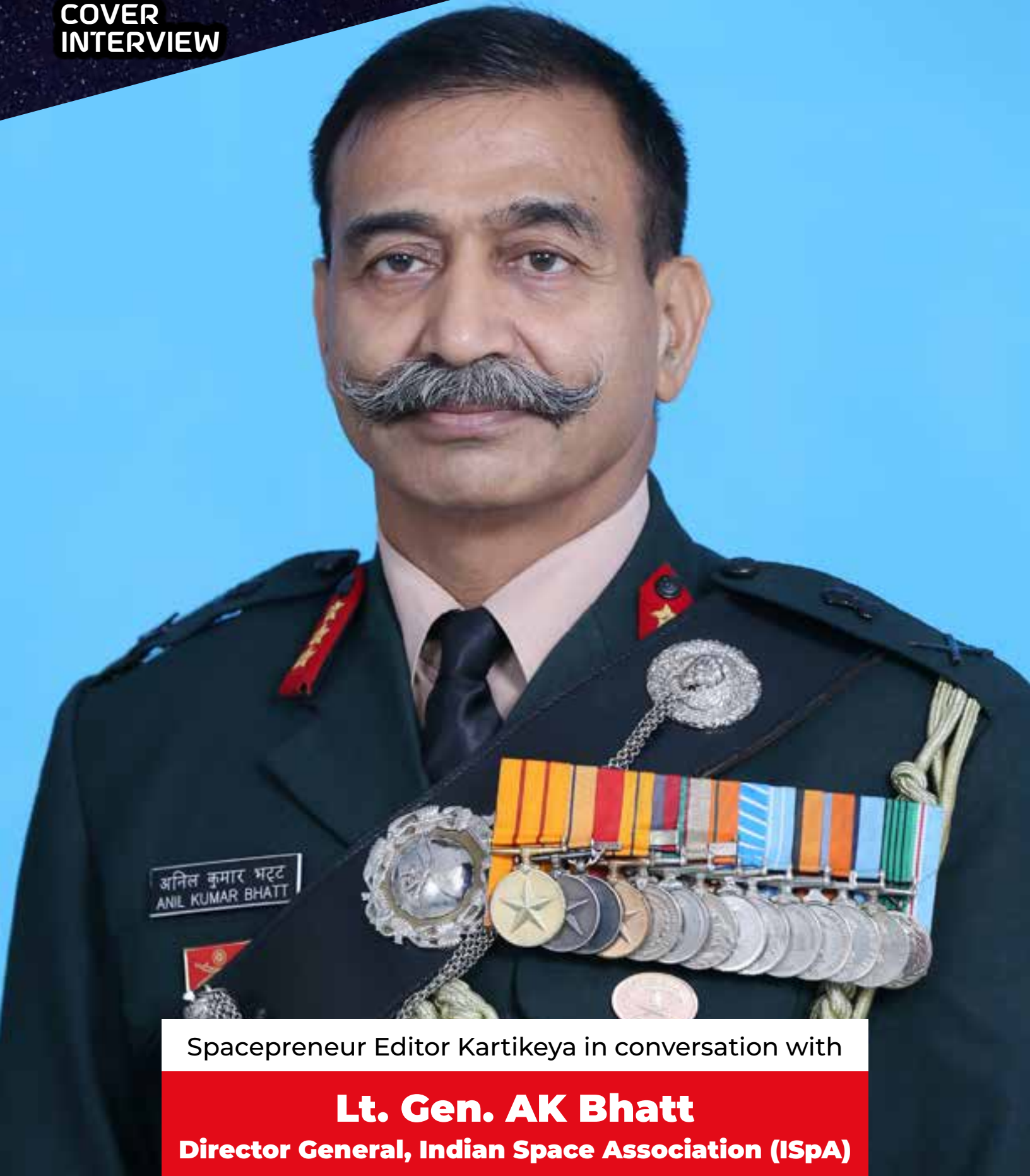
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“The new capabilities Microsoft Azure Orbital brings together with Viasat RTE are transformational for ground stations and customers pushing for rapid innovation like True Anomaly,” said Stephen Kitay, senior director, Azure Space at Microsoft. “This collaboration plays a role in increasing resiliency and reducing latency with real-time streaming across the community.”

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sensing missions.

Viasat RTE provides Ground-Station-as-a-Service (GSaaS) capabilities to connect commercial and government customers with their satellites on a pay-per-use basis. It is a fully-managed, cost-effective ground network that enables operators with geosynchronous orbit (GEO), medium earth orbit (MEO) and low earth orbit (LEO) satellites using the S-, X- and Ka-bands, to meet increasing data requirements.



Spacepreneur Editor Kartikeya in conversation with

**Lt. Gen. AK Bhatt**

**Director General, Indian Space Association (ISpA)**





**Q** What are the key objectives of the ISpA? How does it plan to revolutionise the Indian space sector? What are the new initiatives have been implemented so far since inception?

**A** The key objective of the Indian Space Association (ISpA) is to promote and strengthen the Indian space industry, foster innovation and entrepreneurship, and facilitate collaborations among various stakeholders. ISpA plans to revolutionize the Indian space sector by advocating for policy reforms, promoting technology development, fostering industry-academia collaborations and participate in formulating effective, efficient and appropriate policies and regulatory frameworks for ease of doing business and policy stability. The four pillars of our focus are Policy Advocacy for Ease of Doing Business, Capacity

development, international collaboration and interface with Strategic sector. Since inception, ISpA has taken several initiatives such as organizing space related industry events like the Indian Space Conclave and Indian DefSpace Symposium. We have also been promoting space education through our space education series through various social media platforms. In the last one-year ISpA has worked towards collaborating with various ministries such as MoD and DoS and also launched whitepapers on development of space technology parks in India, etc. We also along with MOD, all the defense services and industry have been actively involved in curating the DefSpace Challenges which were released by the honourable Prime Minister in Oct 2022 at DefExpo at Ahmedabad

**Q** What are the current opportunities & challenges are there in Indian space industry?

**A** The Indian space industry offers immense opportunities for growth and innovation and the new Indian Space policy's ambition for the NGEs to participate in end-to-end activities is evident of governments push for self-reliance and technological advancement. This is a forward-looking policy for the Indian space sector which will help us to fulfil our Hon'ble Prime Minister's vision for the growth of the Space industry in India. The space industry in India had been mainly overseen by the government, with the Department of Space and the Department of Telecom regulating the Satcom business. ISRO is the primary service provider for all Space activities. Private sector participation has been



**INDIAN SPACE ASSOCIATION**  
Bhumandal Se Brahmaand Tak

mostly limited to manufacturing components and sub components. With an increase in space sector over the past decade, there is a growing need for private companies to move up the value chain and become full-scale manufacturers of satellites, launch vehicles and applications. India as a known space faring nation needs to have a larger Share of the Global Space economy. From a meagre 2.6 % it needs to grow to at least 10 % in the near future.

The satellite communication industry relies heavily on efficient utilization of the scarce and valuable spectrum resource and safeguarding it for space usage is crucial. The globally accepted method of allocation of spectrum administrative method needs to be ensured. Also frequencies allocated to space should be in alignment with International practises. In order to attract foreign capital, liberal FDI guidelines need to be brought out at the earliest by the

Government. As a follow up of the Space Bill, It is also important that the consultations for the Space Activity Bill commences without delay. Being a spacefaring nation, we need to look at things from a larger perspective and that should be the government's next step.

**Q How is the current competitive landscape of the space sector? What role can the private sector play in India's space journey? What role ISpA will play in bridging the gap? What are the new initiatives related to academia we can expect from ISpA?**

**A** The current competitive landscape of the space sector is rapidly evolving, with both public and private players contributing to the growth of the industry. The private sector can play a crucial role in India's space journey by bringing in innovative ideas, funding, and

technology. ISpA aims to bridge the gap between the public and private sectors by advocating for policy reforms, promoting industry-academia collaborations, and organizing networking events for stakeholders. In terms of academia, ISpA plans to launch initiatives such as space education programs, research collaborations, and more opportunities for space-related research.

ISpA's recommendation of developing space technology parks have also highlighted that these would help in promoting the region as a knowledge hub in the Space domain, promote innovative products and services, aid talent pool creation, generate more jobs and entrepreneurship opportunities and yield export revenues. ISpA is also actively engaging with students, start-ups, academia, engineering and research institutions, and think tanks in order to spread awareness on the opportunities that are



present in the Indian space sector.

## **Q** What is your outlook for the sector in next 5 years?

**A** The Indian space sector is poised for significant growth in the next five years, driven by the government's push for self-reliance and innovation. With the increasing participation of the private sector, we can expect a surge in technology development, innovation, and entrepreneurship. According to a report launched by ISpA and EY, the space industry in India is expected to grow at a CAGR of 6%, leading to a market value of US\$13 billion by 2025. The "Make in India" initiative would likely drive growth in satellite manufacturing, as the demand for small satellites is increasing. This trend is expected to make satellite manufacturing the second-fastest-growing segment in the Indian space industry by 2025. There are also large opportunities in the downstream segment where we have a natural advantage due to our IT skilled manpower.

## **Q** What will be the key growth drivers?

**A** The key growth drivers for the Indian space industry will be policy reforms, collaborations, and innovation. The government's push for self-reliance and the involvement of the private sector to the development of new technologies, products, and services, driving growth in the industry and will lead India showcase their potential in the global market. Other than this, lower costs for developing and launching satellites, promise of substantial Return on Investment (RoI) and technological advancement in the space industry will be the key drivers for investment in the Indian space segment. We are sanguine that the Indian Space Enterprise led by ISRO along with private industry, startups and academia will be drivers for India's growth

## **Q** What is your message to young entrepreneurs who wish to enter space industry?

**A** My message to young entrepreneurs who wish to enter the space industry is to stay focused on their goals, remain resilient in the face of challenges, and continue to innovate. The space industry offers immense opportunities for growth and innovation, and it is important to stay abreast of the latest technologies and developments in the field. As the space industry is complex and challenging, and it can take years to develop a viable business, the young entrepreneurs should have perseverance and dedication which is critical to become successful in this sector. It is also crucial to develop a strong business acumen to navigate the commercial aspects of the space industry. This involves developing a comprehensive business plan, identifying potential investors, and understanding the regulatory framework.



## Eutelsat Donates State-of-the-art Connectivity Equipment for Paris Fire Brigade's Communication Support Vehicle

The dramatic fire disaster affecting Notre-Dame de Paris has prompted Eutelsat Communications (Euronext Paris: ETL) (Paris:ETL) to support the Paris Fire Brigade (BSPP) services. In the form of a donation, Eutelsat has equipped a Communication Support Vehicle (CSV) with the latest in connectivity infrastructure using next generation satellite networks.

In emergency situations, such as the Notre-Dame de Paris fire or the November 2015 terrorist attacks, public networks and ground-based communications infrastructure are rapidly congested, unavailable and in some cases inadequate. Yet, when it comes to managing emergency relief, communication between front-line responders can play a decisive role. In this respect, the use of a CAV connected via a satellite broadband link is an effective solution, as it provides satellite connectivity between the field and the command units for the transmission of radio, voice and Internet communications. The satel-

lite-based CSV operates independently of any terrestrial infrastructure and public networks that can be damaged in a crisis situation (congestion, breakdown, voluntary outage, etc.). It is therefore the optimum solution to the congestion of other public networks. Satellite connectivity provides a reliable and resilient connection between the command centre, front-line responders, the local population and possibly the media.

The Paris fire brigade can now deploy a 4G tactical bubble connected to other remote communication infrastructure via a satellite broadband link operated by Eutelsat. The resulting private 4G network built around the Communication Support Vehicle can be used by 18 mobile terminals equipped with a highly secure application enabling group voice communications, video-conferencing, data exchange and user geolocation. Also, a Wi-Fi bubble can be set up on board the CSV to enable access to the Internet and to mission critical

operational data. The CSV is equipped with several satellite telephone lines to communicate with the command centre or provide other public services or agencies with voice communications if required. As such, the CSV serves as an autonomous communication hotspot for organizing press briefings and real-time information, to name a few.

Fitted with state-of-the-art technology, the CSV now uses the Ka-band on EUTELSAT KONNECT, a powerful, next-generation HTS (High Throughput Satellite) satellite. The increased throughput enables the CAV to host very high-capacity applications, support more simultaneous calls, file transfers, streaming and teleconferencing, and provide connectivity to the private 4G tactical bubble. With the upcoming entry into service of the EUTELSAT KONNECT VHTS satellite, the communication capabilities of the CSV will be significantly enhanced thanks to high-speed broadband.

Cyril Dujardin, Eutelsat General Manager of the Connectivity Business Unit, commented: "Eutelsat is delighted to play its part in enhancing and boosting the BSPP's mission critical communication capabilities by providing a satellite-based CSV that is essential for ensuring resilient communication channels and connectivity in emergency situations. We are proud to be able to make this technology available to the people of Paris and its inner suburbs. To achieve this, Eutelsat has selected one of its long-standing partners, Telespazio France, for the integration and implementation of the crisis connectivity bubble based on Eutelsat's Ka-band Konnect platform."

Major General Joseph Dupré la Tour, Commander of the Paris Fire Brigade added: "Telecommunications are crucial to our operations which are increasingly demanding in an environment involving various constraints. Our command capacity, which lies at the heart of our operational efficiency, requires robust systems to ensure that orders are transmitted and information is passed on, regardless of the circumstances of the operation. The cooperation between Eutelsat and the BSPP is rooted in the long-standing, solid friendship between our respective former managers. This has been a fruitful relationship that is now materializing with the delivery of the CSV, bringing the BSPP's operational capabilities to new heights."



### Raytheon Technologies and SpiderOak Collaborate to Secure Satellite Communications in Proliferated Low-Earth Orbit

Raytheon Technologies BBN division and SpiderOak announced a strategic partnership to develop and field a new generation of zero-trust security systems for satellite communications in proliferated low-Earth orbit, or pLEO.

Spider Oak's Orbit Secure solution will be combined with Raytheon BBN's Distributed, Disrupted, Disconnected and Denied (D4) secure cloud solution to ensure resilience of mesh networks in contested environments.

"This partnership is paving the way toward secure, on-demand, Geostationary Equatorial Orbit network-like pLEO communications," said Raytheon BBN President Jason Redi. "Raytheon's networking technology ensures that the satellite constellation provides the best routing solution during normal operation, while also dynamically supporting autonomous cross-link routing during disrupted environments. SpiderOak's technology allows us to maintain distributed secure operations with high efficiency, particularly when the constellation is reconfiguring and paths are not preplanned."

"This cooperative effort reflects a common vision for a disruption-tolerant space networking future, which will be important for all mesh networks, and absolutely vital for the future of battle management command and control," said Charles Beames, SpiderOak executive chairman.

The combined solution can be applied across multi-vendor constellations despite orbital or malicious dynamics and will provide maximum resilience and efficiency in difficult or hostile operating environments. This includes cyber and kinetic threats that require on-orbit network and network function redundancy and flexibility.

During this one-year effort, Raytheon, Raytheon BBN, SEAKR Engineering, and SpiderOak will integrate the capability developed during phase one into space-qualified hardware with the goal of making it flight-ready.



### Rocket Lab Launches New Constellation-Class Star Tracker

Rocket Lab USA, Inc. a global leader in launch services and space systems announced a new class of star tracker, the ST-16HV, is now available for commercial use, expanding the Company's Space Systems catalogue of products for the global satellite market.

The new ST-16HV star tracker is an attitude determination sensor based on Rocket Lab's existing high-performance ST-16RT2 star tracker that has been evolved for mass manufacturing. The change results in a more affordable star tracker that is mass producible to meet the short lead time needs of both commercial and government satellite constellation projects.

By using the same electronics and electrical interface and much of the same mechanical design as the heritage star tracker, the ST-16HV can be used in its place as a responsive small satellite solution, especially for satellites and constellations in low Earth orbit.

"Rocket Lab's Space Systems Division has made tremendous strides in developing new technology and products and the new ST-16HV star tracker is the latest to join a long list of reliable and trusted space components," said Brad Clevenger, Vice President, Space Systems. "This new mass-produced star tracker will be a game changer in fulfilling the growing demand from satellite constellation customers and will be made at the Sinclair by Rocket Lab facility where we already mass produce reaction wheels."

The ST-16HV star tracker is the latest new satellite component announced in 2023, after the Frontier-X satellite radio and constellation-class 12Nms reaction wheel assembly were released in February.

The ST-16HV star tracker joins the Company's existing heritage space systems components including reaction wheels, separation systems, radios, flight software, ground software, and solar power solutions. Rocket Lab has more than 100 star trackers on orbit, including on the Defense Advanced Research Projects Agency's (DARPA) Mandrake 1 and Mandrake 2 satellites and Rocket Lab's in-house designed and built Lunar Photon spacecraft which supported NASA's Artemis program that delivered the Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE) CubeSat to orbit the Moon.



## DISH TV Adding to Fleet with New Maxar Satellite Order

Maxar Technologies provider of comprehensive space solutions and secure, precise, geospatial intelligence, received an order for a direct broadcast satellite from DISH, designated ES XXV. This geostationary (GEO) communications satellite will be operated by DISH and deliver content across North America.

ES XXV will be built on the proven Maxar 1300TM series platform at the company's manufacturing facilities in Palo Alto and San Jose, California. ES XXV will be equipped with a high-power, multi-spot beam payload, allowing DISH to provide high-quality content to its customers. A high-resolution render of the spacecraft is available here.

"The GEO market remains important, and Maxar's experience delivering value for our customers continues to be a key focus," said Chris Johnson, Maxar's Senior Vice President and General Manager of Space. "We offer scalable platforms to support a variety of missions, and we're proud to continue that legacy with this new order."

ES XXV joins a fleet of Maxar spacecraft in orbit. Since 1999, Maxar has manufactured 11 satellites for DISH TV's fleet, including several of the largest commercial satellites ever built.



## European Space and Telecoms Players Sign Partnership Agreement to Bid for IRIS2 Constellation

A group of European space and telecommunications players have come together to form a partnership to respond to the European Commission's call for tender related to the future European satellite constellation IRIS<sup>2</sup> (Infrastructure for Resilience, Interconnectivity and Security by Satellite). IRIS<sup>2</sup> aims to bring a new secure and resilient connectivity infrastructure to European governments, businesses and citizens.

The open consortium will be governed by Airbus Defence and Space, Eutelsat, Hispasat, SES and Thales Alenia Space. The consortium will also rely on the core team of the following companies: Deutsche Telekom, OHB, Orange, Hisdesat, Telespazio, and Thales. Together, they will aim to create a state-of-the-art satellite constellation based on a multi-orbit architecture that would be interoperable with the terrestrial ecosystem.

This partnership will set up an integrated best-in-class European space and telecoms team across these companies to leverage the expertise and capabilities in the field of secure satellite communications solutions. The consortium will encourage start-ups, mid-Caps and SMEs to join the partnership, resulting in a more innovative and competitive European space sector where new business models will emerge.

The integrated team aims to foster collaboration among all European space players across the whole connectivity value chain with a view to enabling EU's strategic autonomy through the delivery of sovereign, secure and resilient government services to protect European citizens. The team will leverage synergies between government and commercial infrastructures. The teaming partners are also well positioned to provide commercial services to bridge the digital divide across European territories and to increase Europe's global outreach and competitiveness as a space and digital power on the global market.

IRIS<sup>2</sup> will deliver resilient and secure connectivity solutions to governments to protect European citizens and will provide commercial services in the interest of European economies and societies. It will also bolster the EU partnership policy by offering its infrastructure abroad. IRIS<sup>2</sup> is the EU's new flagship space programme for a digital, resilient and safer Europe.



## Northrop Grumman Rapidly Completes Critical Design Review for Tranche 1 Transport Layer

Northrop Grumman Corporation recently completed a critical design review for its Tranche 1 Transport Layer (T1TL), part of Space Development Agency's (SDA) low-earth orbit network designed to communicate vital information to wherever it's needed to support U.S. troops on the ground quickly and securely.

The Tranche 1 Transport Layer (T1TL) communication satellites will provide resilient, low-latency, high-volume data transport supporting U.S. military missions around the world. Designed to connect elements of an integrated sensing architecture, the network will deliver persistent, secure connectivity, and serve as a critical element for advancing the U.S. Department of Defense's vision for Joint All Domain Command and Control.

"We are leveraging our commercial marketplace partnerships to deliver a rapid, affordable, highly effective solution for SDA," said Blake Bullock, vice president, communication systems, strategic space systems, Northrop Grumman. "Our T1TL solution builds on our decades of end-to-end mission expertise. We are uniquely capable of delivering a credible capability to support the warfighter."

SDA formerly announced that Northrop Grumman is under contract to provide the agency with 56 satellites, including the 42 communication satellites in the Tranche 1 Transport layer and 14 for the Tranche 1 Tracking layer, which includes an infrared sensor payload. The Tracking layer program recently completed its preliminary design review. Northrop Grumman is also providing the ground system for both its Transport and Tracking constellations.



## Boeing Delivers Powerful Satellite Platform to Viasat

Boeing delivered the most powerful satellite platform the company has built to date, the 702MP+, and a custom-designed spacecraft for network provider Viasat.

"Working with Boeing, we're very excited to complete the ViaSat-3 Americas and bring us one step closer to providing higher speeds, more bandwidth, and greater value to our customers on a global scale whether they be on land, on the sea, or in the air," said Dave Ryan, president Space & Commercial Networks, Viasat. "The innovation of this satellite allows us new levels of flexibility to dynamically allocate capacity to the most attractive and engaged geographic markets."

Upon embarking from the Boeing factory in California, ViaSat-3 Americas was flown to the Florida Space Coast where Boeing and Viasat teams will support launch and mission operations as the spacecraft prepares to travel to geostationary orbit, approximately 22,000 miles from Earth. Once in orbit, ViaSat-3 Americas will be the first of three 702MP+ satellites to make up the ultra-high-capacity ViaSat-3 satellite constellation, designed to provide high-quality, affordable global connectivity and coverage.

"We designed, built and delivered the most powerful satellite platform we have ever provided to a customer. The result really is an engineering marvel," said Michelle Parker, vice president of Space Mission Systems at Boeing Defense, Space & Security. "We expanded the boundaries of our design and the platform components to exceed Viasat's demanding mission requirements, while ensuring alignment with Boeing's proven qualification and reliability standards."

Based on the flight-proven 702 vehicle design hosting the U.S. Department of Defense's Wideband Global Satellite (WGS) constellation, and more than 40 other high-performing satellites, including ViaSat-2, Boeing's 702MP+ features all-electric propulsion for the first time aboard a 702MP, providing more sustained thrust and efficiency.

Boeing improved the platform's structure to support Viasat's large payload. The platform also accommodates the largest commercial satellite solar arrays Boeing subsidiary Spectrolab has ever produced, along with batteries and supporting electronics, which generate well over 30 kW of solar power.

The satellite has some of the largest reflectors ever sent to space and will be significantly larger than most geostationary satellites, requiring highly-refined, highly reliable hardware and software to maintain optimal satellite control. In addition to designing and manufacturing the platform, Boeing worked with Viasat to integrate the payload.



sistent surveillance. Additionally, the scalable and versatile design provides a new level of flexibility and the necessary power to quickly meet a wide range of customer needs and missions, including accelerating demand for more proliferated systems. The spacecraft also benefits from production capabilities such as augmented and virtual reality and artificial intelligence. With increased commonality, LM 400 reduces schedule and cost while also maintaining quality.

**The multi-mission satellite offers:**

- Versatility that can host a variety of payloads with limited or no changes in low, medium and geosynchronous earth orbits.
- Broad set of missions with pre-defined trim packages to meet specific mission needs.
- Joint all-domain operations and joint all-domain command and control with a Modular Open Systems Architecture.
- Greater mission adaptability and onboard «Edge» data processing with SmartSat™, Lockheed Martin's software-defined satellite architecture.
- High-rate production capability to meet large constellation needs.
- Cost and schedule efficiency enabled by supply chain agreements and automation throughout the product lifecycle, from inventory management to manufacturing and test.
- “The LM 400's digital design allows for multiple versions to be seamlessly produced – including a ‘flat satellite’ that will support rapid launching of up to six stackable space vehicles at a time,” adds Musawwir. “These types of 21st Century Security agile deterrence capabilities will provide our customers with maximum flexibility for their missions.”
- The LM 400 is already under several contracts, most recently being named as a satellite bus supporting U.S. Space Force's planned Missile Track Custody program in medium earth orbit.
- When launched, the LM 400 will feature a Lockheed Martin-produced Electronically Steered Array.

# Lockheed Martin's First LM 400 Multi-Mission Space Vehicle Completes Demanding Testing Milestone

The first Lockheed Martin LMT LM 400, a versatile, mid-sized satellite which can be adapted for military, civil or commercial uses, has successfully completed Electromagnetic Interference/Electromagnetic Compatibility testing. This trial is crucial to ensure that signals from the satellite bus components will not interfere with critical payloads during operations. The spacecraft, which finished assembly in December, is also working toward completion of rigorous thermal vacuum (TVAC) testing.

“This successful testing of LM 400

helps prove the satellite's design integrity and operational capabilities,” said Malik Musawwir, Lockheed Martin Space's satellite center of excellence vice president. “This is a significant accomplishment for this new satellite and the space vehicles that will leverage this platform from our advanced digital LM 400 production line.”

LM 400 Spacecraft: Higher Power, More Mission Flexibility

The agile LM 400 spacecraft enables one platform to perform multiple missions, including remote sensing, communications, imaging, radar and per-





## Israel Ministry of Defense and IAI successfully launched the “Ofek 13” satellite which has begun to orbit into space

Israel Ministry of Defense and IAI successfully launched the “Ofek 13” satellite which has begun to orbit into space. The IMoD Space and Satellite Administration in the Directorate of Defense Research & Development (DDR&D), the Israel Defense Forces (IDF), and Israel Aerospace Industries (IAI) successfully launched the “Ofek 13” satellite into space at 02:10 IST. The launch took place at a test site in central Israel using a “Shavit” launcher. The satellite successfully entered orbit, has begun transmitting data, and completed an initial series of inspections in accordance with original launch plans. IMoD and IAI engineers will continue pre-planned inspections before it begins full operational activity in the near future.

The “Ofek 13” satellite was developed based on the experience of the defense establishment and IAI in the production of earlier satellites in the “Ofek” series, which have been launched since 1988.

The IMoD’s Space and Satellite Administration has led the development and production of the satellite and its launcher. The development process also includes the IDF’s 9900 Intelligence Unit and the Israeli Air Force. IAI is the prime contractor for the development of the satellite, launcher, and ground station monitoring system. The

System Missiles and Space Group led by the Space division operates the project alongside with ELTA, an IAI subsidiary, and the MLM division. The launch engines were developed by Rafael Advanced Systems and Tomer, a government-owned company.

Once the satellite is deemed fully operational, the Ministry of Defense will deliver it to the IDF’s 9900 Intelligence Unit for operational use.

\*Defense Minister Yoav Galant, who was present during the launch:\* “The successful launch of the satellite is yet another important example of the Israeli defense establishment’s groundbreaking innovation. Israel has already proved its diverse space capabilities many times and is one of very few countries to possess such capabilities - capabilities that we continue to develop and strengthen. Our proud accomplishment today is first and foremost thanks to our engineers’ creativity, talent and consistency in addition to the hard work of outstanding professionals that took part in this operation. We will continue to prove that even the sky isn’t the limit for the Israeli defense establishment and that we continue to enhance its capabilities in every dimension in the face of various challenges.”

Head of the DDR&D, Brig. Gen. (Res.) Dr. Daniel Gold: We launched a SAR satellite

into space that is equipped with the utmost advanced abilities at the peak of global technology. The launch of “Ofek 13” has proven Israel’s superiority in the field of space yet again. It also constitutes a leap forward in operational and technological abilities for the preservation and improvement of Israel’s standing in space for the coming decades.”

Commander of Unit 9900, Brig. Gen. Erez Askal: “This successful launch is an important step for Israel’s defense establishment and for Unit 9900 specifically, and positions us as a regional and international space power. I would like to thank our partners in the space community; our work has only just begun. Our unit’s soldiers and commanders will continue to work around the clock to ensure the satellite’s successful operation and to provide a full operational intelligence picture.”

President and CEO of IAI, Boaz Levy: “The ‘Ofek 13’ satellite that was launched today is additional proof of IAI’s power as Israel’s space home and its significant contribution to the Israeli defense establishment. From now on, Israel will gain groundbreaking intelligence capabilities. The ‘Ofek 13’ is the most advanced of its kind with unique radar observation capabilities and will enable intelligence collection in any weather and conditions of visibility, thus enhancing strategic intelligence. The satellite is comprised of groundbreaking Israeli-made technologies and will join the IAI’s ‘Ofek’ series in space that operate to strengthen the defense establishment’s intelligence superiority. The launch concludes a long and complex process of developing and building the satellite led by the brightest minds in IAI together with the Israel Ministry of Defense’s DDR&D and additional defense industries.”

Head of the IMoD’s Space and Satellite Administration, Avi Berger: “Ofek 13” is a SAR satellite with the most advanced capabilities of its kind, entirely developed in Israel. The launch was successful, according to plan. Initial indications from the satellite are also very good. Within the coming weeks, we will complete technical tests and receive the first pictures before delivering the satellite for operational use by the IDF. ‘Ofek 13’ will join the additional Ofek satellites that the Ministry of Defense and the IDF have operated in space for many years. A SAR satellite will allow, among other things, day and nighttime imaging capabilities, and will drastically improve Israel’s intelligence capabilities from space for years to come.”



## US Space Force and DISA Awards USD 27.54 Million CTC Contract to SES Space & Defense

SES Space & Defense, a wholly-owned subsidiary of SES, will provide satellite communications capabilities in support of the U.S. Army Warfighter Information Network-Tactical (WINT-T) training activities. The five-year Commercial Satellite Communications (COMSATCOM) Transponded Capacity (CTC) contract worth USD 27.54 million has been awarded by the U.S. Space Force's Commercial SATCOM Communication Office (CSCO) through Defense Information Systems Agency's (DISA) Defense Information Technology Contracting Organization (DITCO).

Leveraging SES's global satellite fleet, SES Space & Defense will provide capabilities for the U.S. Army Network Enterprise Technology Command (NETCOM) and the U.S. Army Forces Command (FORSCOM) units to train and prepare a combat-ready, globally responsive Total Force. This will allow the U.S. Army to continue to build and sustain combatant command readiness requirements, as well as enable research and development activities for testing new applications for mobile missions.

"SES Space & Defense has a longstanding relationship with the U.S. Army and has been supporting the WINT-T program's evolving needs for over a decade," said SES Space & Defense President and CEO David Fields. "As the U.S. DoD adopts new and more advanced information technology capabilities, it is key that we support them with the much-needed resilient and secure satellite communications in multiple orbits and bands. Combine that with our extensive experience in network integration, we can ensure our customers' advantage in any critical mission scenarios."



## SES's Fourth and Fifth C-band Satellites for the United States Successfully Launched

SES announced that the SES-18 and SES-19 satellites, designed and assembled by Northrop Grumman, were successfully launched by SpaceX's Falcon 9 rocket from Cape Canaveral Space Force Station in Florida, United States, at 7:38 pm local time on Friday, March 17.

The two American-made satellites are the fourth and fifth – and final – satellites to be launched as part of SES's C-band transition plan, following the launch of SES-22 in June 2022 and the tandem launch of SES-20 and SES-21 in October 2022. These satellites are essential parts of SES's plan to achieve the Federal Communications Commission's (FCC) program to clear C-band spectrum to enable wireless operators to deploy 5G services across the contiguous U.S. (CONUS) while ensuring that SES's existing customers continue to enjoy uninterrupted TV, radio, and critical data transmission services to millions of Americans.

Since 2020, SES, along with other satellite operators, has been clearing 300 MHz of C-band spectrum and transitioning customer services to the remaining allocated 200 MHz of spectrum by launching new satellites, building new ground stations and sending hundreds of satellite earth station technicians across the country to install new filters on customers' antennas.

By providing contractual service protections to customers who receive video services in the U.S., SES-18 and SES-19 will enable SES to safely clear C-band spectrum to help accomplish the FCC's ambitious goals for American 5G innovation. SES-18 is expected to begin operations in June 2023 at 103 degrees West replacing SES-3 C-band payload and SES-19 will be co-located with SES-22 at 135 degrees west.

"This successful launch marks one of the last remaining milestones on our journey to clear a portion of the C-band, and we are incredibly grateful to Northrop Grumman, SpaceX, and all of our partners who helped make this plan a reality," said Steve Collar, CEO of SES. "We are now on the home stretch in protecting our customers' broadcasts while freeing crucial 5G spectrum and we look forward to successfully concluding our work well before the FCC's December 2023 accelerated clearing deadline."



## NRO Exercises Radio Frequency Contract Option with Maxar

Maxar Technologies provider of comprehensive space solutions and secure, precise, geospatial intelligence announced that Aurora Insight Inc., a company acquired by Maxar in December 2022, has received a Stage II contract extension from the National Reconnaissance Office (NRO) for commercial radio frequency (RF) remote sensing.

Aurora Insight, now part of Maxar's Earth Intelligence business, was previously awarded the NRO's Strategic Commercial Enhancements Broad Agency Announcement (BAA) Framework Stage I contract, which focused on the modeling and simulation of its capabilities to support the U.S. government's current and future commercial RF reconnaissance needs. The Stage II option provides Maxar the opportunity to demonstrate real-world performance of its commercial RF constellation to support U.S. government missions.

Maxar will demonstrate how space-based mapping of the world's RF environment can enhance and augment existing capabilities. Maxar's RF measurements span a wide range of frequencies that include LTE, 5G, satellite communications, radars, GPS and other types of signals, and these measurements are being applied to commercial and government use cases. The Stage II award is an important step in getting commercial RF data to U.S. government users.

"We are honored to have the opportunity to demonstrate the value of commercial RF data to support key U.S. government mission needs," said Tony Frazier, Maxar's Executive Vice President and General Manager, Public Sector Earth Intelligence. "We are particularly excited to integrate RF capabilities with our industry-leading satellite imagery, 3D data, and analytics."

Jennifer Alvarez, co-founder and former CEO of Aurora Insight, who now leads Maxar's RF solutions program, is scheduled to speak on the topic of "Radio Frequency Data - the Soundtrack to a Silent Movie" at the GEOINT 2023 Symposium, taking place May 21-24 in St. Louis, Missouri.



## Hughes Introduces Smart Network Edge Software for Mission-Critical DoD Communications

Hughes Network Systems, LLC (HUGHES), an EchoStar company, announced availability of Hughes Smart Network Edge software for defense network operations. Leveraging the company's experience managing widely distributed, multi-transport networks for commercial and government customers, the Hughes Smart Network Edge serves as a virtualized SD-WAN router, interconnecting at the management layer to enable network interoperability across carriers and vendors while meeting U.S. Department of Defense (DoD) security criteria.

Optimizing any combination of commercial and military communication networks - including cable, fiber, 5G, Geostationary satellite and Low Earth Orbit satellite - the Hughes Smart Network Edge remotely manages multi-transport modems, autonomously selecting routing paths and distributing packetized data across multiple networks based on policies and priorities. The software also collects Fault, Configuration, Accounting, Performance and Security (FCAPS) data for enhanced situational awareness and policy refinement.

"Hughes Smart Network Edge represents the culmination of years of work we've undertaken to help the DoD take advantage of equipment and transports from multiple providers combined with our extensive expertise managing large and diverse networks," said Rick Lober, vice president and general manager, Defense & Government Systems Division, Hughes. "It's software-defined networking in the very broadest sense, orchestrating typically stove-piped communications systems in use across the DoD to enable secure network interoperability and resiliency at scale."

Based on Simple Network Management Protocol (SNMP) and HTTP standards, among others, the Hughes Secure Network Edge is engineered for use across diverse network transports from multiple manufacturers and carriers of wired, wireless and satellite connectivity—such as the 5G and satellite terminals in the private 5G deployment Hughes is leading at the Naval Air Station in Whidbey Island. In addition to commercial satellite transports, the Smart Network Edge accommodates modems with anti-jam capabilities that are indispensable under rising threats from near peer states.

"As the DoD relies increasingly on redundant and interoperable terrestrial and satellite networks for mission-critical communications, our Smart Network Edge software automates the decision-making necessary to optimize the edge devices - whether a few or a few hundred," said Dr. Rajeev Gopal, vice president, Advanced Systems, Hughes. "In addition to powering decision-making across network terminals, the software integrates with management platforms, such as Enterprise Management & Control, and includes policy parameters such as cost, availability, speed and latency to meet operational objectives."



## Airbus wins contract from Angola for Earth observation satellite Angeo-1

Maxar Technologies provider of comprehensive space solutions and secure, precise, geospatial intelligence announced that Aurora Insight Inc., a company acquired by Maxar in December 2022, has received a Stage II contract extension from the National Reconnaissance Office (NRO) for commercial radio frequency (RF) remote sensing.

Aurora Insight, now part of Maxar's Earth Intelligence business, was previously awarded the NRO's Strategic Commercial Enhancements Broad Agency Announcement (BAA) Framework Stage I contract, which focused on the modeling and simulation of its capabilities to support the U.S. government's current and future commercial RF reconnaissance needs. The Stage II option provides Maxar the opportunity to demonstrate real-world performance of its commercial RF constellation to support U.S. government missions.

Maxar will demonstrate how space-based mapping of the world's RF environment can enhance and augment existing capabilities. Maxar's RF measurements span a wide range of frequencies that include LTE, 5G, satellite communications, radars, GPS and other types of signals, and these measurements are being applied to commercial and government use cases. The Stage II award is an important step in getting commercial RF data to U.S. government users.

"We are honored to have the opportunity to demonstrate the value of commercial RF data to support key U.S. government mission needs," said Tony Frazier, Maxar's Executive Vice President and General Manager, Public Sector Earth Intelligence. "We are particularly excited to integrate RF capabilities with our industry-leading satellite imagery, 3D data, and analytics."

Jennifer Alvarez, co-founder and former CEO of Aurora Insight, who now leads Maxar's RF solutions program, is scheduled to speak on the topic of "Radio Frequency Data - the Soundtrack to a Silent Movie" at the GEOINT 2023 Symposium, taking place May 21-24 in St. Louis, Missouri.



## Boeing's New Military Satellite Integrates Anti-Jam Payload for Enhanced Battlefield Communication

Boeing unveiled its Protected Wideband Satellite (PWS) design featuring Boeing's Protected Tactical SATCOM Prototype (PTS-P) payload hosted aboard the U.S. Space Force's Wideband Global SATCOM (WGS)-11 spacecraft.

"The joint force is relying on us to deploy capabilities that enable secure communications in a prolific jamming environment," said Charlotte Gerhart, Space Systems Command's Tactical SATCOM division chief at the U.S. Space Force. "We also need mission-relevant speed and affordability, while being mindful of the evolving threat in the battlefield. The Boeing PTS-Prototype payload hosted on WGS-11 is an exciting leap forward for new warfighter capabilities."

The combination of military satellite communications (MILSATCOM) and anti-jam capabilities underpin the PWS design. Both programs are based on Boeing's 702X software-driven technology enabling real-time and automated beam-forming for improved stand-off performance and signal protection.

"The Protected Wideband Satellite combines significantly upgraded WGS capability with PTS-P's automated anti-jam features," said Michelle Parker, vice president of Boeing's Space Mission Systems. "This capability sets the stage for future generations of protected wideband systems that can operate in both legacy transponded and new onboard processed modes."

The program is scheduled for launch in 2024, with on-orbit testing slated for 2025. After on-orbit demonstration, the PTS-P payload will be available to transition for operational use. The PTS-P design features automated anti-jam capabilities, including jammer geolocation, real-time adaptive nulling, frequency hopping and other techniques, harnessing the power of the U.S. military's Protected Tactical Waveform (PTW) to ensure the warfighter can stay connected in a contested environment.

By flying PTS-P on the WGS-11 spacecraft as part of the WGS constellation, PWS works seamlessly with all the existing WGS user terminals, while allowing gradual fielding of PTW modems in a theater of operation. WGS provides the Department of Defense with a broad majority of tactical communications going through the constellation that currently includes 10 satellites.



## Hughes Launches New HughesNet Plans for Small Businesses

**H**ughes Network Systems, an EchoStar company announced new HughesNet® plans for small businesses in the U.S. The new satellite internet service plans include features like business-grade support, express repair and free installation to support the needs of small businesses for network availability and high performance. The plans also include low-latency HughesNet Fusion™ plans that seamlessly blend Geostationary (GEO) satellite and wireless technologies into a fast and responsive satellite internet experience, ideal for business applications like Teams, Zoom and Outlook.

“Late last year, we introduced HughesNet Fusion to the consumer market, offering rural Americans a high-speed, low-latency reliable internet service,” said Doug Medina, vice president, Hughes. “Now, we’re bringing the same multipath technology to the small business market, so companies beyond the reach of fiber and cable internet can choose the HughesNet plan that best meets their needs.”

HughesNet business plans come with built-in Wi-Fi, fast 25 Mbps download speeds, free professional installation and, for peace of mind, they also include premium repair service.

“For people working from home or running a small business, internet access is nothing short of essential,” added Medina. “That’s why we enhanced our HughesNet business plans with new features and plans that keep businesses connected to the critical applications they depend on.”



## Maxar Rebrands Spacecraft Portfolio, Forming Flexible Family That Fits Any Mission

**M**axar Technologies provider of comprehensive space solutions and secure, precise, geospatial intelligence announced a rebranded lineup of spacecraft platforms that reflects Maxar’s broad manufacturing capabilities and continuing investment to serve evolving commercial, civil and national security space missions.

The portfolio, which includes Maxar 300™ series, Maxar 500™ series and Maxar 1300™ series buses, reinforces Maxar’s 60-plus years of satellite manufacturing leadership. These flexible platforms are designed to serve a variety of missions, ranging from proliferated low Earth orbit constellations to multi-orbit systems.

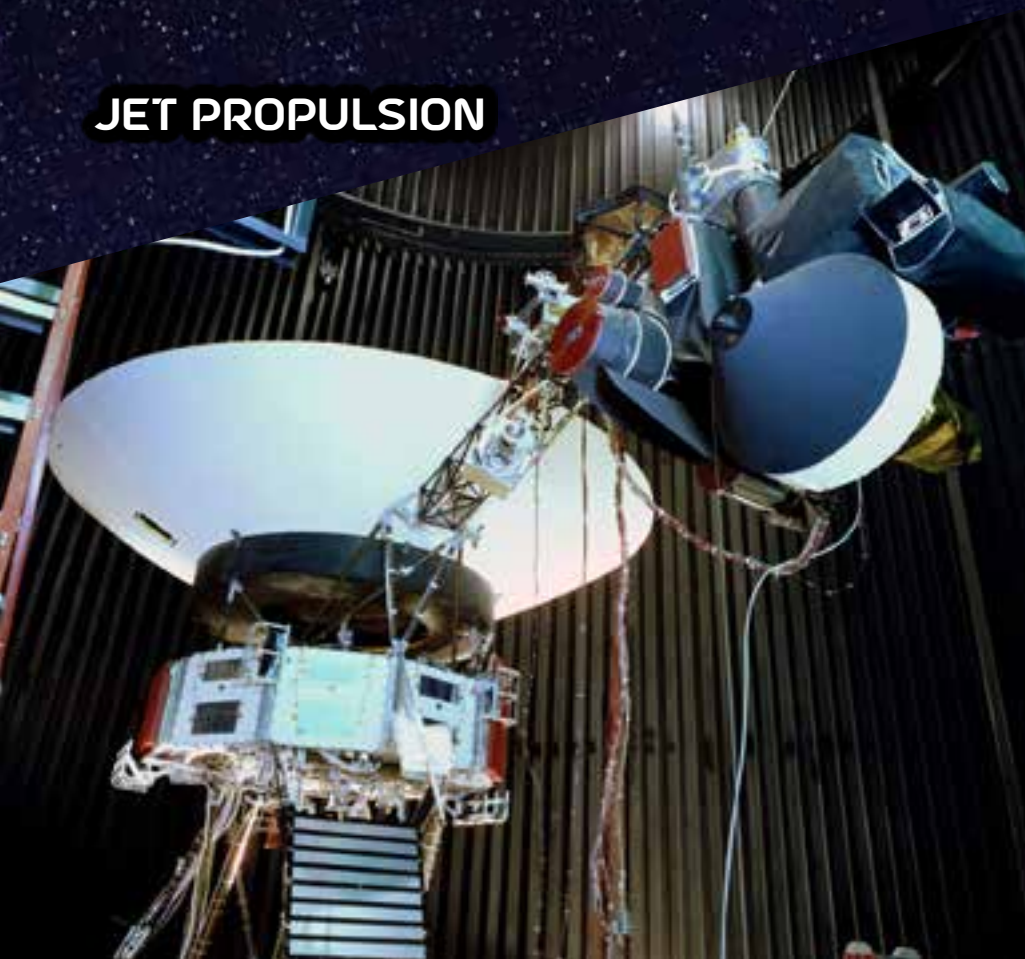
“Customers can come to us with a wide array of critical missions, and our spacecraft family offers the right platforms to fit their needs,” said Chris Johnson, Senior Vice President and General Manager for Space at Maxar. “These products are rooted in Maxar’s deep legacy of manufacturing flexible, reliable spacecraft, and our investments ensure they are relevant now and well into the future.”

Maxar’s family of platforms complement each other, and in some cases collectively can be part of the same solution:

**Maxar 300 series:** First developed as the company’s proliferated low Earth orbit platform, the Maxar 300 series is our smallest and most modular bus. This platform is optimized for high-rate production, rapid constellation deployment and mission-level reliability. L3Harris selected this series as the bus for the Space Development Agency’s Tranche 1 Tracking constellation.

**Maxar 500 series:** A scalable mid-size platform designed for high stability and pointing accuracy. Maxar leveraged the investments and innovations on its WorldView Legion program to make this derivative bus, shaping the Maxar 500 series to be a solution that can be tailored for multiple missions and orbits.

**Maxar 1300 series:** A familiar name for the 1300-Class platform, which is the world’s most popular spacecraft with over 90 in orbit. The Maxar 1300 series is reliable and customizable, commonly serving higher-power missions. The company continues to develop new payload and bus technologies that boost its value to current and future customers, and Maxar evolved the platform so it can be applied in more ways than geostationary satellites. For example, it serves as the baseline for the world’s most powerful deep space engine—NASA’s Gateway Power and Propulsion Element.



# NASA's Voyager Will Do More Science with New Power Strategy

The plan will keep Voyager 2's science instruments turned on a few years longer than previously anticipated, enabling yet more revelations from interstellar space.

Launched in 1977, the Voyager 2 spacecraft is more than 12 billion miles (20 billion kilometers) from Earth, using five science instruments to study interstellar space. To help keep those instruments operating despite a diminishing power supply, the aging spacecraft has begun using a small reservoir of backup power set aside as part of an onboard safety mechanism. The move will enable the mission to postpone shutting down a science instrument until 2026, rather than this year.

Voyager 2 and its twin Voyager 1 are the only spacecraft ever to operate outside the heliosphere, the protective bubble of particles and magnetic fields generated by the Sun. The probes are helping scientists answer questions about the shape of the heliosphere and its role in protecting Earth from the energetic particles and other radiation found in the interstellar environment.

"The science data that the Voyagers are

returning gets more valuable the farther away from the Sun they go, so we are definitely interested in keeping as many science instruments operating as long as possible," said Linda Spilker, Voyager's project scientist at NASA's Jet Propulsion Laboratory in Southern California, which manages the mission for NASA.

## Power to the Probes

Both Voyager probes power themselves with radioisotope thermoelectric generators (RTGs), which convert heat from decaying plutonium into electricity. The continual decay process means the generator produces slightly less power each year. So far, the declining power supply hasn't impacted the mission's science output, but to compensate for the loss, engineers have turned off heaters and other systems that are not essential to keeping the spacecraft flying.

With those options now exhausted on Voyager 2, one of the spacecraft's five science instruments was next on their list. (Voyager 1

is operating one less science instrument than its twin because an instrument failed early in the mission. As a result, the decision about whether to turn off an instrument on Voyager 1 won't come until sometime next year.)

In search of a way to avoid shutting down a Voyager 2 science instrument, the team took a closer look at a safety mechanism designed to protect the instruments in case the spacecraft's voltage – the flow of electricity – changes significantly. Because a fluctuation in voltage could damage the instruments, Voyager is equipped with a voltage regulator that triggers a backup circuit in such an event. The circuit can access a small amount of power from the RTG that's set aside for this purpose. Instead of reserving that power, the mission will now be using it to keep the science instruments operating.

Although the spacecraft's voltage will not be tightly regulated as a result, even after more than 45 years in flight, the electrical systems on both probes remain relatively stable, minimizing the need for a safety net. The engineering team is also able to monitor the voltage and respond if it fluctuates too much. If the new approach works well for Voyager 2, the team may implement it on Voyager 1 as well.

"Variable voltages pose a risk to the instruments, but we've determined that it's a small risk, and the alternative offers a big reward of being able to keep the science instruments turned on longer," said Suzanne Dodd, Voyager's project manager at JPL. "We've been monitoring the spacecraft for a few weeks, and it seems like this new approach is working."

The Voyager mission was originally scheduled to last only four years, sending both probes past Saturn and Jupiter. NASA extended the mission so that Voyager 2 could visit Neptune and Uranus; it is still the only spacecraft ever to have encountered the ice giants. In 1990, NASA extended the mission again, this time with the goal of sending the probes outside the heliosphere. Voyager 1 reached the boundary in 2012, while Voyager 2 (traveling slower and in a different direction than its twin) reached it in 2018.

## More about the Mission

A division of Caltech in Pasadena, JPL built and operates the Voyager spacecraft. The Voyager missions are a part of the NASA Heliophysics System Observatory, sponsored by the Heliophysics Division of the Science Mission Directorate in Washington.



## Viasat Announces K. Guru Gowrappan as President

Viasat Inc., a global leader in satellite communications, announced that K. Guru Gowrappan has been appointed as the new company President, effective April 13, 2023. As President, Gowrappan will work closely with Mark Dankberg, Viasat's Chairman of the Board and CEO in leading Viasat's global operations and the company's growth strategy.

Gowrappan brings over 20 years of exceptional executive leadership and technology experience in creating, operating and growing consumer internet media, transactional and subscription-based products. His diverse background across different technology sectors, coupled with a product-driven mindset, enables Gowrappan to deliver innovative customer-first experiences that create value for brands and partners. Previously, Gowrappan was CEO of Verizon Media Group, the media division of Verizon Communications, Inc., consisting of leading brands such as Yahoo, HuffPost, Tech-

Crunch and others. Earlier in his career, he held various leadership roles, including a focus on international growth initiatives at Alibaba and Zynga. He also brings a very successful track-record in value creation via large-scale M&A and integrations. He has established a reputation for data driven operational efficiency and innovative business strategies, while enabling an engaged and focused team.

"Guru is an accomplished leader with extensive international technology experience, and we are extremely pleased to welcome him to Viasat," said Mark Dankberg, Chairman and CEO of Viasat. "His experience in integrating large technology organizations, operating and growing one of the world's largest internet platforms, delivering content to hundreds of millions of users, identifying new growth opportunities and creating powerful global partnerships are especially pertinent as we scale our fixed and mobile businesses globally. Guru's strong

background in M&A, interactive digital products, sharp focus on cost effective execution, and his attention to organizational culture can help us realize the operational and financial goals enabled by the ViaSat-3 constellation and the pending Inmarsat acquisition."

"I am excited to be appointed as the new President of Viasat at such a dynamic and transformative time for our company. The satellite industry is experiencing unprecedented change in the way customers experience connectivity, interactivity and mobility. The Viasat team is the best in the business, having developed a strong foundation in serving customers and delivering products with a technology advantage. I am committed to building on this momentum with Mark while continuing to strengthen our customer-first approach. I believe the time is now for Viasat to shape the future of our industry and I am excited to be part of this incredible team," Gowrappan commented.



Spacepreneur Magazine editor Bethireddy Kartikeya in conversation with

## **DR. SRIMATHY KESAN FOUNDER & CEO AT SPACE KIDZ INDIA**

**Q** What inspired you to come up with the idea of setting up Spacekidz? What are your achievements so far from inception?

**A** In the year 2009, I helped my friend who was running a travel agency in Chennai for 2-3 hours a day. During a travel conference, I ran into my old friend Ms. Reema Sisodia, an NCC camp mate who represented RDC from the Maharashtra directorate. That

month-long camp in Delhi made us close friends. Reema, who worked as an editor in Travel Express, motivated me to become an entrepreneur and also proposed my name for an international travel conference at Florida (USA), in February 2009. That fully paid trip changed the life of me for good. "I felt great to represent India at the two day meet in the US. I enjoyed being one of the 10,000 delegates and there were 3,600 booths at the conference, "but, the booth of NASA was what captured

my eyes".

After 16 years of married life, being at home as a complete home maker, entrepreneurial bug stung me in the year 2009 and i gave birth to "Space Kidz India", but, as a "Homepreneur ", to take children from India to NASA, KSC - USA for a Scientific educational travel. There was nothing as Space education, Space travel, or anything to do with Space in India in the private sector or schools/ Universities during that period, this gap initiated/



## FOCUS ON CAREERS



instigated me to work on filling that gap. I faced a lot of challenges initially as I found it hard to convince parents to send their kids to the US. Paperwork and processing US visas for children was equally challenging. Despite the challenges, I managed to mobilize as many as 108 children from 8th to 12th standard in the 12-16 years age group. My first delegation of children for NASA left on April 27, 2010, "it's the 13th anniversary of our maiden trip and my entry to entrepreneurship." I was adorned with the Ambassador status to the top 3 research centres of the World, "NASA, ESA, and GCTC - Russia, subsequently.

I did not stop with taking children. I looked beyond the blue sky and got ambitious to launch Satellites and build Rockets. "Space Kidz India" (SKI), was officially born (registered as a partnership company in 2016 January 2016), is an Indian Aerospace Startup pioneering in the design, fabrication and launch of small satellites, spacecraft and ground systems. The goal of SKI is to provide economic and sustainable access

to space to cater to the needs of education, research and industry. With 7+ years of experience, SKI has launched 18+ BalloonSats, 3 Suborbital Payloads and 4 Orbital Satellites.

Since its inception, SKI, my brainchild, has touched millions of young minds and will continue to impact future generations in a positive manner. I have been showered with many awards, and has been frequently nominated as a "Pioneer" in the field of "Space Education" and awarded as the "Pride of India". I have also won other awards as a "Social entrepreneur" and "Woman Achiever".

SKI has received wide international attention, and found mentions in the Asia Book of Records, URF Book of Records, India Book of Records, Assist Book of Records, and Official World Record, in addition to recognition from Space Agencies, schools, colleges, universities, and political party's world over.

### opportunities you see in the space industry?

**A** Challenges are the costs involved as Space by default is an extremely expensive industry to deal with. Launching satellites, building rockets, and conducting research missions all require significant financial investments. Regulations and Policy in the space industry operates within a complex framework of national and international regulations. Navigating these legal and policy landscapes can pose challenges, especially as new technologies and commercial players emerge. Historically, space access has been limited to a few government agencies and large corporations. Expanding access to space for smaller companies and nations can be challenging due to the high costs and technological barriers involved. Licensing is yet another huge challenge Space Debris with the increasing number of satellites and space missions, the issue of space debris has become a significant concern. Managing and mitigating space debris is crucial to

**Q** What are the challenges &

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ensure the long-term sustainability of space activities.

Opportunities are Exploration and Research, Space offers immense potential for scientific discovery and exploration. Missions to other planets, studying asteroids and comets, and discovering new celestial phenomena can expand our knowledge of the universe and advance scientific understanding. The growing interest from private companies in space presents opportunities for commercialization. Companies can develop satellite-based services, space tourism, asteroid mining, and other innovative business models. Satellites provide valuable data for Earth observation, including climate monitoring, disaster management, agriculture, and urban planning. Analyzing this data can lead to advancements in various sectors and contribute to solving global challenges. Advances in space technology often have spin-off benefits for other industries. Technologies developed for space exploration, such as lightweight materials, solar panels, and

miniaturized electronics, can find applications in fields like healthcare, transportation, and energy.

It's important to note that the space industry is rapidly evolving, and new challenges and opportunities may arise as technology progresses and new players enter the sector.

### **Q** How are the various programmes currently offering by Spacekidz?

**A** Space Kidz India is focussed on:

- Designing and manufacturing of Cube SAT, Nano SAT and Micro SAT's  
\* Working on economical way to reach the Moon is the next project
- Designing and launching of Balloon SAT's
- Launchpad facility for launching balloon satellites
- SKI LABZ- It is the training wing of Space Kidz India, creating new curriculum and learning programs

for students across the globe to change the way we learn.

- Science awareness camps / Astro camps / Astrobiology camps and Rocketry

### **Q** Are you seeking any support from state or central government to reach more no of students or schools?

**A** By securing financial support from the government, organizations like ours could expand their reach, enhance the quality of space education, and provide opportunities for aspiring students to engage with and excel in the field of space science and technology. Funds could be utilized to establish or improve infrastructure and resources required for space education. This may include setting up dedicated space education centers, procuring educational materials, equipment, or developing interactive online platforms for distance learning. Additional funds could support the expansion of outreach programs that aim to reach a larger number of



students and schools. This could include organizing workshops, competitions, and educational events focused on space science and technology.

Government funding can support research and innovation projects in the space education domain. This could include grants for student-led research initiatives, encouraging innovation in space-related technologies, and fostering collaboration between academia and industry. Space is to work hands on and if government can help give free launch in the POEM (4th stage of the rocket), for hands on experience of reaching Space i think this will create "out of the box", among students and this could pave way for new start up's in the Country and enhance our economy.

**Q** Can you talk about the small satellite-launch market? How is it looking for you? Can we expect anything from Spacekidz?

**A** The small satellite-launch market has experienced significant growth and development in recent years. Small satellites, also known as CubeSats or nanosatellites, have become increasingly popular due to their compact size, lower costs, and versatile applications. This has led to a demand for dedicated launch services tailored to these smaller payloads. Several companies have emerged to address this market, offering dedicated small satellite launch services.

There is no private space organization in India which has launched as many balloonsats & satellites as we have launched. Also the first to build and launch the world's smallest satellite. Standing unique in the country with innovative space solutions and missions. Staying innovative, bringing youth together from across the globe with no boundaries and making the impossible possible is our USP I would say. Yes, Space Kidz India has entered and been working on the Small satellites since its inception. We look forward to catering to the

Industry needs and moving forward into deep space missions.

**Q** Would you elaborate on your association with schools and industry? What are the advantages of such an association?

**A** Collaborations between schools and industry allow students to access real-world applications of their learning. Industry professionals can provide insights into current practices, challenges, and emerging trends, enriching students' understanding of their subject matter. Associations with schools to incorporate practical training and skill development into their curriculum. This hands-on experience helps Students Bridge the gap between theoretical knowledge and practical application, making them more industry-ready.

Industry associations can provide Space Kidz India with access to resources, equipment, and facilities that may not be readily available otherwise. This could include access

## FOCUS ON CAREERS

industry-standard software or hardware, enabling students to gain hands-on experience and enhance their learning outcomes.

Collaborations with industry allow Spacekidz to establish connections with professionals, experts, and mentors. These connections can provide mentorship opportunities, career guidance, and potential pathways for internships or job placements for students who aspire to pursue careers in the space industry.

Associations with the industry can increase the visibility of Space Kidz India and its students within the space community. This can lead to potential career opportunities, internships, or project collaborations with industry partners, enhancing the students' prospects and opening doors for further advancement in their chosen field.

**Q** What is your message to youngsters, schools, parents who wish to choose space as their career?

**A** If you have a genuine interest and curiosity about space, pursue it wholeheartedly. The space industry offers a wide range of opportunities, from engineering and astrophysics to mission operations and satellite technology. Find your area of interest and immerse yourself in it. A solid foundation in STEM subjects (science, technology, engineering, and mathematics) is crucial for a career in space. Dedicate yourself to your studies, excel in these fields, and consider pursuing higher education in relevant disciplines to deepen your knowledge and skills.

Take advantage of internships, workshops, and programs offered by space organizations, universities, and research institutions. These



experiences will provide hands-on exposure, practical skills, and networking opportunities in the space industry.

Space is an interdisciplinary field that combines various disciplines, including physics, engineering, computer science, and more. Develop a broad skill set and be open to learning from diverse fields. This will enable you to tackle complex challenges and contribute to different aspects of space exploration and technology.

The space industry is constantly evolving, and new opportunities are emerging. Don't be afraid to dream big and set ambitious goals. Whether it's contributing to human space exploration, developing innovative satellite technologies, or studying the mysteries of the universe, your passion and dedication can make a difference.

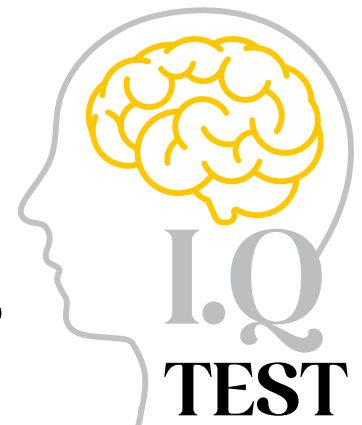
Remember, a career in space offers not only the chance to contribute to scientific and technological advancements but also the opportunity to explore the unknown and inspire future generations. Embrace the wonder of space, pursue your dreams, and be part of shaping the future of space exploration and discovery.

**Q** What is your ultimate goal in next 5-10 years?

**A** My ultimate goal is to lay the foundation for a World renowned Space University with a manufacturing port in India apart from building a "Space research park" (very near future) that can kindle the interest of every child who wishes to pursue Space. In simple terms "a miniature version of NASA". This would mean economically experiencing the simulations, zero gravity and the cutting edge technologies available in the current which will instigate a child/ researcher to think beyond rather than travelling to NASA, ESA or GCTC - which though I am the Only Indian Ambassador, wish to keep everything within India and attract students/ researchers from Countries around us. This is a huge business model for our Country apart from what it looks as a simple Space Education providing space.

With regards to hard core technology, we are coming up with a brand called "Space Rickshaw", that would provide economical solutions to go to the Moon and of course other planets. Hence, going to the Moon and Interplanetary missions are our cup of tea

# Contribution of Indian Astronomers to Astronomy



This Quiz is designed to explore the knowledge of Space Sciences, in this opening Quiz, the questions are dedicated to Indian Astronomers and their contribution to Astronomy.

**1 Arya Bhatta Belong to**

- A. Maurya Dynasty
- B. Gupta Dynasty
- C. Chalukya Dynasty
- D. Sathavahana Dynasty

**2 Arya Bhatta Belong to**

- A. 2 nd Century
- B. 5 th Century
- C. 8th Century
- D. 10 th Century

**3 Arya Bhatta is**

- A. Mathematician & Astronomer
- B. Astronomer & Physicist
- C. Astrologer & Chemist
- D. Economist & Politician

**4 Arya Bhatta Proposed and defined.**

- A. Geocentric Theory
- B. Pericentric Theory
- C. Heliocentric Theory
- D. Cosmo centric theory

**5 Name the first satellite launched by Indian Space Research Organisation ISRO on 19 th April 1975.**

- A. Rohini
- B. Bhaskara-1
- C. Arya Bhatta
- D. Chandrayan

**6 Brahma Gupta belongs to which century.**

- A. 3 rd Century
- B. 5 th Century
- C. 7 th Century
- D. 9 th Century

**7 Bhaskara Guptas calculation on the length of sidereal year is published in**

- A. Surya Siddhanta
- B. Navagraha Siddhant
- C. Chandra Siddhant
- D. Bhu Siddhant

**8 Who was the Sanchalak of the Astronomical Observatory built in Ujjain?**

- A. Arya Bhatta
- B. Bhana Bhatta
- C. Bhaskaracharya/ Bhaskara I
- D. Varahamihira

**9 What is the value of Pi derived by Aryabhata.**

- A. 3.14159
- B. 3.1564
- C. 3.14
- D. 3.1312

**10 Distance between Earth & Moon calculated by Yajnavalkya is**

- A. 238,855 miles
- B. 238,854 miles
- C. 238,857 miles (by LiDAR)
- D. 238,855 miles

Questions prepared by  
**Dr. A.V. Subba Rao**

We request readers to email the answers to [spacepreneurmag@gmail.com](mailto:spacepreneurmag@gmail.com) along with postal Address and Mobile No. Winners will get surprise gift ₹ from Spacepreneur Magazine to your Postal Address.

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## Satellite Facilities

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## Launch Vehicles Facilities

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