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IndSpace War Game 2024:

Conference Report

Assessing India's Space and Defence Preparedness

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Indian armed forces have earmarked funds to the tune of Rs 25,000 crore to meet its defence space requirements, highlighting the significant investment in this sector, and presenting a significant opportunity for the private sector to leverage.

Gen Anil Chauhan, Chief of Defence Staff;
Ministry of Defence, Govt of India

Disclamier

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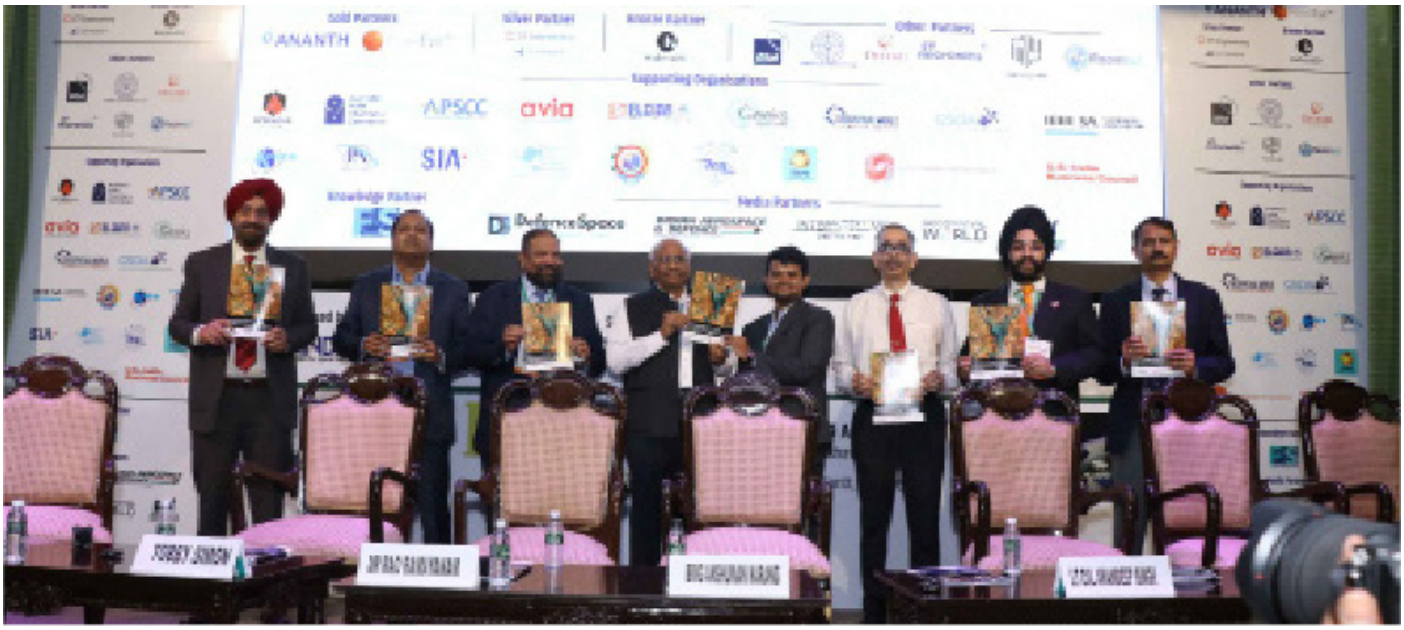


Executive summary

The IndSpace Wargame, pioneered by SIA India, represents a first-of-its-kind groundbreaking initiative in India's space industry landscape. It epitomizes an innovative approach towards assessing the industry's readiness through interactive tabletop exercises, employing simulated scenarios to evaluate critical aspects such as resource allocation, logistics management, action sequencing, and phase durations. This innovative methodology sets a precedent in the industry's landscape, emphasizing the importance of proactive assessment and strategic planning to bolster India's capabilities in the space defence domain.

The IndSpace exercise was part of the DEFSAT 2024 Conference, the second edition organized by SIA-India and convened on 7-9 February 2024, which culminated successfully, marking a significant milestone in the realms of defence and space. Attendees explored innovative strategies and solutions to enhance India's space ecosystem, ensuring both civil and military necessities are met while fostering a self-sufficient Bharat. The success of the DEFSAT Conference underscores the power of collective effort in safeguarding our shared interests and shaping a more secure future.
The three-day event featured a lineup of notable speakers and dignitaries, including Lt. Gen Gurmit Singh, PVSM, UYSM, AVSM, VSM (Retd), Hon. Governor of Uttarakhand, Gen Anil Chauhan, Chief of Defence Staff; Ministry of Defence, His Excellency, Mr. Philip Green, Australia's High Commissioner to India, Padmashree Dr. Shailesh Nayak, Director NIAS, Former Secretary Ministry of Earth Sciences, Dr Samir V Kamat, Secretary DDR&D and Chairman DRDO, and Dr. Subba Rao Pavuluri, President SIA-India, among others.

The industrial wargame, held on day 2 of the DEFSAT Conference, brought Defence & Military, Industry, Academia, and other stakeholders close to understanding each other's needs for forging better synergy through the eight scenarios played during the war game. Different teams belonging to Defence, Industry, Academia, Lawyers, and regulators responded to these scenarios from their perspective, providing innovative solutions to ensure future warfare preparedness.
This report is a result of the invaluable insights drawn from the extensive deliberation during the IndSpace wargame 2024 and the crucial recommendations that could contribute to navigating the complexities of modern defence and satellites. Additionally, curating this report at the behest of the esteemed Chief of Defence Staff (CDS) is a privilege for SIA-India.

INTRODUCTION

The IndSpace exercise serves as a crucial platform for testing contingencies and crises, bolstering India's national interests in space. By uniting defence experts and industry leaders, the wargame aims to identify advanced solutions and innovative technologies essential for safeguarding India's space endeavours.

Following the tremendous success of the industrial space wargame 2023, the event attracted a diverse array of participants from various fields, including Defence Services, Ministry of Defence, ISRO, DRDO, INSPACe, NSIL, NDMA, Niti Aayog, industry, startups, innovators, investors and the academia.

Curated and Conducted by Lieutenant General PJS Pannu, PVSM, AVSM, VSM (Retd), Chairman Space Committee on Defence, SIA-India, and chaired by Lieutenant General Vinod G. Khandare, PVSM, AVSM, SM (Retd), Principal Advisor to Ministry of Defence, the 2024 exercise brought together stakeholders from defence, government, industry, and think tanks, showcasing the nation's potential and collective commitment towards enhancing India's space security and defence positioning. Featuring a distinguished panel of experts including Vice Admiral Pradeep Chauhan, AVSM, VSM (Retd), Director General, NMF, Air Marshal Anil Chopra, PVSM, AVSM, VM, VSM (Retd), DG CAPS, Lieutenant General Dushyant Singh, PVSM, AVSM, Director General CLAWS, and Air Vice Marshal Sanjay Bhatnagar, VM, VSM (Retd), Officiating Director, CENJOWS, the wargame exemplifies a concerted effort towards shaping the future of India's space industry. As it progresses, INDSPACE reaffirms its commitment to advancing India's space capabilities while safeguarding its national security interests.

To accommodate increased interest and feedback, the exercise transitioned from a closed-door setting to an inclusive platform for all stakeholders. General Anil Chauhan, Chief of Defence Staff, emphasized the significance of generating a Comprehensive Report on IndSpace discussions during his address at DefSat, highlighting its pivotal role in shaping strategic decisions.

Scenario 1 - Detecting and Monitoring 'Dark Ships' in the Indian Ocean Abstract:

The first scenario discussed the concerns regarding unidentified ships, termed "dark ships," potentially present in the Indian Ocean or Indo-Pacific region. These vessels pose a significant threat due to their unknown intentions and potential involvement in adversarial activities. Current surveillance capabilities are insufficient to effectively detect and monitor these dark ships, leading to vulnerabilities in maritime security.

To tackle this challenge, a comprehensive strategy is proposed, necessitating collaboration among diverse stakeholders. The de-fence sector aims to bolster space-based ISR capabilities for robust military-grade Synthetic Aperture Radar (SAR) and Automatic Identification System (AIS) intelligence and analysis, ensuring extensive coverage across the Indian Ocean Region (IOR). The IOR's demands of dynamic maritime surveillance, resilient to all weather conditions and with real-time data fusion of high precision, are underscored. Addressing current deficiencies, the development of geostationary satellites with electro-optical resolution of 10-13 meters was considered to be adequate. The industry, suggested utilizing drones and advanced electro-optical satellites for surveillance. Additionally, academia and R&D innovators, proposed deploying high-resolution geostationary satellites and fostering partnerships to advance research toward Very Low Earth Orbit (VLEO). Regulators, policymakers, and other relevant agencies, stress the pivotal role of government support and procurement in driving innovation in satellite technology.

Scenario 1 establishes need for Identifying and monitoring undisclosed "dark ships" in the Indian Ocean or Indo-Pacific region, potentially belonging to a dominant force, poses significant challenges for naval security planners. Detection and identification of "dark ships," including submarines, with unknown intentions and capabilities, leveraging space Intelligence, Surveillance, and Reconnaissance (ISR) capabilities to enhance maritime security. Also, understand the adversary's use of space assets for sea domination and countering these strategies effectively.

Military Space Community	• Prioritising Development of wide-area ocean reconnaissance satellites capable of picking up all RF bands for detecting ships. • Collaborate with industry partners to develop and acquire advanced satellite technologies tailored to address the challenges posed by potential adversaries in the maritime domain focusing geostationary satellites for initial scanning, followed by lower Earth orbit satellites for detailed surveillance. • Emphasis on improving real time fusion and analysis of data by using Low Earth Orbit (LEO) satellites for object identification, mapping objects, and scaling resolution for observing objects from Geostationary Orbit (GSO). • Advocated the importance of having Very Low Earth Orbit (VLEO) with sub-metric resolution for meaningful object identification, noting its crucial role in surveillance. • Need for Investment in Using geostationary satellites with electro-optical resolution of at least 10-13 meters, and low Earth orbit satellites for detailed surveillance, similar to the Chinese Yaogan-36 series. Coupled with increased precision in all-weather imaging.
Industry	• Offered solutions with electro-optical satellites providing 24-hour coverage and two-hour revisit time for de tecting ships in the Indian Ocean, ensuring better dynamic coverage of maritime tracks. • Emphasized the need for large and small satellites with high resolution, which can be built in India, where India currently can fare well, with Ministry of Defence orders.
Regulators, Lawyers, Policy makers, Government of India agencies	• Establish regulatory frameworks governing satellite surveillance activities to ensure compliance with international laws and regulations. • Formulate policies that promote the responsible use of satellite communication and surveillance technologies while safeguarding privacy and security concerns.
Academia, R&D and Innovators	• Consider leveraging capabilities such as the MQ 9 Predator drone capabilities and high-altitude pseudo satellites to augment existing ISR capabilities. • Consider High Altitude Satellites (HAPS) as a bridging strategy for quick deployment but focus on long-term requirements. • Engage in interdisciplinary studies to address challenges in satellite-based surveillance and reconnaissance. • Advocate for government funding and support for research and development initiatives in satellite technology.

Scenario 2: Urgent Need for ISR Resource Allocation in Emergency

Abstract:

The second scenario cantered around ongoing conflict in the Indian Ocean Region, prompting an urgent 30% surge in Intelligence, Surveillance, and Reconnaissance (ISR) resource allocation within a week. In this scenario, adversaries have consolidated their resources, and India's allied nations face hurdles in sharing their ISR capabilities. Moreover, there's a pressing need for pre-emptive measures and protocols adaptable to emergencies, advocating for a nationwide strategy.

Addressing this challenge, the defence sector, underscores the significance of adopting a forward-looking approach in sensor deployment, considering long-term perspectives and scalability. The industry, explores the notion of integrating Launch-on-Demand (LoD) services to complement sensor placement. It highlights its capacity to produce sensor swarms while stressing the necessity for enhanced funding to expedite delivery and optimization through robotic manufacturing facilities. Additionally, academia and R&D innovators, propose investment in innovative concepts like geostationary balloons and rapid deployment technologies. Regulators, policymakers, and relevant agencies, represented by the White team, express endorsement for improved human capital management practices.

Scenario 2 involves the urgent need to allocate ISR resources by 30% within a week for the Indian Ocean Region (IOR) due to ongoing war. Approximately 200 targets need tracking, including vessels at sea or in transit. The international community's willingness to assist needs determination, as existing resources in the South China Sea and at sea are already targeted.

Military Space Community	• Formulation of long-term perspectives while deploying sensors should strongly consider their configuration and scenarios during decision-making, to ensure increased sensor density. • Highlighted the need for Utilizing existing civilian and commercial resources for satellite deployment. • Develop policies to maintain necessary stockpiles and anticipate adversary actions, including satellite deployments, to inform strategic decisions effectively. Promote a national approach and strategy for wartime goals. • Need skilled manpower pool. Address human resource policies and alumni tracking to enhance human capital in the defense sector, opening up industry routes for skill development.
Space Industry	• Manage launch on demand aspects alongside deploying sensors to avoid gaps in coverage. • Accelerate production through optimization, robotic factories, and swarm or formation flights by Incorporating capital infusion for optimization enhancements. • Optimize technology for efficient production and consider transformation and formations for three-dimensional observation in LEO.
Regulators, Lawyers, Policy makers, Government of India agencies	• Explore the role of Department of Defense production in addressing resource shortages, focusing on overcoming challenges faced by defence space missions. • Consider High Altitude Pseudo-Satellites (HAPS) for quick launch and positioning capabilities. • Translate discussed ideas into actionable strategies, focusing on addressing attrition of assets and building strategic partnerships at both government and industry levels. • Highlight the innovative potential of Configurable CubeSat and geostationary balloons to enhance ISR capabilities swiftly and effectively. The geostationary balloon satellites, operate at 20 to 25 kilometres altitude. These platforms cover 500,000 square kilometres and can be repositioned within hours.
Academia, R&D and Innovators	• Invest in the Integration of previously sourced data, AI data, and other sources into downstream software to track changes over time for understanding trends. • Highlight the full range of capabilities, not just downstream functions, to ensure efficient tracking and sensor deployment.

Scenario 3: Strategies for Battlefield Transparency

Abstract:

The third scenario in the exercise revolves around a military movement scenario, the headquarters must pin strategic moments for its operations by uncovering "dark zones" — specific areas when enemy surveillance is absent. Achieving this will require assessing the necessary resources and capabilities to detect these dark zones.

To tackle this challenge, the defence sector stressed on the importance of adapting warfare strategies based on timely and accurate identification of dark zones. The industry stressed upon Integrating cyber and laser capabilities for effective enemy degradation. Furthermore, academia and R&D innovators highlighted Considering a ubiquitous surveillance scenario for battlefield transparency. While the Regulators, policymakers, and other agencies contributed through their insights on producing greater momentum and strategic understanding that can be used at higher levels before conflicts begin.

Scenario 3 establishes the needs to identify opportunity slots for its activities by identifying dark zones, which are areas and timings where the adversary is not monitoring or observing our activities. This requires determining the resources and capabilities needed to identify t these dark zones and exploring R&D and industry assistance.

Military Space Community	• Focus on strategic deception tactics over bolstering ISR resources for an edge on the open battlefield. • Build and enhance hyperspectral data capabilities to effectively counter adversaries' advanced technology in this domain. • Explore the retention of outdated weaponry for decoy use, enhancing strategic deception efforts to pinpoint obscured areas. • Emphasize the importance of space domain awareness and forging strategic alliances to ensure precise and timely intelligence
Space Industry	• Incorporate cyber and laser capabilities into military strategies. • Strengthen cybersecurity measures within the defence industry to effectively mitigate cyber threats, ensuring readiness in modern warfare scenarios. • Develop countermeasures against spoofing using AI and collaborate with defence for vertical activities.
Regulators, Lawyers, Policy makers, Government of India agencies	• Focus on resources and site identity, considering the adversary's surge to cover dark spots. • Generate more impetus and strategic insights that can be utilized at the strategic level before conflicts arise. • Emphasised the potential role of ASAT capabilities in ensuring peace and serving as a deterrent.
Academia, R&D and Innovators	• Consider a ubiquitous surveillance scenario for battlefield transparency. • Collaborate with international partners to improve space domain awareness, identifying blind spots and dark zones. • Supported the Industry's perspective on launch-on-demand capabilities, especially in the space and air domains. • Reevaluate existing processes to adapt to evolving technological landscapes, focusing on innovation in defense logistics and capability development.

Scenario4: Countering A2AD Strategies and Hypersonic Threats

The fourth scenario in the exercise revolved around how effectively we can address the Anti-Access/Area Denial (A2AD) strategies and cater for threats from newer technologies such as hypersonic weapons. Measures need to include the reliability of our Ballistic Missile Defence (BMD) system. Furthermore, it is important to define the role that the space domain must play in neutralising a target.

Abstract:

The fourth scenario in the exercise revolved around how effectively we can address the Anti-Access/Area Denial (A2AD) strategies and cater for threats from newer technologies such as hypersonic weapons. Measures need to include the reliability of our Ballistic Missile De-fence (BMD) system. Furthermore, it is important to define the role that the space domain must play in neutralising a target.
In response to this challenge, the defence sector emphasised the need for Plume detection of missile launch despite the manoeuvrability of the hypersonic weapons. Also, they underscored the importance of developing indigenous capabilities in this area to bolster national defence capabilities. The industry began upon a poignant realization regarding the existing technology's potential juxtaposed against the lack of a supportive ecosystem for its implementation. Highlighting that beyond ISRO, there's a dearth of infrastructure capable of calibration, testing, and technology development pertinent to specific satellite payloads like MW (Microwave) and LWI (Long Wave Infrared). Furthermore, academia and R&D innovators highlighted concerns raised about overreliance on satellite hiring and the potential vulnerabilities associated with external dependencies, such as GPS disruptions. While the Regulators, policymakers, and other agencies extended insights on regional security implications, with a focus on the Maldives conflict as a potential threat to second-strike capabilities. Participants underscored the importance of safeguarding strategic interests in the region and maintaining vigilance against potential threats emanating from neighbouring countries.

Scenario 4 addresses challenges from Anti-Access/Area Denial (A2AD) strategies and hypersonic weapons, stressing the critical need for a reliable Ballistic Missile Defence (BMD) system. It emphasizes the urgency of developing robust response mechanisms to counter these evolving threats.

Military Space Community	• Develop ISR capabilities for early warning on Medium-Range Ballistic Missile (MSL) threats. • Focus on tracking and neutralizing hypersonic threats and MSLs, particularly targets in space. • Collaborate with industry to advance technology and standards in R&D for countering these threats effectively. •
Space Industry	• Emphasize drone detection technologies for different phases of drone operation.• Advocate for collaboration between industry and user groups to identify feasible drone detection technologies. • Drones could be used for close reconnaissance and target designation for precision strikes
Regulators, Lawyers, Policy makers, Government of India agencies	• Mitigate satellite data costs by using high-end drones for boot space detection and detecting disturbances in GPS signals. • Explore novel solutions to reduce costs and improve missile classification based on characteristics. • Stress the importance of international cooperation in space activities, particularly in census cooperation, to prevent over-dependence on specific countries. • Highlight the Maldives conflict as a reminder of the importance of monitoring regional developments for national security planning.
Academia, R&D and Innovators	• Address infrastructure in dual use and calibration challenges to support sensor technology for climate change. • Plan and invest in infrastructure to enable better utilization of sensor technology.

Scenario 5: Mitigate disruptions in satellite communications and space-based capabilities

Abstract:

The fifth scenario revolved around the adversary's intensive use of satellite resources to monitor and disrupt communications and surveillance capabilities. The scenario also expresses apprehension about overreliance on systems during peacetime, which could leave them vulnerable to disruption during conflicts, highlighting the need to identify countermeasures and technologies to address disruptions in satellite communications and space-based capabilities.

In response to this challenge, the defence sector stresses the importance of ground-based solutions, such as electronic jamming and cyber weapons, as cost-effective alternatives to traditional satellite-based defences. The industry focuses on developing cost-effective deception systems, such as inflatable systems, to confuse adversaries. Furthermore, academia and R&D innovators highlight the importance of data sharing for the development of AI-driven solutions for space defence. They emphasize the need for services to collaborate and share data with industry partners to enable the development of effective AI algorithms. Meanwhile, the Regulators, policymakers, and other agencies acknowledge the wealth of robotics expertise within the diaspora that could be leveraged for de-fence purposes.

Scenario 5 addresses the challenge of an adversary deploying intensive satellite resources to monitor and disrupt communications and activities, requiring effective countermeasures to mitigate disruptions caused by the adversary's satellite resources.

Military Space Community	• Emphasise Space Situational Awareness (SSA) for effective monitoring and understanding of the space environment. • Advocate for analytical solutions and precise intelligence from SSA for improved capabilities. • Highlight the role of AI in extracting intelligence from SSA data, especially for detecting compromisers and monitoring disturbances in the ionospheric layer. • Address technology policy limitations in India regarding SSA to facilitate the development of required technologies. • Integrate technology with SSA to provide timely and accurate intelligence to operators for effective response to space threats. • Emphasize on Ground weapons exhibiting high attributability, complemented by low-cost electronic jamming and cyber weapons suitable for deployment on ground and orbital platforms
Space Industry	• Propose a network of sensors on GRASS Network, ground, RF, air, and sea to create a comprehensive sensor backbone for consolidating information and providing it to users. • Incorporate "security by design" principles in satellite system design for cybersecurity and countermeasures against cyberattacks. (SIA MoU with ISAC based on this input) • Emphasise indigenous design for cyber-secure satellites, with collaboration where necessary, and ensure cybersecurity is integrated into the overall ecosystem. • Develop cost-effective deception systems, such as inflatable systems, to confuse adversaries.
Regulators, Lawyers, Policy makers, Government of India agencies	• Discover and utilize cyber warriors outside the traditional defence establishment for cybersecurity. • Consider directed energy offense as a more viable option than Anti-Satellite (ASAT) technology, focusing on moving forward with directed energy solutions. • Advocate for data sharing for AI development and collaboration between services and industries. • Retain fighting capabilities in space under degraded conditions, emphasizing robotics and engaging with experts in the field.
Academia, R&D and Innovators	• Invest in ground-based Directed Energy Weapons (DEW) as a response to satellite threats, ensuring technical feasibility and industry support. • Address challenges with DEW being a fixed target by exploring mobility options to avoid being easily targeted. • Collaborate with industry to propose solutions for improving the accuracy and effectiveness of DEW.
More remarks / Clarifications	• Shift mindset to consider all citizens as potential contributors to national security, not just those in uniform or funded by defence budgets. • Highlight ongoing work in directed energy offense and the importance of finding solutions in this area. • Advocate for practical approaches to engaging with the Indian diaspora, particularly in robotics, and overcoming barriers such as citizenship restrictions.

Scenario 6: Navigating Communication Disruptions in Satellite Operations

Abstract:

The sixth scenario was played as communication disruption being experienced along with heavy sound in voice circuits, latency in ISR imagery, and pixilation in areas of satellite imagery, presenting challenges that require prompt resolution. What can be the effective countermeasures, restoration practices, and the potential role of Launch on Demand solutions.

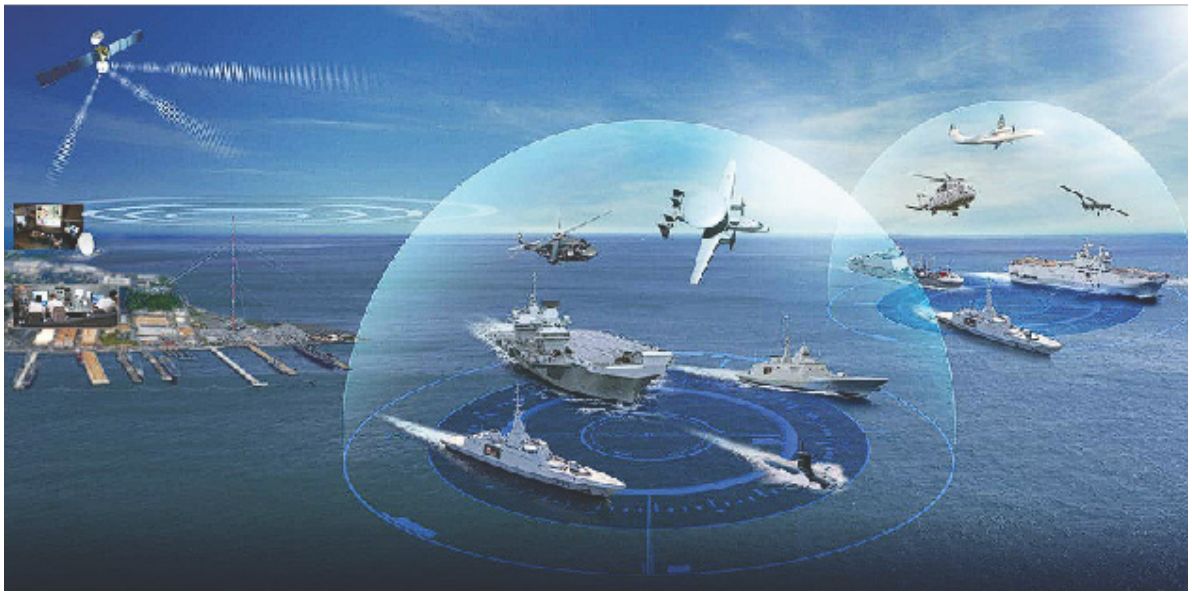
In response to this challenge, the defence sector (Orange team), underscored the necessity of giving emphasis to degrade paths alongside redundancy paths to ensure operational effectiveness in the face of technological disruptions. The industry (Green team), addressed communication disruptions, including the integration of frequency hopping, encryption techniques, spoofing prevention, and the development of proprietary waveforms. These measures aim to enhance communication resilience and security in the face of potential disruptions or hacking attempts. Furthermore, academia and R&D innovators (Silver team), highlighted utilizing High Altitude Pseudo-Satellites (HAPS) as a degrade strategy, highlighting the crucial role of orchestration in managing complex systems effectively. While the Regulators, policymakers, and other agencies (White team), acknowledged that achieving effective orchestration requires a deeper understanding and consensus on operational structures and strategies, which is still evolving in the current conceptual debate

Scenario 6 involves reported communication disruptions, heavy sound in voice circuits, sluggish ISR imagery, and pixilation in areas of satellite imagery, presenting challenges that require prompt resolution.

Military Space Community	• Implement explicit recording of factors causing degradation for graceful degradation of satellite imagery, including detailed fault reporting mechanisms. • Invest in upfront design time to incorporate fault reporting and restoration practices into systems for effective real-time issue addressing. • Develop and maintain planned degrade paths in ISR systems to ensure graceful degradation under various conditions. • Ensure a balance between reliability and redundancy, supplementing redundancy with a planned degrade path for continued effective system operation.
Space Industry	• Integrate frequency hopping into communication solutions to prevent disruptions by rapidly switching frequencies. • Emphasize the use of encryption techniques to secure communication channels and prevent unauthorized access. • Incorporate encryption techniques into all communication solutions to enhance security and prevent unauthorized access. • Develop waveforms for communication systems to enhance security and prevent hacking, ensuring a good Data Path (DP) link margin in all communication systems
Regulators, Lawyers, Policy makers, Government of India agencies	• Address the lack of fundamental awareness among military and industry personnel regarding different types of satellites to prevent misunderstandings and complications in satellite operations. • Consider using HAPS as a bridging strategy to overcome challenges, but be cautious of employing them as a degrade strategy in certain scenarios. • Emphasize the orchestration of various strategies and technologies in satellite operations to achieve success, likening it to creating a symphony. • Revisit basic concepts and strategies in satellite operations to progress and address conceptual debates within the industry and military.
Academia, R&D and Innovators	• Scale down capabilities to essential tools for futuristic war fighters, emphasizing distributed capabilities for effective military operations. • Orchestrate multiple sensors and vast amounts of data to enhance capabilities while balancing vulnerability. • Maintain a balance between high-tech and low-tech solutions, similar to the Swiss Armed Forces, for effective military operations. • Express concern about the use of anti-satellite rockets, highlighting potential negative consequences for international relations.
More remarks / Clarifications	**• Emphasize clarity in war-waging methodology for effective in, focusing on power war and clear direction. • Reduce friction and bureaucratic delays, especially due to varied level of technical proficiency, through clear problem statement shaping. • Ensure detailed Request for Proposal (RFP) shaping for clarity and effectiveness in addressing various measures. • Consider critical infrastructure security as a key consideration in planning and decision-making.**

Scenario 7: Establishing Network-Centric Warfare with C5 I2 Star2

Abstract:



The seventh sceanario in the exercise revolves around activating C5 I2 Star2, a system comprising autonomous non-terrestrial control systems networked together and establishing NWC (Network-centric Warfare) and SYS of SYS (System of Systems). The task was to configure a space-based network, determine target acquisition needs, oversee sensor-seekers, reconcile differences between naval and ground operational requirements, and integrate various MESH (GEO, MEO, LEO, VLEO) systems.

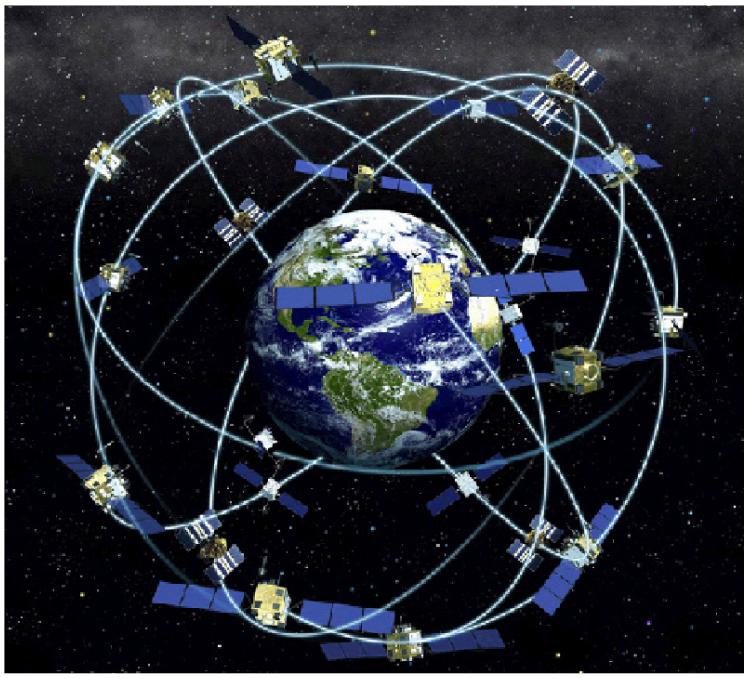
In response to this challenge, the defence sector, NGF under NTRO must for data fusion at the national level, aims for a format usable by all service branches and addresses challenges in transferring the fusion solution to field formation. The industry, proposed Standardised sensor data from different sources into a unified platform with a basic metadata management system for future satellite constellations, simplifying data integration. Furthermore, academia and R&D innovators, highlighted integrated data retrieval approaches. While the Regulators, policymakers, and other agencies underscored multi-agency intergovernmental efforts for effective disaster management at the national level.

Scenario 7 involved the activation of C5 I2 Star2, which includes autonomous systems with non-terrestrial control as a network, and the creation of NWC and SYS of SYS. The scenario requires configuring a space network, identifying target acquisition requirements, managing sensor-seekers, addressing differences between naval and ground needs, and integrating MESH (GEO, MEO, LEO, VLEO) systems.

Military Space Community	• Understand and cater to the different resolution requirements of Army, Naval, and Air force targets, with a focus on vessel size for naval targets and close proximity army targets. • Deploy satellite constellations for Army and Air Force targets, ensuring agility and adaptability to changing technology with shorter lifespans and different orbits for diverse geographical areas. • NGF under NTRO data fusion at the national level, aiming for a format usable by all service branches and addressing challenges in transferring the fusion solution to field formations.
Space Industry	• Standardize sensor data from different sources into a unified platform with a basic metadata management system for future satellite constellations, simplifying data integration. • Transition to a hybrid cloud architecture for better security and national coordination, with a phased approach starting with a hybrid system for a smooth transition. • Consider a hybrid cloud architecture for transitioning to a more secure cloud system, emphasizing national coordination.
Regulators, Lawyers, Policy makers, Government of India agencies	• Coordinate multi-agency intergovernmental efforts for effective disaster management at the national level. • Address resolution and sensor-seeker management differences between the Navy and other branches, focusing on closer civil applications for the Navy and compatibility between aerial and satellite data.
Academia, R&D and Innovators	• Implement integrated data retrieval approaches involving semantic tagging and GIS-oriented methods for clarity in data fusion outputs and ease of use for human operators.

Scenario 8: Meeting Military Branches' Satellite Constellation Needs

Abstract:



The eighth scenario dealt with disaster warnings and mitigation and the need for a nuanced understanding of satellite constellation requirements across different branches of the military. While naval operations demand resolution over vast expanses, army and air force operations necessitate constellations due to the proximity of targets. The scenario highlighted the importance of tailored solutions to meet the diverse needs of each branch, considering factors such as resolution, coverage area, and satellite orbit.
In response to this challenge, the defence sector (Orange team), highlighted need for edge analytics and onboard computation to process near-real-time imagery for disaster response. The industry (Green team), voiced concerns regarding the asymmetry between defence requirements and industry capabilities, called for greater collaboration between the defence sector and innovative start-ups, citing successful models of venture capital-backed initiatives in the United States. Furthermore, academia and R&D innovators (Silver team), highlighted need for standardization of formats, particularly in the context of warning systems for natural disasters such as earthquakes and volcanic eruptions. Additionally, suggested that satellite resources, particularly those equipped with interferometric capabilities like NISAR, could play a crucial role in providing timely and accurate weather warnings. While the Regulators, policymakers, and other agencies (White team), the need for a proactive approach in fostering innovation and technology development within the Indian defence ecosystem.

Scenario 8 involves regular monitoring of weather warnings, earthquake detection, and cyclone monitoring. It also considers the concept of using weather manipulation as a weapon, necessitating a robust monitoring mechanism and effective disaster response planning.

Military Space Community	• Utilize edge analytics for processing near-real-time imagery from ISR constellations to provide critical information for disaster response, such as earthquake or cyclone monitoring, without requiring high granularity. • Consider onboard computations on satellites for quick and cost-effective extraction of insights, crucial for disaster response planning. • Explore the dual-use capabilities of space assets deployed for disaster management to enhance both civilian and military disaster response capabilities.
Space Industry	• Use satellite data for disaster management, as demonstrated in studies for identifying areas prone to flooding, earthquakes, and landslides, aiming to prevent recurring expenditures by identifying high-risk areas before construction. • Encourage private sector involvement in similar exercises for other regions to benefit disaster response efforts. • Share study results with services and organizations like the National Disaster Management Authority (NDMA) for effective use of the information.
Regulators, Lawyers, Policy makers, Government of India agencies	• Focus on effective warning solutions for weather and earthquake events, utilizing resources like the NISAR satellite for weather warnings, especially for earthquakes and volcanic eruptions, using interferometric.
Academia, R&D and Innovators	• Conduct simulation exercises to understand the impact of dam construction and other projects on the environment, emphasizing the need for vigilance and proactive measures in studying climate and weather patterns. • Recognize space assets as valuable tools for studying space weather and other weather phenomena to enhance disaster response planning.

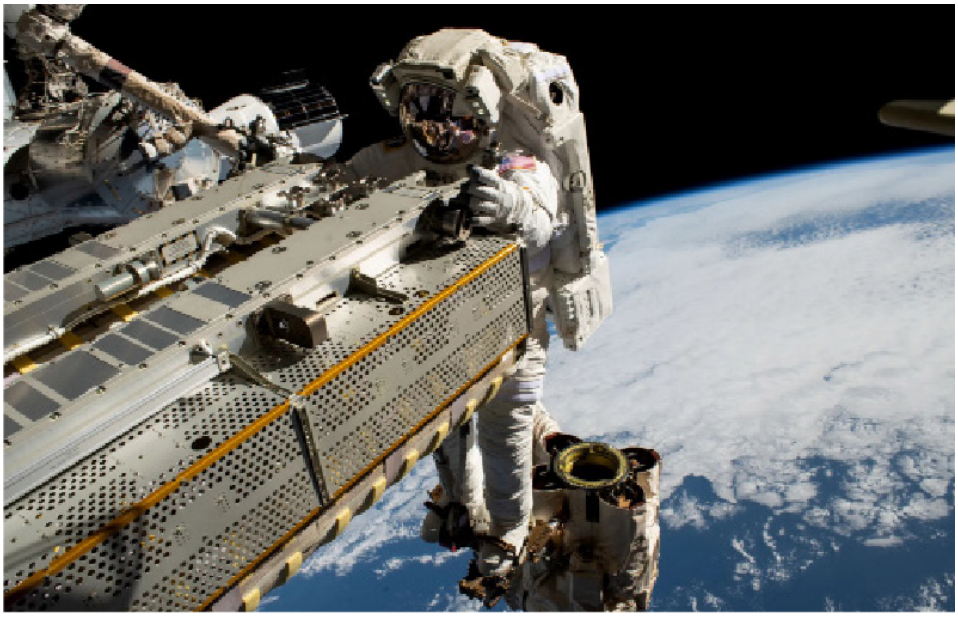
Consolidated Recommendations

- Consider High Altitude Satellites (HAPS) as a bridging strategy for quick deployment but focus on long-term requirements
- Establish a robust data library for storing and analysing hyperspectral data, facilitating ongoing intelligence efforts.
- Establish wartime reserve at state and national levels, with trained individuals, including ex-servicemen, at state and national levels like Territorial Army.
- Consider long-term perspectives when deploying sensors, making decisions now on configuration and scenarios for increased sensor density.
- Ensure a balance between reliability and redundancy, supplementing redundancy with a planned degrade path for continued effective system operation
- Establish launch-on-demand capabilities for both sea and land-based operations, ensuring flexibility and agility in executing missions.
- Emphasize clarity in war waging methodology for effective fighting, focusing on power war and clear direction.
- Invest in plume detection infrastructure to enhance space situational awareness and mitigate risks associated with space debris and rocket launches.

Industry

- Invest in Advance incubation of satellite-based sensor technology.
- Emphasis on the Development of wide-area ocean reconnaissance satellite's capability to pick up all RF bands for detecting dark ships.
- Develop the ability to launch satellites within compressed time frames to facilitate rapid deployment and response.
- Invest in the development of dark zone identification capabilities, allowing for strategic positioning of activities beyond enemy surveillance.
- Invest in upfront design time to incorporate fault reporting and restoration practices into systems for effective real-time issue addressing.
- Foster efforts toward cyber resilient infrastructure
- Prepare for a surge in satellite demand by strategically investing in booking satellite slots at all times, ensuring India's access to essential space assets for various missions and applications.
- Foster partnerships between academia and industry to drive innovation and technology transfer.
- Utilize existing civilian and commercial resources for satellite deployment

Academia and Innovators



•Establish a Space Force with a clear charter outlining its objectives and responsibilities, paving the way for the creation of a dedicated organization focused on space defense and security. 16
• Address inffavstructure and calibration challenges to support sensor technology for climate change.
• Plan and invest in infrastructure to enable better utilization of sensor technology backed by research.
• Integrate previously sourced data, AI data, and other sources into downstream
• software to track changes over time for understanding trends.
• Promote interdisciplinary collaboration in space research to address complex security challenges
• Support the development of educational programs to cultivate talent and expertise in space-related fields.
•Incorporate "security by design" principles in satellite system design for cybersecurity and countermeasures against cyberat-tacks.
•Use satellite data for disaster management, as demonstrated in studies for identifying areas prone to flooding, earthquakes, and landslides, aiming to prevent recurring expenditures by identifying high-risk areas before construction.
• Encourage private sector involvement in similar exercises for other regions to benefit disaster response efforts.
•Share study results with services and organizations like the National Disaster Management Authority (NDMA) for effective use of the information.

Policymakers and Regulators

- Discover and utilize cyber warriors outside the traditional defense establishment for cybersecurity.
- Develop and maintain planned degrade paths in ISR systems to ensure graceful degradation under various conditions.
- Develop a comprehensive roadmap for defence space readiness, fostering collaboration among government, research institutions, industry, and military stakeholders
- Acquire hyperspectral data and strategic planning data capabilities to create a comprehensive inventory of enemy assets, enabling informed decisions.
- Utilise existing civilian and commercial resources for satellite deployment.
- Explore the role of Department of Defense production in addressing resource shortages, focusing on overcoming challenges faced by defense space missions.
- Establish clear military-grade standards for space operations to maintain security and reliability.
- Prioritise budget allocation for space ISR capabilities to ensure effective threat detection and analysis.
- Foster closer collaboration between military and civilian sectors to enhance overall defence capabilities.
- Formulate robust policies, doctrines, and strategies to safeguard India's space interests, emphasizing transparency, cooperation, and adherence to international norms.
- Prioritise the deployment of Anti-Satellite (ASAT) capabilities for both offensive and defensive purposes, essential for winning conflicts and maintaining peace.
- Advocate for global sensor cooperation initiatives to foster international collaboration in space activities, particularly benefiting the private sector by providing access to shared resources and data.
- Reduce friction and bureaucratic delays, especially due to varied levels of technical proficiency, through clear problem statement shaping.
- Ensure detailed Request for Proposal (RFP) shaping for clarity and effectiveness in addressing various measures.
- Consider critical infrastructure security as a key consideration in planning and decision-making

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