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Space 2.0: Prospects for Quad Collaboration

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Space 2.0: Prospects for Quad Collaboration

Space 2.0

It has been 64 years since the launch of the world's first artificial satellite, Sputnik 1 that officially marked the dawn of humanity's ever-growing fascination with exploring the vast reaches of outer space. From launching manned missions, orbiters, exploratory probes to landers and rovers, in the matter of a few decades mankind has made significantly great strides in space exploration. In addition to being an arena for scientific curiosity and exploration, space, particularly the Lower Earth Orbit (LEO) and the Geostationary Earth Orbit (GEO) have emerged as important avenues for the functioning of several new technologies. Essential services and devices such as Global Positioning System (GPS), televisions, phones, online payment and broadband services are all embedded in infrastructure that is dependent on satellites for their functioning.

Gone are the days of space dominated by a select few countries and their space agencies driven by cold war competition. We have entered a new space age, a 'Space 2.0', which has marked a distinct shift within the space sector. This transition to a new era in space was largely a result of

technological innovations and key changes in satellite and rocket design which prioritized cost-effectiveness and reusability. This transformation has been driven by the growing footprint of the commercial sector in space. Multiple projects spearheaded by private enterprises have led to innovations that have significantly reduced the costs of operating in space. Space is thus no longer the sole preserve of governments; it is getting increasingly populated with governmental and private entities alike. The 'Space 2.0 paradigm' signifies a positive step in humanity's long tryst with space exploration, as it opens up a whole new realm of possibilities with ideas of colonisation of the Moon and Mars now on the near horizon[1].

According to the Space Report 2021 Q2, the global space economy has grown to a whopping 447 billion USD in 2020. And the commercial space sector singularly accounted for approximately 80 per cent of this figure[2]. Several billionaires, namely Jeff Bezos and Elon Musk have been increasingly eyeing the space with their respective space ventures, Blue Origin and SpaceX having pioneered the growing accessibility to space. Consequently, space tourism, which seems like a concept straight out of science fiction is now on the cards with Bezos' Blue Origin announcing plans to launch a commercial space station that will function as a 'mixed-use business park' in space[3]. Not to be left far behind, other private entities such as Nanocraft, Lockheed and Voyager have also announced their

1 "Space 2.0- enabling war in space?" at https://www.aspistrategist.org.au/space-2-0-enabling-war-in-space/(Accessed 7 December 2021).

2 "Global Space Economy Rose to $447B in 2020, Continuing Five Year Growth" at https://www.spacefoundation.org/2021/07/15/global-space-economy-rose-to-447b-in-2020-continuing-five-year-growth/ (Accessed 9 December 2021).

3 "Blue Origin: Jeff Bezos unveils plans for 'space business park'" at https://www.bbc.com/news/world-us-canada-59046076(Accessed 9 December 2021).

plans to launch a space station in partnership by 2027[4]. The magnitude of this growing accessibility to space is perhaps best illustrated by the recent food delivery to astronauts at the International Space Station by the food delivery app, Uber Eats[5]. In addition to individual projects and ventures, a sizeable portion of the growth in the commercial space sector has been propelled by government contracts. The United States and China have emerged as the most notable sources of both capital and investment within this sector[6]. In the bid towards replacing the ageing International Space Station (ISS), NASA has awarded 400 million USD in contracts to three companies, Nanoracks, Blue Origin and Northrop Grumman, for developing a viable commercial space station by 2030[7]. Another new phenomenon in the new space age has been the development of mega constellations. True to their name, mega constellations refer to the launching of multiple identical, small-sized satellites into orbit instead of the traditionally used larger and expensive specialized satellites. These mega-constellations have a wide range of commercial applications ranging from remote sensing operations, high-speed internet connectivity to climate and weather tracking[8]. Increased production efficiency and lowered costs have created a preference and subsequent demand for

4 Ibid.

5 "Uber Eats makes its first food delivery to space" at https://www.cnet.com/news/uber-eats-makes-its-first-food-delivery-to-space/(Accessed 19 December 2021).

6 Secure World Foundation, "Space Policy and Sustainability: Issue Briefing for the Biden Administration," December 2020,pp. 27.

7 "NASA awards Blue Origin, Nanoracks, Northrop Grumman over $400M in contracts to avoid space station gap" at https://techcrunch.com/2021/12/02/nasa-awards-blue-origin-nanoracks-northrop-grumman-over-400m-in-contracts-to-avoid-space-station-gap/(Accessed 16 December 2021).

8 Secure World Foundation, No.6, pp. 30.

smaller and more numerous satellite networks i.e. mega-constellations. A plethora of companies have thus been announcing plans for satellite constellations with over 100 satellites. SpaceX's ambitious Starlink project is estimated to comprise 4,400 satellites placed in 5 different orbital shells, out of which 700 satellites have already been placed into orbit[9]. Similarly, other such mega-constellations have been planned by Amazon (Project Kuiper: 3,236 satellites), OneWeb (900 satellites, with a licence filed for 48,000 satellites) among many others[10]. Apart from western entities, multiple firms in China, India and Japan have also announced similar plans for launching mega-constellations[11]. The Earth's orbital space is a finite resource, and the proliferation of multiple space actors operating in this limited space is gradually unleashing a whole new set of problems, ranging from issues of rising space debris, overcrowding, heightened chances of collisions and consequent governance issues. As a result, in this new era, space is becoming increasingly more "contested, congested and competitive"[12].

While overcrowding has become a significant cause for concern due to proliferating satellites in the LEO and GEO, the proverbial sky has not been the limit in this case, as there is a deepening interest in extending activities to the Cislunar space. Cislunar space refers to the area of space lying between the earth and the moon. It subsumes activities taking place above the geostationary orbit and on the surface of the moon[13]. Both

9 Ibid.

10 Ibid.

11 Ibid.

12 "Space 2.0—why it matters for Australia's defence" at https://www.aspistrategist.org.au/space-2-0-matters-australias-defence/(Accessed 18 December 2021).

13 Secure World Foundation, No.6, pp. 33.

the US and China have been chalking up plans of putting boots on the moon in the near future, thus turning the moon into a potential arena for resource competition[14]. Other states like India, Japan and Russia among several others are also planning a variety of lunar projects and missions[15] signifying the key position of the moon as the fulcrum for future human activities in space.

Managing space debris has been a persistent challenge ever since the first few satellites were launched into space. The advent of several new actors with their own satellite launches in addition to mega-constellations has severely aggravated this problem. Space debris in this context refers to man-made junk left in space, consisting of spent rocket stages, defunct satellites and debris created as a consequence of anti-satellite weapons testing. This space junk continues to persist in earth's orbital space and can vary in size, with large pieces posing a significant threat to other active satellites, space vehicles and space stations alike. It is believed that approximately half of all current debris in space can be attributed to two major events– an anti-satellite test conducted by China in 2007 and an accidental collision in space between a US communications satellite and a defunct Soviet-era military satellite[16]. For the safety of crew and equipment in space, thousands of this debris are continuously tracked by states on the ground (largely the US); but nearly 900,000 pieces of small orbital

14 "Space 2.0- enabling war in space?" at https://www.aspistrategist.org.au/space-2-0-enabling-war-in-space/(Accessed 7 December 2021).

15 Global Exploration Roadmap, 'Lunar Surface Exploration Scenario Update', Supplement August 2020, International Space Exploration Coordination Group, National Aeronautics and Space Administration Headquarters, Washington DC.

16 "Why satellite mega-constellations are a threat to the future of space" athttps://www.technologyreview.com/2019/03/29/136268/why-satellite-mega-constellations-are-a-massive-threat-to-safety-in-space/(Accessed 16 December 2021).

debris within the size range of 1-10 cm remain untracked. Irrespective of their size, even these small pieces of junk can cause significant damage to an active satellite in case of a collision[17]. It is in this context that Space Situational Awareness (SSA), referring to the knowledge and observation of activities, objects, particles and energies in space, has emerged as a vital necessity in space 2.0. It extends to both man-made and natural objects and occurrences in space[18]. SSA is conceptually quite similar to Maritime Domain Awareness and in the rising complexity of the present space environment with multiple actors conducting activities in a shared arena without a formalized legal framework in place, "SSA capabilities are becoming increasingly critical to the safety of operations"(in space)[19].

Weaponization in Space

The existence of counter-space technology and weaponised space assets is in no terms a new phenomenon. Several states namely US, China, Russia and India have developed and tested counter-space capabilities. Numerous military assets, weapons systems, intelligence gathering systems and critical infrastructure hinge upon specialized satellite networks. A CSIS Space Threat Assessment Report, 2018 distinguishes counter-space weapons into four broad categories:

Kinetic Physical Counter-space Weapons

As the name suggests, these kinds of weapons directly strike and detonate a warhead on the target which can either be a satellite or a ground station.

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17 Secure World Foundation, No.6, pp.2.

18 "Space Situational Awareness (SSA): An Essential Strategic Requirement" at https://www.vifindia.org/article/2020/december/17/space-situational-awareness-ssa-an-essential-strategic-requirement(Accessed 16 December 2021).

19 Secure World Foundation, No.6, pp. 2.

The infamous anti-satellite weapons (ASAT) fall within this category. ASAT weapons can either be direct ascent or orbital, wherein they are placed in orbit to be used to intercept and take down satellites as directed.

Non-Kinetic Physical Counter-space Weapons

This category subsumes lasers, electromagnetic pulse weapons and high powered microwaves that can negatively impact both satellites and ground stations without any sort of physical contact. The speed of these attacks makes it difficult to attribute to a particular source. Attacks from such systems can range from blinding and permanently damaging critical satellite sensors to disrupting electronics and corrupting stored data.

Electronic Counter-space Weapons

Electronic attacks include the jamming and spoofing of data signals by interfering and tampering with requisite radio frequencies. Both these technologies are relatively inexpensive to develop and deploy and are also commercially available.

Cyber Attacks

Lastly, cyber attacks have emerged as another form of counter-space ability wherein system data is the primary target. Cyber attacks are difficult to attribute to a particular source and can inflict significant damage to satellite systems and functioning[20].

Malcolm Davis differentiates between the physical and electronic/cyber counter-space weapons by classifying them as 'hard kill' and 'soft kill' attacks respectively. According to him, these soft kill weapons are ideal for

20 Todd Harrison, Kaitlyn Johnson, Thomas G. Roberts, 'Space Threat Assesment 2018', CSIS Aerospace Security Project Report, Center For Strategic and International Studies, April 2018, pp. 5.

"grey zone operations in orbit"and he stresses that the "threat of hostile and aggressive behaviour in orbit is real"[21].

The rationale behind growing contestation and weaponization in space in large part can be attributed to the conceptualization of space as the 'ultimate high ground'. The perception of space as high ground is rooted in astro-politics which is defined as, "the study of the relationship between outer space terrain and technology and the development of political and military policy and strategy"[22]. Set in this context, the significance of cislunar space increases manifold as it represents "vast astro-strategic terrain" which can emerge as new grounds for competition and contestation[23]. The transformation in the space sector is increasingly propelling astro-political constructs to relevance and there is a gradual shift in "mindsets from geocentric to space centric thinking"[24]. This shift towards space centric thinking is reflected in the emerging space policies of several nations. From US' Space Force to China's 'Space Dream', multiple states are increasingly looking at space via the astro-political lens. Malcolm Davis contends that the moon and cislunar space represent a quintessential high ground that can accord a potential adversary/ space actor the ability to oversee and control strategic GEO and LEO while

21 "Boosting space capabilities through AUKUS" at https://www.aspistrategist.org.au/boosting-space-capabilities-through-aukus/(Accessed 15 December 2021).

22 "China, the US and the race for space" at https://www.aspistrategist.org.au/china-the-us-and-the-race-for-space/(Accessed 15 December 2021).

23 Ibid.

24 Ibid.

also having the ability to regulate access to the moon[25].

China's 'Space Dream'

The gist of China's space ambitions is perhaps best captured via the quote attributed to Ye Peijian, the head of the Chinese Lunar Exploration Program, he said,

> "The universe is an ocean, the moon is the Diaoyu Islands, Mars is Huangyan Island. If we don't go there now even though we're capable of doing so, then we will be blamed by our descendants. If others go there, then they will take over, and you won't be able to go even if you want to. This is reason enough.[26]"

Ironically, China's space programme was kick-started as a direct consequence of America's (largely unfounded) fears of a Chinese scientist working as an undercover communist at the Jet Propulsion Lab. These concerns led to the scientist unfortunately losing his clearance in addition to facing partial house arrest, after which he eventually migrated to China and was responsible for founding the Chinese nuclear and space programs[27]. 51 years post launching their first satellite into space, China has gradually emerged as a space power to reckon with. The focus on developing a robust and prolific space capability has been driven by China's perception of developing space power as a necessary requisite for

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25 "Space 2.0- enabling war in space?" at https://www.aspistrategist.org.au/space-2-0-enabling-war-in-space/ (Accessed 7 December 2021).

26 "China's Looming Land Grab in Outer Space" at https://www.thedailybeast.com/chinas-looming-land-grab-in-outer-space(Accessed 18 December 2021).

27 Secure World Foundation, No.6, pp. 20.

comprehensive national power. It has quickly become evident that China aspires to become a "space power on par with the United States and (seeks) to foster a space industry that is equal to that in the US, Europe and Russia"[28]. This goal is also a key component of China's larger objective of realizing the 'great rejuvenation of the Chinese nation'[29]. To this end, China's white paper on space activities released in 2016 explicitly stated that, "To explore the vast cosmos, develop the space industry and build China into a space power is a dream we pursue unremittingly"[30].

On its path towards emerging as a global leader in space technology by 2045, China has plotted several milestones it seeks to achieve in this time frame, ranging from suborbital space flight in 2025, the development of a reusable carrier rocket by 2035 followed by the development of a nuclear powered space shuttle in 2040 and finally emerging as a world leader in space technology by 2045[31]. It has been noted that apart from space exploration, China also plans to "industrially dominate the space within the moon's orbit of earth."[32] It has been allocating significant resources towards exploring the "potential of space-based manufacturing,

28 Kevin Pollpeter, Eric Anderson, Jordan Wilson, Fan Yang, 'China Dream, Space Dream: China's Progress in Space Technologies and Implications for the United States, A report prepared for the US-China Economic and Security Review Commission, 2015, pp. iii.

29 Ibid.

30 "Full text of white paper on China's space activities in 2016" athttp://english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm(Accessed 15 December 2021).

31 "China aims to be world-leading space power by 2045" athttp://www.chinadaily.com.cn/china/2017-11/17/content_34653486.htm

32 US-China Economic and Security Review Commission, '2019 Report to Congress', November 2019, US Government Publishing Office, Washington, pp. 359.

resource extraction and power generation" in the cislunar space[33]. Reports also suggest that China aims to build a research station on the moon within the next decade[34]. At present, China's Tiangong space station is on schedule and the construction is set to be completed by the end of 2022[35]. In the light of space 2.0, China has relegated two divisions within the PLA towards space and counter-space capabilities: the Strategic Support Force (SSF) and the PLA Rocket Force (PLARF). The SSF is tasked with the development and operation of China's military space systems in addition to cyber and electronic warfare systems[36]. It is important to note that although officially China continues to maintain the garb of peaceful use and scientific objectives of its designs in outer space, it has designated space as a military domain[37].

The Quad Powers in Space

Across the Indo-Pacific region, multiple states are increasingly eyeing the progressively relevant space domain. In addition to the US; Japan, China and India have established their presence as credible space powers in their own right. Countries like South Korea, Vietnam, Pakistan, Iran,

33 Ibid.

34 "China to build moon station in 'about 10 years'" athttps://phys.org/news/2019-04-china-moon-station-years.html(Accessed 17 December 2021).

35 "China's Tiangong space station" athttps://www.space.com/tiangong-space-station (Accessed 17 December 2021).

36 Todd Harrison, Kaitlyn Johnson, Makena Young, 'DefenseAgainst The Dark Arts In Space: Protecting Space Systems from Counterspace Weapons', CSIS Aerospace Security Project Report, February 2021, Center for Strategic and International Studies, pp. 4.

37 Brian Weeden, Victoria Samson, 'Global Counterspace Capabilities: An Open Source Assessment', Secure World Foundation, April 2021, pp. viii.

Indonesia, Australia and Malaysia are some of the other actors that have newly entered this domain.

The United States has traditionally dominated space right from the heydays of its space race with the Soviet Union. A key indicator of America's shift in response to the evolving space environment was the establishment of the United States Space Command (USSPACECOM) and the creation of the US Space Force. Namrata Goswami notes that China's ASAT test in 2007 followed by the establishment of PLA's SSF in 2015 has seemed to have spurred US actions in terms of viewing space as a war-fighting domain[38]. In a bid towards maintaining its leadership in space, the US has also announced a slew of projects including robotic and human space exploration missions and the creation of a robust cislunar system[39]. In this regard, the US has launched a new lunar exploratory programme called Artemis. This programme seeks to enable human missions to space in a sustainable manner that will further pave the way forward for Mars missions in the future[40].

From the launch of its first satellite in 1975, India has come a long way towards establishing itself as a legitimate space-faring nation. India currently possesses a robust, self-reliant space programme and provides cost-effective launch services to several other states[41]. With plenty of

38 "The US 'Space Force' and Its Implications" at https://thediplomat.com/2018/06/the-us-space-force-and-its-implications/(Accessed 15 December 2021).

39 The White House, United States Space Priorities Framework, December 2021, pp. 5.

40 Global Exploration Roadmap, No. 15, pp. 10.

41 Maj. Gen PK Mallick, '*India in Space Domain: Pathbreaking Developments*', VIF Brief, Vivekananda International Foundation, New Delhi, pp. 4.

space exploration milestones under its belt, India's national space agency, the Indian Space Research Organisation (ISRO) has announced a slew of ambitious projects including a plan to send crewed missions to space on the 'Gaganyaan' capsule[42]. The successfully conducted ASAT test in 2019 reflects the shift in India's perception of space from a purely scientific domain to one that has astro-political and strategic significance as well. It is in this context that India established the Defence Space Agency (DSA) which subsumes the existing Defense Imagery Processing and Analysis Centre and the Defense Satellite Control Centre. The DSA's primary objective is the coordination of space assets of all three branches of the military in addition to defending Indian space infrastructure[43]. In its submission to the UNGA Resolution 75/36, India explicitly stated that its "focus is on the use of space for 'welfare' and not for 'warfare'". It is strictly opposed to the weaponization of outer space and called upon all space-faring nations to "contribute to safeguard outer space as the common heritage of humankind"[44].

Holding the prestige of being the fourth country in space[45], Japan has continued to maintain its position as a respectable space-faring nation. Japan set an enviable benchmark in space exploration with the

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42 "India's human spaceflight plans coming together despite delays" athttps://www.space.com/india-human-spaceflight-plans-gaganyaan(-Accessed 18 December 2021).

43 Todd Harrison et.al. No.36, pp. 5.

44 India's Submission to UNGAResolution 75/36: Reducing space threats through norms, rules and principles of responsible behaviors. https://front.un-arm.org/wp-content/uploads/2021/04/India-Submission-on-Resolution-75-36-.pdf

45 "The Rise of Japan into New Space" at https://media.nature.com/full/nature-cms/uploads/ckeditor/attachments/8865/00_Editorial_UK.pdf(Accessed 17 December 2021).

successfully conducted deep space asteroid sample mission, Hayabusa[46]. The establishment of the Japanese Aerospace Exploration Agency (JAXA) in 2003 has effectively centralized its objectives and ambitions under the purview of a single body[47]. The Japanese government has also implemented various measures geared towards energizing and stimulating investment and growth in the emerging commercial space sector. Although Japan doesn't possess any significant military space capabilities due to its restrictive defence policies, it has taken concrete organizational measures towards developing military operations. To this end, it created the Space Domain Mission Unit in 2019 which is tasked with the protection of Japan's space assets. This unit will coordinate with both JAXA and the USSPACECOM and Space Force, and is slated to be operational by as early as 2022[48]. In addition to actively participating in the US' Artemis programme, JAXA is also working on multiple projects, both individually and in partnership with other space agencies like ISRO[49]. The 2021 edition of the Defense of Japan had a special focus on challenges in the space, cyber and electromagnetic spectrum domains. It stressed on strengthening SSA, improving information gathering and strengthening resiliency in space usage[50]. In its submission to the UNGA resolution 75/36, in addition to maintaining that Japan continues to uphold outer space as a peaceful, stable and secure environment, embedded in shared rules and norms. It called upon the global community to focus on addressing the

46 European Space Policy Institute, New Space in Asia: Experts views on space policy and business trends in Asian countries, Full Report, February 2021,pp. 13.

47 "Japan's Space Ambitions" at http://www.cescube.com/vp-japan-s-space-ambitions(Accessed 17 December 2021).

48 Todd Harrison et.al. No.36, pp. 5.

49 Global Exploration Roadmap, No.15, pp. 10-11.

50 Ministry of Defense, Japan, Defense of Japan, 2021, pp. 13.

management of space debris, rendezvous and proximity operations and harmful interference[51].

In sheer contrast to the aforementioned states, Australia is a relatively nascent space-faring nation. The creation of the Australian Space Agency (ASA) happened as recently as 2018, before which all of Australia's space contributions were conducted via other states, namely the US[52]. Waking up to the growing possibilities and prospects offered by Space 2.0, the Australian government has released a roadmap plotting the objectives and development of the Australian space industry. The report makes 38 recommendations geared towards bolstering Australia's space industry and paving the way for further opportunities in space infrastructure and services. Apart from recommendations surrounding growing industry engagement, increasing domestic visibility of the space sector and the endowment of statutory authority, the report also stresses the need for creating a cleaner space environment. Although a little behind its Quad partners, the Australian space industry has vast potential for emerging as a competitive player within the global space scenario[53].

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51 Japan's Submission to UNGA Resolution 75/36: Reducing space threats through norms, rules and principles of responsible behaviors. https://front.un-arm.org/wp-content/uploads/2021/05/%E3%80%90JPN%E3%80%91-National-Submission-for-UNGA-Resolution-75-36.pdf

52 "It's not rocket science, Australia needs a stronger space strategy" athttps://www.lowyinstitute.org/the-interpreter/it-s-not-rocket-science-australia-needs-stronger-space-strategy(Accessed 19 December 2021).

53 "The roadmap to the future of the Australian space sector" athttps://spaceaustralia.com/index.php/news/roadmap-future-australian-space-sector(Accessed 19 December 2021).

Prospects for Quad Collaboration

In the recently held landmark Quad Leaders' summit, several fairly diverse areas of cooperation were identified for collaboration between the four democracies. Amongst these areas, Space was also recognized as a relevant domain providing new collaboration opportunities in terms of sharing satellite data for monitoring climate change, disaster mitigation and the sustainable use of oceans and its resources, in terms of responding to several shared challenges in this domain. The joint statement released post this summit explicitly stated that the quad partners will, "consult on rules, norms, guidelines and principles for ensuring the sustainable use of outer space"[54].

Collaboration on Space Situational Awareness (SSA)

As space becomes increasingly congested and contested, working towards space sustainability i.e. managing space crowding and addressing the proliferation of space debris is a pressing concern and also a shared responsibility for all space-faring nations. Thus, it presents a lucrative avenue of collaboration for the quad. All the four states share an interest in developing robust SSA capabilities, with the US leading the pack in terms of existing SSA capabilities. The US has also signed 100 SSA agreements with multiple states and space agencies (including Japan, India and Australia) which allow for a smooth data and information sharing of crucial tracking activities in space. The other three states have also been expressly working towards building SSA capabilities. Japan plans to build a SSAsystem by 2022, with the aggregated SSA information being shared

54 The White House, Joint Statement from Quad Leaders, September 24 2021 https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/24/u-s-india-joint-leaders-statement-a-partnership-for-global-good/

with the Combined Space Operations Centre in the US[55]. Australia is also developing its capabilities in space domain awareness by "expanding space surveillance under Defence's joint project 9360 and hosting a C-Band radar and optical telescope for space surveillance at Exmouth in Western Australia"[56]. In the recent iteration of the AUSMIN dialogue, both the US and Australia stressed the "importance of establishing shared capabilities in Space Domain Awareness, Space Command and Control, Satellite Communications, and Positioning, Navigation, and Timing"[57]. Meanwhile, India has been actively working towards building credible SSA capabilities of its own; ISRO has established the Directorate of Space Situational Awareness and Management which will be tasked with the objective of protecting India's space assets from debris and collisions. The Space Situational Awareness Control Centre, set up in 2019, would enable India to ensure Space Situational Awareness and Management[58]. In order to bolster its efforts, India is also working closely with NASA, JAXA and ASA on projects geared towards building

55 "Transcript: U.S. Space Strategy and Indo-Pacific Cooperation" at https://www.hudson.org/research/15481-transcript-u-s-space-strategy-and-indo-pacific-cooperation(Accessed 16 December 2021).

56 "Boosting space capabilities through AUKUS" at https://www.aspistrategist.org.au/boosting-space-capabilities-through-aukus/ (Accessed 15 December 2021).

57 Australian Government, Department of Defense, The Australia-US Minsterial Consultations Joint Statement: An Unbreakable Alliance for Peace and Prosperity, 17 September 2021. https://www.minister.defence.gov.au/minister/peter-dutton/statements/australia-us-ministerial-consultations-joint-statement-unbreakable

58 "Assessing India's Space Situational Awareness Capabilities: Prospects and Challenges" at https://www.claws.in/assessing-indias-space-situational-awareness-capabilities-prospects-and-challenges/(Accessed 18 December 2021).

space domain awareness[59]. In addition to this India has also engaged in space security dialogues with the US and Japan while working towards concluding an MOU with the US on SSA data sharing framework aimed towards protecting each other's satellites from threats in space. Within the Indo-Pacific the quad has often identified the need to build effective Maritime Domain Awareness (MDA); in this context space domain awareness can be understood as being analogous to MDA and thus it seems quite natural for the quad partners to extend collaboration towards this emerging domain as well.

With habits of cooperation and information sharing already in place, the quad can emerge as a suitable platform for all four states to develop a comprehensive and expansive information sharing network to boost their existing capabilities in space domain awareness. China is already leading an effort in this regard in the form of the Asia-Pacific Space Cooperation Organisation (APSCO) which seeks to provide a cooperation mechanism for developing countries for resource sharing in space science and facilitates capacity building among its many regional members. Towards this end, China has also developed many ground-based tracking stations across multiple states such as Pakistan, Kenya, Brazil, Chile and several others[60].

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59 ISRO is closely working with NASA on the NISAR project on developing a unique dual band SAR satellite for earth observation. With JAXA, ISRO is jointly working on a Lunar Polar Exploration mission in addition to on going projects on earth observation and satellite navigation. And with ASA, ISRO has recently inked an amendment to '2012 India Australia Inter-Governmental MoU for cooperation in Civil Space Science, Technology and Education', opening up prospects for further collaboration. For more information, see: https://www.livemint.com/science/news/quad-push-isro-taking-space-ties-with-us-japan-australia-to-a-higher-orbit-11615889635390.html

60 "The Case for US-Japan Space Cooperation in the Indo-Pacific"at https://thediplomat.com/2020/06/the-case-for-us-japan-space-cooperation-in-the-indo-pacific/(Accessed 17 December 2021).

In addition to concerns regarding collision from overcrowding and space debris, the emergence of space as a strategic arena has also ignited concerns regarding protecting space assets from deliberate attacks. The lack of adequate SSA capabilities can lead to the creation of a grey-zone situation making it difficult to attribute attacks or damage from a belligerent actor. China's growing space presence and grandiose ambitions have also emerged as a shared concern, particularly with regard to the control and exploitation of resources in the cislunar space; and the preservation of shared rules and norms in space. Collaboration on SSA is thus an imperative step for the quad in the emerging dynamics of the new space age.

Collaboration on Governance and Norms in Space

In the era of space 2.0, with the advent of multiple private entities and actors, the issue of space governance has become quite murky. As activities in space increase, the existing frameworks seem to fall short of accounting for the massive changes that have taken place in the space domain. Currently, the 1987 Outer Space Treaty (OST) continues to persist as the basis for space law, but it is in sheer need of review and revision as multiple aspects of the treaty fail to account for the new elements in space. For instance, the treaty doesn't contain any provision for an outright ban on counter-space weapons. In addition to this, while it does state that the moon and other celestial bodies cannot be militarized, it does allow the use of military personnel for 'scientific research'. Also, while it does prohibit national entities from resource extraction and sovereign claims in space, it doesn't prohibit private or commercial entities from doing the same[61]. To this extent, in 2019 a United Nations committee approved 21

61 "Avoiding a free-for-all: the Outer Space Treaty revisited" at https://www.aspistrategist.org.au/avoiding-a-free-for-all-the-outer-space-treaty-revisited/(Accessed 19 December 2021).

new guidelines for long-term sustainability in space, which was signed off by a 92 member UN Committee on the Peaceful Uses of Outer Space (COPUOS). The guidelines ranged from calling for enhanced registration of space objects, sharing information and SSA data to designing satellites with increased trackability[62]. It is in this context that the quad can present a platform for further deliberation and put forth a subsequent framework for rules and norms tailored to govern the new space domain. The quads adage of a free and open Indo-Pacific can be extended to the space as well, with the four partners working towards promoting fair use of space.

Development of Space Solar Power Stations

Another ambitious yet fairly possible avenue of collaboration lies in the development of satellite solar farms. While this idea may seem far-fetched and absurd, it is something that multiple states have been looking into, with China having the most concrete plans. It is a revolutionary concept within the energy sector wherein a space based solar power station would capture solar energy which doesn't quite make it to the earth and send it to earth via laser beams. This futuristic idea has been gaining traction, as China has recently announced that after successfully testing wireless high-voltage power transmission, it will move ahead towards developing solar power projects in the stratosphere. It plans to open a commercial solar power plant in space by 2050[63]. According to John Mankins, the quad states are well poised to undertake such ambitious projects as well. He believes that there is a unique opportunity for developing a solar power satellite system in partnership. He states that the project can initially start

62 "Indo-Pacific Space Age" athttps://ipdefenseforum.com/2020/06/in-do-pacific-space-age/

63 https://www.cnbc.com/2019/03/15/china-plans-a-solar-power-play-in-space-that-nasa-abandoned-long-ago.html(Accessed 15 December 2021).

with delivering power to remote areas in Australia and then gradually expand to subsume the entire region[64].

In keeping with India's preference towards maintaining the quad's status as a non-military grouping, the space collaboration prospects between the four states will largely be limited to information sharing, creating a comprehensive SSA framework, collaborating in the development of resiliency in space assets, providing a framework for rules and norms for navigating an evolving space order; and lastly, continuing to work towards sustained scientific exploration of the cislunar space and beyond.

64 "Transcript: U.S. Space Strategy and Indo-Pacific Cooperation" at https://www.hudson.org/research/15481-transcript-u-s-space-strategy-and-indo-pacific-cooperation(Accessed 16 December 2021).

About the VIVEKANANDA INTERNATIONAL FOUNDATION

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The defining feature of VIF lies in its provision of core institutional support which enables the organisation to be flexible in its approach and proactive in changing circumstances, with a long-term focus on India's strategic, developmental and civilisational interests. The VIF aims to channelise fresh insights and decades of experience harnessed from its faculty into fostering actionable ideas for the nation's stakeholders.

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