Space Alert

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A Swarm of Legal Issues Launched by First Rogue Satellites

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The Background

On 9 March, it was first reported that four small satellites were operating in space without a license. Since then, reports have been steadily emerging regarding various aspects of the events that led up to the launching of the SpaceBees. However, these reports emerging in public domain are yet to clarify the critical question of how such an unauthorised space object cleared U.S. border area and made it all the way to orbit.

What is known is that, in the month of April 2017, Swarm Technologies of California filed for a license to launch and operate their experimental SpaceBee satellites with the US Federal Communications Commission (FCC). These tiny satellites measured 10cm in width and length, but only a quarter of that size in thickness. The FCC raised concerns about this matter, worried that the SpaceBees were too small to track and, ultimately, decided not to grant Swarm Tech a license in December 2017. Curiously, the SpaceBees were scheduled to fly in September 2017. Swarm Tech contracted with Spaceflight Inc, a launch broker, to organise a flight with Antrix onboard a PSLV rocket.

Unfortunately, a failed launch in August 2017 pushed the launch of the SpaceBees back to January 2018. By this time, Swarm Tech would have been made aware of the FCC's refusal. Nevertheless, shortly after the launch of the PSLV, amateur space trackers detected and were able to track four mysterious objects (contrary to the FCC's concerns, private actors have been able to track the SpaceBees). By March 8, Swarm Tech had been reprimanded by the FCC, having a second license application revoked.

Even as regulators in the United States investigate the lapses that allowed for an unauthorised space object to find its way to space, the Space Bees have revealed the cracks in regulations, both domestic and international, thus provoking nations to reflect on the limitations governing international legal systems applicable to the launch of space objects and explore solutions to prevent the repeat of such episodes.

It is important to recognise the need for policy and regulations to identify points of responsibility, to address the critical question of liability in the event of rogue satellites causing damages either on earth or in space. In this article, we explore the concerns from the perspectives of both the United States of America, the nation who has jurisdiction over Swarm Technologies and India, the state that launched the space bees and propose solutions that could likely prevent such unauthorised space activities in the future.

From the US perspective

As it has emerged, there are primarily three actors in the United States of America involved in the Spacebees incident, viz., Swarm Technologies, the owners of the Spacebees, Spaceflight Inc., the launch broker and finally the U.S. regulatory authorities, starting with the FCC.

At the very least, Swarm Technologies required a clearance from the FCC for being able to operate the Spacebees. In addition to the FCC clearances, the Spacebees would also have to secure an export license as a dual-use item from the Commerce Department in terms of the Export Administration regulations. Considering that the clearances issued by the

FCC and the Commerce departments are the subject matter of independent processes, the likelihood of a space object receiving export clearances even before FCC clearances cannot be denied and the Spacebees may have thus been the beneficiaries of the independence and autonomy with which the FCC and the Commerce Department work. In the wake of this incident, it would be useful to reflect on optimizing inter agency cooperation even within the realm of domestic regulations.

The Spacebees incident also brings to focus, the roles and responsibilities of launch service brokers like Spaceflight Inc. A typical launch service brokering contract would a) Require the payload owners to represent and declare that they have secured requisite regulatory clearances and that their payload launch would not violate any laws, domestic and international and b) Indemnify launch service brokers against any claims or actions arising out of the payload owner's aforesaid declarations being found false. The question however, remains whether, launch service brokers must be expected and called upon to do more than just act on self declarations from payload owners?

While no precedents exist to answer this question, an analogous case that could throw some light on this question is that of Tiffany v. eBay , where Tiffay brought a claim against eBay, an online marketplace brokering sale and purchase of consumer goods, for failing to prevent counterfeit goods from being through its website to purchasers. eBay successfully argued that it does not have the responsibility of taking positive action to prevent counterfeit goods from being sold online and instead its responsibility is limited to taking down products for sale, if it is notified that they are counterfeit goods. To put it in simpler terms, brokers were absolved of liability if they had no knowledge of the illegality of the transactions they were facilitating.

In contrast, the judgement of the European Union Court of Justice in the case of L'Oréal v. eBay, better addressed the nuances of brokering services. In its landmark judgement, the court classified services of brokers like eBay into two categories, viz., a neutral function i.e., providing technical and automatic processing of data and an active function i.e., those functions which gives brokers active knowledge and control over data. Ultimately, it concluded that while brokers like eBay could claim exemption from liability for illegal transactions conducted through them, if they merely assumed a neutral function; wherever they played an active function, they were liable for allowing illegal transactions through them.

On a perusal of the above judgements from the U.S.A. and the European Union, launch brokers who play an active role in facilitating the launch of the satellite of satellite operators, may not be able to claim immunity from liability if the launch of the satellite is ultimately found without the authority of law. Though, no doubt, the context of a launch broker is very different from that of a ecommerce provider, because the stakes are higher in the launch service market, the responsibility that law might ascribe on the broker could either reflect the position expressed by the European Union Court of Justice or be much more stringent.

Looking at the flight of the SpaceBees from the US perspective then, one can see at least three checkpoints (operational authorisation, export authorisation, commercial facilitation) where the SpaceBees should have raised alarms. The main reason that the US would want to detect such an unauthorised launch by one of its nationals, even aboard a foreign

rocket, is that the US may still be responsible for the activities of its nationals in space, even if it never granted the authorisation.

The Indian Perspective

It is a testament to the lack of detail and clarity in existing international regulations, when the point of responsibility for an unauthorised launch cannot be precisely identified. While the U.S. has much to reflect upon and change from its perspectives, questions are being asked on the role of a launching state like India in preventing the launch of unauthorised space objects.

Shortly after it emerged that Swarm Technologies had launched the Spacebees without requisite permissions and authorisations, Antrix, the company that acts as the commercial wing of the Indian Space programme, issued a statement in which it reminded that its customers have the onus of securing regulatory clearances effectively leaving it to the U.S. administration to address what Antrix felt was an internal issue.

The position expressed by Antrix is supported by its launch service agreement, in which the customer procuring the launch service is obligated to secure the requisite clearances. In defence of Antrix and ISRO, a key problem remains that domestic regulations governing the launch of satellites are not standardised from one country to the other and can often be complex and voluminous and thus indecipherable to other nations and its nationals.

Furthermore, unlike a launch broker like Spaceflight Inc., Antrix and ISRO are at the very end of the launch process and thus can't be expected, in the ordinary course of their activities, to have knowledge of the satellite operator's actions prior to the launch. Thus, Antrix's position is not unreasonable and therefore understandable.

However, in the recently released notice of proposed rule making by the Federal Communications Commission, a specific reference is made to ITU notification procedures for small satellites providing SATCOM services, which may make India's position a little vulnerable. After all small satellites are not exempt from ITU notification procedures. Though the procedures for such notification vary depending upon the frequency being utilised, the U.S. administration would still have to notify the ITU about any small satellites which have been assigned frequency by them small satellite utilising frequency.

These notifications are specifically required to be undertaken by the State administration and not the Satellite operator. Needless to say, an administration would not notify the ITU unless the satellite operator is compliant with applicable domestic regulations. This notification requirement of the ITU essentially acts as a medium for transparency, enabling other countries like India in this instance, to verify whether or not satellite operators like Swarm Technologies have in fact operated within the realms of domestic and international regulations.

The question for Antrix, ISRO and India is essentially the same as that for Spaceflight, Inc., viz., will contractual clauses obligating satellite operators to secure clearances absolve the launching agency of the responsibility to verify claims of regulatory compliance using the ITU platform? Unfortunately, international law at the moment fails to effectively answer this question. So in the worse case scenario of the Spacebees causing damage either in space or on earth, international law will not be able

to easily assess who should be held responsible.

Containing the Swarm

Perhaps the least disruptive solution is simply one of inter-agency communication. At the national level, at least in the US, the FCC and Commerce might be able to form a dialogue that would provide greater awareness of where space objects are on both geographical and administrative maps. However, this would leave the problem of speaking to foreign agencies, like ISRO. To this end, it is worth noting that nearly every country has a requirement, particularly for telecommunication authorisations, to publish notices of licenses.

Though it could be argued that the notification system within the ITU platform, renders weak, the defence of launch service brokers as well as State owned launch service providers that it is not within their means to verify claims of regulatory compliance by Satellite Operators, the need to enable faster and more transparent means of verifications is never the less significant and important.

As commercial space activity increases and States increasingly actively facilitate commerce in this domain, systems of notifications within the ITU which is driven and managed by State representatives and agents may not have the speed and accessibility that the future of space activities demand. Keeping in mind that commercial space activities, albeit rogue launches, may still continue with greater momentum, more pragmatic solutions are necessary to contain the swarm.

Firstly, we propose that states should strive to harmonize domestic regulations governing clearances for satellite payloads. In the context of Intellectual property regulations, experience suggests that such harmonization efforts can potentially enable nations to better regulate the subject matter of cross border trade, as for example in the case of Intellectual Property.

Simultaneously, for commercial space actors, states ought to look at developing a transparent database under the aegis of the ITU, to where information of commercial applicants seeking domestic clearances for satellite launches and the status of their applications can be readily made available for stake holders like launch service providers and launch brokers to access and verify claims of regulatory compliance.

In addition to the long-term vision of harmonizing domestic and international SATCOM regulations, it is also necessary to define the responsibilities of launch brokers and launch service providers, through international and domestic regulations. However, if the idea is to make them liable for verifying claims of regulatory compliance made by Satellite operators, then it reiterates the need for harmonization of domestic regulations governing satellite launches and the regulatory compliance database referred to above.

Conclusion

In conclusion, the incident involving the Spacebees have thrown more questions than answers. Scenarios like this fundamentally challenge the originalist approach to space laws and invite the international community to reflect on the need to think innovatively in evolving more detailed and specific international laws to address space activities of both state and non-state actors in the day and age of space commerce. As alarming as it is to realise that there are unauthorized satellites in space, it is also a timely call for

action. If states can remain committed to the spirit of existing international instruments like the Outer Space Treaty and build on the principles enshrined therein to evolve laws for emerging challenges, we are confident that mankind's foray into space will be not just be beneficial and inclusive but also sustainable.

Acknowledgement

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New Space and the Geo-economic Space Race to Come in the Indian Ocean Region: A Role for the Quad?

John B. Sheldon

There is a geo-economic space race developing between China and other Great Powers in developing a space economy that supports, and corresponds to, their infrastructure and governance programmes on the Earth's surface. Nowhere is this competition more evident than in the Indian Ocean Region (IOR).

What is the character of this geo-economic competition, especially in space, and what is in it for the IOR? How should countries – especially the so-called Quad powers – respond to Chinese initiatives? This essay provides a brief overview of these developments, and argues that the Quad powers need to harness commercial space companies as a strategic and economic counter to China's statist approach.

Geo-politics and Geo-economics in the IOR

While Geopolitics (with a capital 'G') is back, how competition between Great Powers is played out in the 21st Century is taking on different, yet concurrent forms. On one level, 21st Century geopolitics is the classical Great Power competition of historic fame (or infamy) over honour and interest using militaries, ballistic missiles and nuclear weapons, and Realpolitik statecraft, as can be seen in the tensions between India and China over such issues as the Doklam plateau at the intersection of the Chinese, Indian, and Bhutanese borders, or over the political influences at work between China and India in the Maldive islands in the Indian Ocean.

On another, yet interconnected, level, 21st Century geopolitics is in fact about geo-economic competition over the creation of infrastructure, trade routes, financial systems, information and digital networks, and all of their associated regulatory and policy frameworks, and the political and economic systems and ideas that animate them. This geo-economic competition is readily visible through the Chinese-led Belt and Road Initiative (BRI), and over the past few weeks, talk of an alternative geo-economic vision known as the Free and Open Indo-Pacific (FOIP) region put forward by the so-called Quadrilateral (also just known as the Quad) countries consisting of Australia, India, Japan, and the United States.

China's BRI not only consists of ports, roads, railways, pipelines, and submarine cables, but also of communications, Earth observation, and positioning, navigation, and timing (PNT) satellites for use by the Chinese government, citizens, companies, and participating BRI countries across its geographical expanse emanating from China through Southeast, Central, and South Asia, the Middle East, Africa, and the Indian Ocean itself.

For example, China's so-called Space Silk Road consists of an expanding user community for its Beidou PNT system, the use of loans to build communication and Earth observation satellites for countries in return for favourable access to their natural resources, and plans to build large constellations of communications and imaging satellites for commercial use across the Eurasian supercontinent and the Indian Ocean Region.

The Growing Problem with BRI

BRI is starting to raise a number of concerns among an increasing number of countries.

First, there is the concern that, despite Chinese protests to the contrary, BRI has more than geo-economic goals and purposes. Almost no one believes claims by Beijing that BRI is an altruistic construction initiative where in fact it is a vehicle for expanding Chinese economic and political influence. Further, even if China has no immediate geostrategic intentions for the BRI, most of the infrastructure being built – to include the Space Silk Road – has military utility.

Second, some of the infrastructure projects being built under the umbrella of the BRI have been criticized for being nothing more than vanity projects for corrupt local leaders, and possess no, if any, economic viability or practical use. This only further encourages corruption across the IOR, stymies much-needed economic development, and is a waste of scarce resources and financing.

Third, and lastly, China is coming under growing criticism from countries such as Japan and the United States for essentially using predatory loans for infrastructure in poor IOR countries, placing these already vulnerable and unstable states into unsustainable debt and, again, thwarting meaningful economic development. The Quad's proposed FOIP offers an alternative that could provide targeted and high-quality infrastructure throughout the IOR as a form of overseas aid, and so not place the poorest and least developed countries in the region into unnecessary debt.

Targeted infrastructure also involves conducting in-depth economic, political risk, and environmental impact assessments to make sure that whatever infrastructure is built has the maximum economic impact in return for the least adverse political and environmental consequences.

Providing communications connectivity and precise and reliable PNT coverage, as well as continued monitoring and surveillance of infrastructure and transportation corridor usage and the general environment of the IOR is as much a priority as the building of ports, airports, roads, and railways on Terra Firma.

Enter the Quad…in Space?

It is on this point that the existing government and commercial space capabilities of the Quad powers can offer this maximum benefit in return for minimal adverse political and environmental impact.

The Quad countries - Australia, India, Japan, and the United States - have existing space infrastructure that could be offered to countries throughout the IOR, ranging from enhanced PNT services provided by India's NAVIC, Japan's Quasi-Zenith Satellite System (QZSS), and the U.S.' Global Positioning System (GPS), through to advanced and timely environmental monitoring through Indian, Japanese, and U.S. meteorlogical satellites. Of course, many of these space services are provided to IOR countries for free, but it is perhaps worth reminding regional publics and governments of this.

Other space infrastructure, such as a basic Space Situational Awareness service for IOR satellite operators, could be set up using Indian and Australian facilities, as well as American and Japanese technologies and support. Further, the effort to establish common sense 'rules of the road' in safe and predictable space operations could be revived with IOR space activities as the centre and fulcrum of that diplomatic effort.

Quad New Space Power

Just as importantly, however, and certainly less considered when contemplating how best to offset China's growing influence with its Space Silk Road, is to put Australian, Indian, Japanese, and U.S. commercial space power to work in the service of a Free and Open Indo-Pacific.

The IOR is evolving into one of the most populous and economically vibrant parts of the world, with increasingly busy sea and air routes criss-crossing the Indian Ocean between Africa, the Middle East, South Asia, Southeast Asia, and Australasia, as well as new and exciting markets for space services.

There is a burgeoning need for commercial satellite communications throughout the IOR for everything from satellite television broadcasting and air and maritime connectivity through to High Throughput Satellite services for Smart Cities and broadband access. Certainly, companies such as Intelsat, Optus, and JSAT are obvious contenders here, but so are LeoSat and SpaceX's proposed Starlink constellation.

With its own, yet varied, weather patterns as well as the need to monitor the impact of climate change, environmental monitoring services – on top of those already provided as public goods by India, Japan, and the U.S. – are needed to save lives, provide relief when disasters and extreme weather occurs, and to mitigate the impact of such events to local and regional economies and trade. Companies such as Spire and exactEarth come to mind here.

Similarly, Earth observation and geospatial intelligence services and products, such as those provided by DigitalGlobe, Planet, and Orbital Insights are needed for everything from monitoring infrastructure operations and national security through to urban planning and land and ocean resource management. Air and maritime safety and security are also very important issues throughout the IOR, creating opportunities for space-based aviation and maritime domain awareness.

The United States and Australia, and increasingly India and Japan, are home to hundreds of established and New Space companies that are ideally placed to fill these market gaps. Furthermore, the Quad powers, perhaps through institutions such as the Asian Development Bank, could provide financing and other aid to IOR countries to assist them in procuring the services of commercial space companies.

Another idea might be to use Quad country commercial space companies to mentor IOR countries in the use of certain satellite functions, such as communications and geospatial products and services, for maximum economic, social, and environmental benefit in order to provide an alternative to China's satellites for resource access strategy.

Conclusion

We should not be naïve about this geo-economic competition throughout the IOR. Countries in the region, and understandably so, will look to gain as much for themselves from both China's BRI and from whatever the Quad powers may have to offer. The point, however, is that an alternative form of infrastructure development and governance – to include in space and the use of satellites – is available to show a more meaningful and sustainable approach to economic and social development throughout the region.

There is also an added benefit to the Quad powers getting collectively involved in the infrastructure and development business. As the ancient Silk Roads demonstrated, trade, development, and cultural discourse flourishes where there is a balance of power and productive competition among the more powerful nations. Ancient China, Persia, and Byzantium were forever in competition and conflict with each other, yet were wise enough most of the time to cooperate – even tacitly – in maintaining and securing the trade routes that crossed Eurasia at the time.

Not only did their economies benefit, but, so to did the quality of the infrastructure and the lives and safety of those who used it. It was only when these ancient empires failed to cooperate, or when competition broke out into open conflict, did the Silk Roads whither and the transcontinental trade they enabled with it.

The geo-economic competition between China's BRI and the Quad powers is more than just about infrastructure and economic aid and development. The competition is a vehicle for each side's preferred economic and political system of governance and vision for society. What better way to provide an alternative for IOR countries to China's statist and authoritarian vision than to harness the commercial and technical assets of the Quad's free and open space industries and expertise for a Free and Open Indo-Pacific region?

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Japanese Approaches to Assume Sustainability in Space

Kazuto Suzuki

Introduction

New Japanese approach for space sustainability for increasing the resiliency of space system is focusing on the concept of "Mission Assurance". This concept is defined as "in the situation where the threats and risks for space assets are increasing, Japan shall develop a capability to provide continuous and stable services for the users by replacing alternative methods and recovering the functions of those space assets as soon as possible".

Mission assurance is defined that Japanese government is responsible for securing the continuity and stability of the capacity of achieving the objectives of space system. In order to achieve these objectives, the government has to identify the risks and implement the measures to avoid those risks; to improve resilience of the system; and to be able to recover from the loss of the functions of those systems.

Five Principles

For implementing the concept of mission assurance, Japanese government set up five principles: cost effectiveness; future prediction; combination of measures; cross-domain cooperation; and international cooperation. These five principles are uniquely Japanese governance problem where the budget for space is inherently limited.

Cost Effectiveness

The foremost important principle to consider is the cost effectiveness. The sustainability and continuity can be ensured if the government can duplicate everything it owns. However, there is always a limit of budget and resources that can pour into mission assurance. Thus, the government should consider desired level of resilience, the amount of investment into the mission assurance system, and the capability of the system that may satisfy as a back-up. It is also important to consider the minimum level of functions that the system shall perform even in the case of recovery and reconstruction. It needs to have a clear priority of functions. Which of the functions are the most important? What are acceptable level of losses? What is the minimum requirement for other systems, which are dependent on the space-based system, to function? How much should we pay for the cost of developing back-up system?

Future Predictions

The risks on space assets are the consequence of the technological and socio-economic changes. The new technology opened the window for large number of new actors in space such as commercial space ventures and emerging countries which were not the major players in previous decades. Such changes are now making a lot of differences in the space environment. Although new space actors are responsible players, the congestion of orbits, particularly the Low Earth Orbit, would increase the risks of collision and other possible hazards. Furthermore, new technologies may increase the potential interference of space-based services by jamming and dazzling.

Cross-domain Cooperation

If capacity of space-based system is lost for some reasons, it would have a significant impact on the socio-economic lives and national security. The measures to take back-ups in space is important, but it is also

important to fully activate the infrastructures and systems in other domains (i.e. terrestrial systems). The coordination of using terrestrial capabilities has not been considered, particularly in the context of emergency, but there are many ways that terrestrial and space systems can complement each other. This would remain for the measures in case of emergency.

International Cooperation

The back-up system and reconstruction of capabilities does not have to be done only by Japanese assets. It can be possible that the foreign assets, particularly with the infrastructure of allied partners. Japanese government has to put its effort to make sure that the sharing of assets with partners in case of emergency and sharing satellites for different purposes such as hosted payload. The government should engage in those international activities and pursue the possibilities for sharing information and assets for better, cost effective and value for money cooperation.

Mission Assurance Architecture

There are three components upon which the concept of mission assurance is built. Those are (1) improving resilience of space systems, (2) mitigation of risks, and (3) reconstruction.

Improving Resilience of Space Systems

In order to prevent the discontinuation of the services, the design of spacecrafts and systems needs to incorporate the risks of collision and potential damages. Although it would increase the cost of production and launch, hardening spacecraft is the first step to mitigate risks. It is also important not to put all eggs in one basket. The development of small satellite technologies allows the operators to disperse multiple functions on a large satellite into multiple satellites with single function. If the operator uses a large satellite with multiple functions and a collision takes place, all those functions will be lost at once. The use of different frequencies would avoid radio interference on particular frequency. Diversification of functions and hardware would avoid risks of simultaneous loss of function.

Mitigation of Risks

In order to avoid risks, it is essential to collect information about the debris and any intentional and non-intentional collisions and threats. It will include intelligence gathering activities. The information of the trajectory of debris and other possible threat to the space assets needs to be shared among the relevant agencies. The government needs to construct a system that facilitates the collection and dissemination of information.

Reconstruction

Accidents may happen. It is crucial to be capable of recovering and reconstructing existing capabilities in order to secure the minimum function to be continued. The government needs to assess what is the minimum requirement for the system and to develop capabilities to restore the similar functions that allows continuous services in a short period time. It can be done through rapid deployment of similar back-up satellites, but also can be done by substituting with other systems (i.e. terrestrial system) or systems of partner countries.

Road Ahead

The government should take actions to activate the concept of “mission assurance”. First, the government should evaluate the vulnerabilities of not only the new and developing programs but also existing space

assets. There are existing operational spacecrafts which are not designed to withstand external interventions, including jamming and non-kinetic actions such as cyber-attacks. Second, improve SSA capabilities. Currently, JAXA and the Ministry of Defence working on the improvement of existing SSA capabilities in Okayama Prefecture, but there should be further upgrade of these assets. Third, the government needs to develop reconstruction capabilities.

So far, there is no planning or guideline in case of the loss of space functions. The government needs to draw a response plan for clarifying who is responsible for what in case of emergency, and make sure that the resources are allocated to meet the challenges. Table Top Exercises (TTX) can also be useful to make sure that all relevant agencies would understand and aware of their roles in those situations.

Finally, the reconstruction cannot be done without the support from the industry. Currently, Japanese industry were good in producing spacecrafts in a long-term work schedule, but the reconstruction process requires much shorter time to respond and provide sufficient product to meet the requirements from the operators. Thus, the government should develop industrial strategy for mission assurance.

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FROM THE MEDIA

India Successfully Launches GSAT-6A Communication Satellite

India on Thursday successfully launched the GSAT-6A satellite that would provide mobile communication facilities, using its heavy rocket Geosynchronous Satellite Launch Vehicle (GSLV-F08), in a copy book style. The GSLV-MkII rocket slung the satellite in a geosynchronous transfer orbit (GTO) from where it would be taken up to its final geostationary orbit by three orbit raising manoeuvres.

Source: Economic Times, March 29, 2018

BHEL Gets ISRO Tech to Make Li-ion Cells

Indian Space Research Organisation (ISRO) has signed a technology transfer agreement with Bharat Heavy Electricals Ltd. for the manufacture of space grade lithium ion (Li-ion) cells for the space programme and other national requirements. BHEL said it would set up a facility at its Bengaluru unit to make the cells.

Source: The Hindu, March 28, 2018

Isro to Launch Chandrayaan-2 in October After Tests

"Our panel of eminent space scientists comprising former Isro chairmen, top space experts and IIT professors has praised our preparations for the Chandrayaan-2 mission. However, keeping in mind the complexities involved in the mission as for the first time Isro is experimenting with a orbiter, a rover and a lander, the panel recommended postponing the launch till we complete all tests and are confident of a perfect mission."

Source: Times of India, March 25, 2018

ISRO Experimenting with Potential Structures for Lunar Habitation

In a written response to a question in the Lok Sabha, Jitendra Singh, minister of state in the Prime Minister's Office that looks after the Department of Space, said: "The ISRO, along with academic institutions, is doing experimentation on potential structures for lunar habitation," he said.

Source: Economic Times, March 21, 2018

Isro, DoT Turf Wars Delaying Connectivity Reach

DoT's special secretary N Sivasailam also flagged issues of costs and said Isro should do more in order to take the charges at par with global experience. "Here is the paradox, we produce the cheapest satellite but the costliest bandwidth," Sivasailam said, adding that we require more transponders on satellites. Sivasailam said there is a "problem of domains" between the DoT and the Indian Space Research Organisation (Isro) that has impacted the roll-out of connectivity in the far flung areas for 20 years.

Source: Economic Times, March 6, 2018

Isro Tests Payload Based on Origami, the Japanese Paper-folding Art

The Indian Space Research Organisation (Isro) has tested the Indigenously Developed Metal-based Origami Payload in Indian Nano Satellite-1C (INS-1C). INS-1C is an

experimental satellite launched by PSLV-C40 on January 12, 2018 as a co-passenger payload. It is the third vehicle in the Indian Nano Satellite (INS) series.

Source: Business Standard, March 21, 2018

HMT Delivers Precision Machine to ISRO

HMT Machine Tools Ltd, Hyderabad, has designed, developed, manufactured and assembled a 3-axis CNC Vertical Facing Mill for ISRO's Satish Dhawan Space Centre, Sriharikota (SDSC SHAR) to machine solid rocket motors.

Source: The Hindu, March 7, 2018

'India's GPS' Delayed by Deadline Overruns, ISRO's 'Administrative Laxity': CAG

Following an audit conducted by the Comptroller and Auditor General (CAG), it has been found that the project is riddled with major deadline and cost overruns, lack of performance evaluation and what the CAG report calls "sheer administrative laxity".

Source: The Wire, March 14, 2018

Isro to Transfer Tech on Low-cost e-Vehicle Batteries to Industry

Giving thrust to the Centre's ambitious e-vehicle project with the objective of reducing air pollution and crude oil import, Indian Space Research Organisation (Isro) is in the process of transferring the technology of the cheaper version of space batteries developed by it to the automobile industry for commercial use in e-vehicles.

Source: Times of India, March 11, 2018

China to Offer Commercial Recoverable Satellites in Next Two Years: Xinhua

The satellites allow scientists to send experiments into space on unmanned missions and recover the results. China has used these satellites in the past to send seeds into space, developing new types of plants from seeds that have been exposed to zero gravity and cosmic radiation.

Source: Reuters, March 18, 2018

China's Long March 5 Heavy-lift Rocket to Fly Again in November in Crucial Test

China's most powerful rocket will fly for the third time late this year, with success of the launch to be crucial to upcoming projects including a lunar sample return, space station module launch and a 2020 mission to Mars.

Source: SpaceNews, March 14, 2018

China Working on a New Heavy-Lift Rocket as Powerful as Saturn V

A senior official in the Chinese space industry told Aviation Week that the total thrust at liftoff for Long March 9 should be between 3,500 and 4,000 metric tons, compared to 3,400 metric tons of thrust for the Saturn V rocket that took NASA astronauts to the moon.

Source: Popular Mechanics, March 20, 2018

China Announces Development of Multipurpose, Reusable Space Plane

Although still at an early stage of research, the space plane will be capable of sending tourists to space, launching satellites and supplying the space station, providing emergency space rescue and offering cheap and timely space launching services

Source: Sputnik News, March 16, 2018

China Developing New Crewed Spacecraft for Moon and Deep Space Missions

While China's 8-tonne Shenzhou spacecraft can carry three astronauts to low Earth orbit - and will be used for transporting crew to the Chinese Space Station - the new generation crewed spacecraft will come in two versions: 14 tonnes for trips to the CSS, near Earth asteroids and Mars, and 20 tonnes for lunar landings.

Source: GB Times, March 09, 2018

US Space Companies Aim to Help Brazil Rocket Base Lift Off

U.S. companies eager to tap into the fast-growing market for low-cost satellite launches could become the first customers when Brazil's Alcantara space center near the equator opens as a commercial spaceport

Source: Reuters, March 8, 2018

Gen. Hyten Wants More Allies to Fight Alongside US in Space

The United States could use more allies in space, not only to help deter common enemies but also to share the financial burden of developing and launching systems into orbit, Air Force Gen. John Hyten told lawmakers.

Source: SpaceNews, March 8, 2018

SpaceX's Broadband-From-Space Plan Gets Final FCC Approval

Elon Musk's SpaceX won approval from the U.S. Federal Communications Commission to offer broadband service from space, using a constellation of 4,425 satellites racing around the Earth in low orbits.

Source: Bloomberg, March 30, 2018

Trump Floats the Idea of Creating a 'Space Force' to Fight Wars in Space

"Space is a war-fighting domain, just like the land, air, and sea," Trump told audience of service members at the Marine Corps Air Station Miramar. "We may even have a Space Force, develop another one, Space Force. We have the Air Force, we'll have the Space Force."

Source: CNBC, March 13, 2018

Rocket Lab: US Space Startup Says First Commercial Flight in 'Coming Weeks'

California-headquartered space startup Rocket Lab has revealed that its first commercial flight will take place in the "coming weeks", two months after becoming the first fully private company to launch satellites into orbit.

Source: NewsWeek, March 14, 2018

SpaceX Constellation Approved, But Waiver for Deployment Deadline Denied

US telecom regulators accepted SpaceX's application to reach US customers with a megaconstellation of 4,425 broadband satellites, but denied the company's request to relax the deadline by which it must have its entire constellation in orbit.

Source: SpaceNews, March 29, 2018

NASA's James Webb Space Telescope Slips to 2020, and Astronomy Suffers

"All the observatory's flight hardware is now complete—however, the issues brought to light with the spacecraft element are prompting us to take the necessary steps to refocus our efforts on the completion of this ambitious and complex observatory."

Source: Scientific American, March 27, 2018

Air Force Chief of Staff: US 'On Track' to Replace Russian RD-180 Rocket Engine

The US effort to transition from Russia's RD-180 rocket engine to two domestic suppliers is progressing as planned, Air Force Chief of Staff General David Goldfein said. "Right now we are on track... to complete the transition period [and] come out the back end with two domestic service providers."

Source: SpaceDaily, March 16, 2018

FCC Accuses Stealthy Startup of Launching Rogue Satellites

The Federal Communications Commission (FCC) had dismissed Swarm's application for its experimental satellites on safety grounds. The FCC feared that the four SpaceBees now orbiting the Earth would pose an unacceptable collision risk for other spacecraft.

Source: IEEE Spectrum, March 9, 2018

Stephen Hawking, Who Unlocked the Secrets of Space And Time, Dies at 76

Hawking's formidable mind probed the very limits of human understanding both in the vastness of space and in the bizarre sub-molecular world of quantum theory, which he said could predict what happens at the beginning and end of time. Hawking died peacefully at his home in the British university city of Cambridge.

Source: Reuters, March 14, 2018

Russia Working on Military Satellite Grouping to Counter US Space Warfare Plans

According to the defence minister, the subject of his meeting included the production of the Pion-NKS, a next-gen radio surveillance satellite, and the Bars-M, Russia's newest electro-optical area surveillance satellite.

Source: Sputnik News, March 6, 2018

Japan Space Colony Looking for Solutions So Humans Can Live on Moon, Mars

"It's in our nature to explore. The Earth is too small for us, don't you think?" asked Mukai, a petite and energetic 66-year-old who spent more than 500 hours in space on two separate missions. "It's very realistic to establish a colony on the moon by 2030."

Source: Hindustan Times, March 30, 2018

ESA to Investigate Links Between Debris Removal and Satellite Servicing

"What we are implementing at the moment is a study to find out whether we should modify the mission design to make the vehicle more flexible and be able to perform a variety of servicing missions including removing objects from orbit," said Luisa Innocenti, head of ESA's Clean Space Office.

Source: Space News, March 21, 2018

Japanese Government Launches $940 Million Fund for Space Start-ups

As part of a government-led initiative to double Japan's more than $11 billion space industry, funds will be made available through investments and loans over the next five years. With less than 20 Japanese space start-ups currently operating, many see this as critical to helping new companies cover costs such as research or applying for patents.

Source: CNBC, March 20, 2018

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Alan Boyd, "Asia's space race gathers pace," *Asia Times*, January 6, 2018

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The panel presentations, special addresses and discussions of the 4th ORF Kalpana Chawla Annual Space Policy Dialogue held on February 15-17, 2018 can be accessed here

India-France Joint Vision for Space Cooperation, Ministry of External Affairs, India, March 10, 2018

European Commission and Department of Space of India signed historic Cooperation Arrangement to share satellite Earth Observation data, March 19, 2018

President Donald J. Trump is Unveiling an America First National Space Strategy, U.S. White House Statement, March 23, 2018

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Jonathan Sydney Koch, "Institutional Framework for the Province of all Mankind: Lessons from the International Seabed Authority for the Governance of Commercial Space Mining," *Astropolitics* Vol. 16, Issue 1, March 8, 2018, pp. 1-27

Biswanth Gupta and Raju KD, "Chartering Territories in Outer Space: Obligating the Need for a National Legal Framework in India," *Astropolitics* Vol. 16, Issue 1, March 8, 2018, pp. 59-74

Elon Musk, "Making Life Multi-Planetary," *NewSpace*, Vol. 6, Issue 1, March 1, 2018, pp. 2-11

Benjamin Scott, "Exploration to Exploitation: An Industry Analysis of Suborbital Space Tourism," *NewSpace*, Vol. 6, Issue 1, March 1, 2018, pp. 87-98

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