



Space Alert

Volume IV, Issue 2 – April 2016

ORF Quarterly on Space Affairs

CONTENTS

COMMENTARIES

Role for Middle Powers in Space Security?

By Brett Biddington

Since the 1950s the hard questions about space security have largely been left to the major powers. In more recent times second echelon launch states including India, Japan, Israel and South Korea are insisting on having their voices heard.

Unveiling Myths around International Space Law

By Bayar Goswami

With emerging interest in exploitation of space resources, it is important to interpret the applicable laws accurately. Over time, a couple of provisions of the Outer Space Treaty have been misinterpreted, relying on which, race towards appropriation of space resources is gaining momentum.

National Planetary Defence Mechanisms

By Vidya Sagar Reddy

The NEO pose grave threat to the survival of mankind and therefore appropriate counter-measures are required. The US, Europe and Russia have proposed developing their own defence mechanisms against NEO.

FROM THE MEDIA

- Space Act will be in place soon, says ISRO Chairman
- Space Agencies Must Fulfil Kalpana Chawla's Dream: Sunita Williams
- Time for India to join global space rule framing to avoid NPT like mistake, says experts
- ISRO looks at using GSLV for foreign satellite launches
- SAARC satellite project: Pakistan decides to opt out
- Satellite that fixes other satellites comes closer to reality

OPINIONS AND ANALYSES

NEW PUBLICATIONS

Report and videos of the 2nd ORF Kalpana Chawla Annual Space Policy Dialogue, 2016

EDITORIAL BOARD

Editor: Dr. Rajeswari Pillai Rajagopalan

Associate Editors: Arka Biswas and Vidya Sagar Reddy

A Role for Middle Powers in Space Security?

Brett Biddington

Since the 1950s the hard questions about space security have largely been left to the major powers – the United States, Russia and China. Europe has been active in promoting space security, notably through the International Code of Conduct (ICoC) for space. In more recent times second echelon launch states including India, Japan, Israel and South Korea are insisting on having their voices heard.

In the 1960s and 1970s, the Cold War calculus allowed for treaty making to be method for articulating a set of basic rules to govern the conduct of states in outer space. This process tolerated holes and ambiguities but there was enough substance to balance the competitive and cooperative behaviors of the spacefaring nations, notably the superpowers.

In the past decade the situation has become more complex. Spacefaring nations have realised that comprehensive multi-lateral treaties are almost impossible to negotiate. They have also realised that the environment of outer space is becoming less safe and secure and that some practical understandings are needed to allow all spacefaring nations to pursue their ambitions and interests in space at acceptable (meaning very low) levels of operational risk.

In particular, space faring nations are concerned to minimize the possibility of collisions in space between their satellites and other space objects and also to reduce the possibility of radio interference.

To address these concerns, considerable effort has been expended by the major space faring nations, with support from broader sections of

the international community, to devise less formal international understandings by which the space faring nations will agree to conform in the interests of all.

To established operational and engineering practices and standards developments have included the proposed ICoC and the Group of Government Experts (GGE). Collectively, these initiatives have become known as Transparency and Confidence Building Measures (TCBMs).

Progress at this practical level was promising until the ICoC discussions in New York in July 2015 when, for all intents and purposes, the initiative was killed off. With this effort stymied, the question is how to rebuild necessary and sufficient consensus, especially between the United States, Russia and China, to ensure that some basic level of coordination is achieved to minimise the risk of unintended collisions and radio interference.

Having stated the problem, the question is whether small and medium powers, all of which have profound dependencies on secure and assured access to space-based services, might play some helpful role in bringing the major powers back to the negotiating table. This might not be through a re-invigorated ICoC, or something similar, but through a new initiative, yet to be enunciated, that provides a pathway to the necessary and sufficient cooperation that is sought.

A question exercising my mind is whether there is there anything that so called middle powers might be able to do to help to break the present impasse. I have in mind nations such as, but not necessarily confined to Canada, Australia, Mexico, Turkey, Chile, South Africa and Indonesia.

The argument might run as follows:

- The global economy is fundamentally dependent on secure and assured access to space-based services.
- Collectively, the economic health of the middle powers is essential to the overall health of the global economy and the national economies of the middle powers are as dependent on secure and assured access to service from satellites as are the spacefaring nations.
- Some middle powers occupy geography or provide materials that are essential to the economic and national security interests of one or more of the great powers.
- Any serious degradation of the operating environment of satellites, such as from space debris or radio spectrum congestion, may be expected to have first, second, and 'n' order impacts well beyond the immediate interests of the spacefaring nations. Reduced access to raw materials and to export markets may be so compromised as to present unacceptable costs to the major space faring nations.
- These calculations, carefully presented, may help to encourage spacefaring nations to re-start negotiations around TCBMs.

There are also some procedural questions to consider. These might include:

- Noting the failure of the ICoC, when the discussions were brought within the auspices of the United Nations, should the middle powers consider establishing a dialogue of their own that would develop the evidence base proposed and also a coherent narrative?
- Should there be a permanent secretariat, or should the group be *ad hoc* and voluntary in nature?

- Is there a natural leader from within the middle powers whose authority, objectivity and credentials would be accepted as legitimate by the three major space powers?

Looking further ahead, the major spacefaring nations, and others, essentially for national security reasons, are developing national or pan-national Global Navigation Satellite Systems (GNSS). Each of these nations, whilst making these investments, is also conducting well-funded research into alternatives to satellite-based global navigation due to the vulnerability of these systems. A day can be envisaged, in the 2030 timeframe when dependence on all GNSS, but GPS especially, may well decline considerably.

Should this occur, the question then becomes what do nations that take access to GNSS as a free good and whose economies are tightly coupled to the global economy through integrated supply chains do, if GNSS (GPS especially) is no longer available? Alternative technologies may not be immediately available to them or may only be available at considerable cost.

An opportunity, and I would say responsibility, exists for a number of the world's medium powers to begin informal discussions about the role they may play to build some basic consensus between the United States, Russia and China about acceptable behaviour in space. The argument would be grounded in global economics as a counter to the selfish national security interests of each of the main protagonists.

The middle powers need to encourage the major spacefaring nations to put the vexed questions around arms control to the side in

order to focus on the poor and declining health of the space environment and the potential negative consequences for the global economy and all nations if some measures are not agreed reasonably quickly (within five-ten years) to tidy up the mess.

Brett Biddington is a director of the Institute for Regional Security and also of the Space Environment Research Cooperative Research Centre (SERC). He leads the team that will deliver the International Astronautical Congress 2017 in Adelaide.

[\(Back to Contents\)](#)

Unveiling Myths around International Space Law

Bayar Goswami

Introduction

With emerging interest in the exploitation of space resources, it is important to interpret the applicable laws accurately. Over the time, a couple of provisions of the Outer Space Treaty have been misinterpreted, relying on which, race towards appropriation of space resources is gaining momentum. This article attempts to bring to light the intended meaning of such provisions.

1. Outer Space is “NOT” a province of all mankind.

It is often suggested that outer space is the province of all mankind. Article I of the Outer Space Treaty, 1967 in this sense is widely misinterpreted. Article I, states that “The exploration and use of outer space.....shall be the province of all mankind”. It is a common misinterpretation amongst space lawyers to connote outer space to be a province of all mankind, while the treaty only states that it is the exploration and use of outer space which shall be the province of all mankind. While the difference between the two interpretations is very thin, it is of great consequences.

The term ‘province of all mankind’ is not defined and in cases where ambiguity exists in interpretation of a treaty, the Vienna Convention on the Law of Treaties, 1969 (VCLT) posits travaux préparatoires (the preparatory texts which lead to the drafting of the treaty) as supplementary means of interpretation. It is conclusive from the travaux préparatoires that the drafters of Outer Space Treaty did not intend to use the word province to entitle territorial rights.

While the VCLT has no retrospective applicability because the Outer Space Treaty precedes the VCLT, it is well established by the International Court of Justice that certain provisions of the VCLT are codification of customary international law (CIL). And it is through CIL, many provisions of VCLT, particularly Articles 31 & 32 find their applicability.

Briefly put, if it is interpreted that outer space is the province of all mankind, then this interpretation is suggestive of unrestricted rights, and in this way outer space can be considered as an extension of terrestrial territory, be appropriated and colonized. This goes against the actual meaning of the provisions of the treaty (exploration and use of outer space to be province of all mankind) which is a curtailment of rights in itself, coupled with the following prohibition on appropriation in Article II of the Outer Space Treaty.

Thus, human ‘activities’ in outer space are province of all mankind and not outer space per se.

2. Appropriation of outer space by private actors is “NOT” allowed.

Article II of the Outer Space Treaty prohibits national appropriation and it is an establishment of a principle that no State party to the treaty can claim any part of outer space (including celestial bodies) as its own or in any way can establish its sovereignty in outer space to the exclusion of others.

Many space law enthusiasts have argued that since the term used in the provision is national appropriation, this does not restrict private actors (non-State personalities) to appropriate outer space. This notion is a fallacy rooted in

interpreting the treaty provisions in blind to the other relevant provisions of this very treaty.

The VCLT providing rules for interpretation of treaties states that a treaty has to be interpreted as a whole.

Thus, Article II when interpreted in light of the Article VI of the Outer Space Treaty, wherein States party to the treaty bear international responsibility and are under an obligation to authorize and continuously supervise the activities of its nationals (private actors) in order to comply with State's international obligations. Therefore, if a State authorizes a private actor for an act which is in contravention of State's international obligation, the State shall be held internationally responsible for the actions of a private actor.

Therefore, it is clear that the term national appropriation applies to both State and non-State actors and State party to the treaty is bound to ensure that no private actor under its supervision violates Article II obligation of non-appropriation.

Title IV of the (recently enacted) [United States Commercial Space Launch Competitiveness Act](#) (CSLCA) allows private enterprises to have ownership rights over mined space resources. It is interesting to weigh the position taken by a US court in 2005 in this context. The claim to own an asteroid by Mr. Gregory William Nemitz, who served a parking ticket to NASA for landing a spacecraft on his asteroid, was struck down in affirmation of the non-appropriation principle as applicable to private actors. ([Refer case note by Robert Kelly](#)). Furthermore, a claim of ownership of the Moon by a company named [Lunar Embassy to China](#) involved in selling

lunar land was also struck down by a district court in China.

While in the Nemitz case the reasoning to strike down the ownership claim cannot be attributed to be based purely or directly on the Outer Space Treaty, the decision in the Chinese court has clearly ruled against the company's appeal in accordance with the Outer Space Treaty, stating that no individual or state could claim ownership of the moon.

Therefore, understandably prohibition on appropriation applies to both State and non-State actors.

3. Extraction of Space Resources “IS” Appropriation.

Recently enacted United States CSLCA has triggered a space race towards creation of private commercial rights to the mined resources. Following this enactment, [Luxembourg](#) soon made a statement regarding drafting of a similar legislation. International Institute of Space Law, also came up with a [position paper](#) on commercial rights to space mining and supported the United States' analogy that extraction of space resources is not appropriation and in absence of clear prohibition, it is in line with the International Law.

It can be said that no violation of International Law has yet occurred, since such mining (in context of the US, which is subject to its domestic laws and its international obligations) has not yet been carried out and neither have any commercial benefits been derived. Future holds the answer to exactly what would be the procedure followed for the rights towards mining space resources commercially while ensuring compliance with the international obligations.

It seems unfathomable that space miners (private actors) driven solely by motive of profit-making would appreciate any mechanism of sharing of benefits with international community as against making independent economy driven business choices.

Speaking of black letter law, Article I of the Outer Space Treaty allows only exploration and use of outer space without discrimination of any kind, on a basis of equality and in accordance with the International Law. It is hard to derive a meaning that could point to allowing of exploitation of resources from the term exploration and use of outer space.

This particularly so in light of the Moon Agreement which specifically prohibits appropriation of outer space natural resources by any State and further states that, if and when exploitation of resources in outer space becomes a possibility, State parties to the agreement should establish an international regime for governing such exploitation. Such international regime has not been put in place.

It is an argument that the Moon Agreement has not been ratified by majority of space faring States. However, inspite of low number of ratifications of the treaty, the negotiations towards the drafting of the Moon Agreement involved participation from a number of varied States, including most space faring nations. Thus, it is a clear reflection of instilled understanding of difference between the two terms exploration and exploitation.

This participation and later abstinence from signing and ratification of the agreement points towards avoiding a more clear binding obligation regarding exploitation of space resources under the Moon Agreement and taking recourse through and to rather beyond

the plain and simple interpretation of the Outer Space Treaty.

Therefore, interpreting the plain and simple meaning of the Outer Space Treaty (according to VCLT), it can be conclusively said that extraction leading to exploitation of natural resources from outer space would lead to (prohibited) appropriation, not only in a *common sensical* way but also in an accurate legal interpretation.

Conclusion

In light of the above interpretations, we must carefully understand the principles established in the Outer Space Treaty. We should critically analyze the position of enacted or proposed legislations legalizing appropriation of outer space resources in order to avoid conflict of interests in outer space.

Bayar Goswami is an Erin J.C. Arsenault Fellow, writing his LLM thesis on Space Law at the Institute of Air and Space Law, McGill University, Canada

[\(Back to Contents\)](#)

National Planetary Defence Mechanisms

Vidya Sagar Reddy

The United States has [established](#) the Planetary Defence Coordination Office marking the beginning of a formal program to coordinate various national efforts at detection and tracking of Near Earth objects (NEO). The US, Europe and Russia have also proposed developing their own defence mechanisms against NEO.

The NEO pose grave extraterrestrial threat to the survival of mankind and therefore sophisticated early detection sensors need to be deployed and connected in order to take appropriate counter-measures. In 2013, a roughly 20 meter wide meteoroid, weighing 10,000 ton entered Earth's atmosphere over Russia causing collateral damage and injuring 1500 residents around the town of [Chelyabinsk](#). As it disintegrated, [energy](#) equivalent to 30 Hiroshima atomic bombs was released into Earth's atmosphere.

The Chelyabinsk meteoroid is part of a near Earth asteroid 1999 NC43 whose orbit crosses Earth's orbit every few years. This meteoroid snuck past the detection telescopes coming from the Sun's direction and the astronomical community focused on observing the passing of another asteroid 2012 DA14.

Incidentally, the 2012 DA14 made a dangerously close approach to Earth at 27,680 kilometres. In 2029, asteroid [Apophis](#) will buzz our planet at an altitude of 31,000 kilometres. These objects have indeed come or proposed to come closer to Earth than the orbit of communication satellites required for running our daily lives.

Russia also experienced what is considered to be the largest airburst of a planetary body in recorded history. This airburst in the Tunguska region released [energy](#) equivalent to 1,000 Hiroshima bombs flattening 2,000 square kilometres of forest. These impacts are capable of [melting](#) Saharan desert sand into glass, a process requiring high amount of energy. The leading cause for the extinction of dinosaurs is also one such impact.

Although the [risk](#) of a larger NEO impact with devastating global consequences is on average one per 100,000 years or less, the danger posed by smaller NEO is immense owing to their comparatively higher population and lack of characterization.

NASA has [constituted](#) the NEO Observations Program that uses ground based optical and radio telescopes along with NEOWISE and Spitzer space telescopes for detection and characterization of NEO. The Observations Program operating on a budget of \$4 million around 2010 received \$40 million in 2014 and \$50 million is appropriated for the fiscal year 2016.

About 90 percent of NEO larger than one kilometre have already been detected and characterized. 13,866 NEO have been [discovered](#) as of March 1, 2016 with 1,680 (and counting) of them been classified as potentially hazardous asteroids (PHA). An asteroid is considered potentially hazardous if it is larger than 150 meters in diameter and can come closer than 0.05 AU to Earth during orbital intersection.

This size allows a PHA to sustain atmospheric entry and impact the surface of the Earth. Therefore, NASA is now tasked with detecting 90 percent of NEO that are 140 meters across or larger by 2020. Continuous observations

help better characterization of the PHA and NEO in addition to detecting newer bodies.

Better the characterization better is the probability of knowing a lurking danger and accordingly implement defence mechanisms. A number of soft and hard kill mechanisms have been proposed for relieving impact danger from a PHA including using directed solar power, beaming lasers, ion beams, kinetic impact, gravitational tractors and even nuclear bombing.

NASA has proposed [testing](#) 'gravity tractor' as a viable solution for planetary defence against potential hazards as part of its Asteroid Redirect Mission (ARM). Gravity tractor mechanism is the process of using a spacecraft of sufficient mass to impart gravitational pull on a PHA to deflect its path away from hitting Earth.

NASA is also collaborating with the European Space Agency (ESA) to validate planetary defence mechanism using kinetic impactors. Under the Asteroid Impact and Deflection Assessment [mission](#), a NASA impactor will hit the smaller of a binary asteroid 65803 Didymos when it passes close by Earth in 2022. The ESA spacecraft positioned near the binary asteroid will measure the resultant changes in the structure, dynamics and orbit of the binary asteroid. This mission will validate a range of technologies for future asteroid deflection mechanisms.

Meanwhile, Russia has proposed more risky approach. It [intends](#) to morph the inter-continental ballistic missiles (ICBM) into kinetic kill vehicles to target threatening NEO. Unlike the deflection approach, the kinetic impactor supposedly breaks up the large asteroid into smaller pieces, small enough to be burnt up during atmospheric entry.

Russia can utilize its missile defence sensors and technologies for this purpose but these sensors are designed to detect hot plumes of missiles in the boost phase and are therefore oriented towards the Earth. They can only be useful once the potential extraterrestrial threat coming from behind the sensors starts burning up in the atmosphere. Whether Russia can successfully track and engage such an object in a time frame lesser than an ICBM threat is an obvious question. The more frightening issue is the management of communications with other countries, especially the nuclear armed ones, within the minimum time frame regarding the intention of a launch.

The proposed defence mechanisms are still under-matured in terms of planning, funding, technology innovation and testing. However, the threats are so diverse that even a matured strategy might become incapable of wholly preventing an impact requiring national and international emergency management organizations prepared with relevant mitigation plans and equipment at least to handle a regional threat.

Information from Earth based observation posts and robotic missions that have already orbited, impacted and landed on these bodies needs to be disseminated for characterizing the composition and dynamics of NEO threats and various appropriate defence mechanisms. China and India are the world's two most populous countries and they need to be engaged in this effort.

The threat from NEO may not appear 'immediate' like many of the traditional and non-traditional threats facing the world. However, the threat posed by these objects is real and scale of destruction has already been demonstrated. Our planet may not be much resilient to every danger.

The leading scientific countries can assemble a global coordinating body in this context and build on the existing technology for a truly universal extraterrestrial defence framework consisting of various defence mechanisms.

Vidya Sagar Reddy is a researcher at the Observer Research Foundation, New Delhi.

[\(Back to Contents\)](#)

FROM THE MEDIA

Space Act will be in place soon, says ISRO Chairman

Papers have been submitted to the government based on discussions with academicians and legal experts in January 2015. A Space Act will be finally brought out through Parliament.

Source: [The Hindu](#), March 3, 2016

Space Agencies Must Fulfil Kalpana Chawla's Dream: Sunita Williams

“I have a feeling that the responsibility I was talking about are those kids who are here in this country. They will be a part of it and that will be the responsibility of the group here and people here to let that happen to live in Kalpana’s dream,” she said at the Kalpana Chawla Annual Space Policy Dialogue organised by Observer Research Foundation.

Source: [NDTV](#), February 27, 2016

Time for India to join global space rule framing to avoid NPT like mistake, say experts

Space scientists and experts participating in the ORF Kalpana Chawla Annual Space Policy Dialogue feel it is the right time for India to take active part in the negotiations on framing rules and regulations and the international code of conduct for space.

Source: [Business Standard](#), February 28, 2016

State of Play of the Outer Space Regime and U.S.-India Space Cooperation

“SSA is a foundational capability for spaceflight safety and preventing collisions in space, and we remain interested in establishing

an SSA arrangement with India,” Mr. Frank Rose said while speaking at the Kalpana Chawla Annual Space Policy Dialogue organised by the Observer Research Foundation.

Source: [US Department of State](#), February 24, 2016

U.S. launch companies lobby to maintain ban on use of Indian rockets

The U.S. Department of Transportation’s Federal Aviation Administration (FAA) endorsed an advisory committee’s recommendation that commercial U.S. satellites continue to be barred from using the PSLV.

Source: [SpaceNews](#), March 29, 2016

Plan to largely privatize PSLV operations by 2020: ISRO chief

Once the plan materializes, the integration and launch of the rocket will be handled by an industrial consortium through the commercial arm of ISRO, Antrix Corporation.

Source: [The Times of India](#), February 15, 2016

Budget 2016 gives major boost to Department of Space

The Union budget 2016-17 allocated Rs. 7,509 crore to the department, an increase of around Rs 550 crore as compared to the last budget.

Source: [The Times of India](#), March 1, 2016

India-US set up space cooperation mechanism

A bilateral mechanism for sharing information for tracking movements of satellites, avoiding collisions and identifying potential threats to space and ground assets has been set up by Delhi and Washington.

Source: [Economic Times](#), February 28, 2016

Make in India: ISRO lures industry into space with technology promise, brand benefit

ISRO wants more private companies to make space and satellite components for the government-run enterprise by assisting them with technology transfer and required infrastructure in a bid to help incubate a space industry in India.

Source: [The Economic Times](#), February 17, 2016

U.S. Ambassador promotes U.S.-India space engagement

“The United States and India have a long and successful history of space cooperation. Auspicious would be a good way to describe the cooperation between India and the United States on space science.” Ambassador Richard R. Verma said.

Source: [Business Standard](#), February 17, 2016

India to build its heaviest rocket to carry 10-tonne satellites

ISRO plans to build its heaviest rocket, which can carry satellites weighing 10 tonnes into space. The proposed rocket would be powered by a semi-cryogenic engine

Source: [Business Standard](#), January 5, 2016

Second Vehicle Assembly Building being realised at ISRO

ISRO's Second Vehicle Assembly Building is being realised as an additional integration facility, with suitable interfacing to the second launch pad at Sriharikota.

Source: [The Economic Times](#), January 11, 2016

ISRO's ability to build communication satellites in Ahmedabad to rise five-fold

The new facility which is coming up on 60 acres in Bopal locality of the city, will cater to ISRO's demand for building newer and more sophisticated communications satellites.

Source: [Indian Express](#), January 4, 2016

ISRO looks at using GSLV for foreign satellite launches

Antrix Corporation, the commercial arm of ISRO, is in preliminary discussions with several countries on possible satellite launches using the GSLV, the Lok Sabha was informed.

Source: [livemint](#), March 2, 2016

ISRO Developing Station in Vietnam

As part of Space Cooperation between India and ASEAN, ISRO, at the behest of Government of India, is working towards the establishment of a Satellite Tracking & Data Reception Station and Data Processing Facility in Vietnam for ASEAN member countries.

Source: [Press Information Bureau](#), March 10, 2016

110 Long March Rockets to be Launched in 5 Years

A Chinese rocket scientist said Wednesday that 110 China-made Long March rockets will take to the skies over the next five years, as more models are developed.

Source: [China Aerospace Science and Technology Corporation](#), March 10, 2016

China to launch second space lab Tiangong-2 in Q3

China will send its second orbiting space lab Tiangong-2 into space in the third quarter of this year, which is expected to dock with a cargo ship scheduled to be launched in the first half of next year.

Source: [Xinhuanet](#), February 28, 2016

UAE to finalise space laws soon

A space law covering both human space exploration and commercial activities such as mining is currently being drafted, said the UAE Space Agency director general Mohammed Al Ahbabi.

Source: [The National](#), March 8, 2016

UAE Mars Hope mission to launch from Japan

The UAE's space probe to Mars in 2020 will be launched from Japan, it was announced on Tuesday during the UAE-Japan cooperation ceremony held in Abu Dhabi.

Source: [Gulf News](#), March 25, 2016

ExoMars on its way to solve the Red Planet's mysteries

The first of two joint ESA-Roscosmos missions to Mars has begun a seven-month journey to the Red Planet, where it will

address unsolved mysteries of the planet's atmosphere that could indicate present-day geological – or even biological – activity.

Source: [European Space Agency](#), March 14, 2016

Satellite that fixes other satellites comes closer to reality

The US space launch company Orbital ATK Inc has said it hopes to announce within the next six to eight weeks its first contract for a new “in-space” service using a specialised spacecraft to dock with older satellites and keep them in orbit.

Source: [The Guardian](#), March 8, 2016

Russia Approves Long-Awaited 10-Year Space Budget

The Russian government has approved a long-awaited federal program for space exploration, valued at 1.4 trillion rubles (\$20.5 billion) over the next decade

Source: [The Moscow Times](#), March 17, 2016

SAARC satellite project: Pakistan decides to opt out

Pakistan has decided to opt out of the ambitious SAARC satellite project which was proposed in November 2014 by Prime Minister Narendra Modi for all member countries of the regional grouping.

Source: [The Indian Express](#), March 25, 2016

[\(Back to Contents\)](#)

OPINIONS AND ANALYSES

Ashok GV, "[Before ISRO Can Go Onward and Upward, India Needs a Good Space Law,](#)" *The Wire*, February 26, 2016

Narayan Prasad, "[Even as it Dares to Dream, ISRO Needs Clear Metrics of Success,](#)" *The Wire*, February 10, 2016

Raja Murthy, "[India and the global spring of space commerce,](#)" *Asia Times*, January 8, 2016

Kiona Smith-Strickland, "[What's the X-37 Doing Up There?,](#)" *Smithsonian Air & Space Magazine*, February 2016

Bob Clarebrough, "[Making it happen,](#)" *The Space Review*, February 22, 2016

Vid Beldavs, Bernard Foing, David Dunlop, and Jim Crisafulli, "[NASA's Journey to Mars and ESA's Moon Village enable each other,](#)" *The Space Review*, January 18, 2016

Michael Nayak, "[CubeSat proximity operations: The natural evolution of defensive space control into a deterrence initiative,](#)" *The Space Review*, January 18, 2016

Jeffrey Lin, P.W. Singer, and John Costello, "[China's Quantum Satellite Could Change Cryptography Forever,](#)" *Popular Science*, March 3, 2016

Chen Lan, "[One track, two stations: A proposal for cooperation on the ISS and the Chinese Space Station,](#)" *The Space Review*, March 14, 2016

Lee Billings, "[An Israeli Moonshot \[Q&A\],](#)" *Scientific American*, March 17, 2016

Andy Pasztor, "[Race Is On to Deliver Internet From Space,](#)" *The Wall Street Journal*, February 16, 2016

Stephen Cass, "[The Saddest Lesson of Challenger: Columbia,](#)" *IEEE Spectrum*, January 28, 2016

Dimitri Elkin and Woodrow Clark, "[Politicians Determined to Kill the US-Russian Space Joint Venture,](#)" *The Huffington Post*, March 14, 2016

Marisa Kendall, "[Silicon Valley's zero-gravity space startup boom,](#)" *Santa Cruz Sentinel*, March 19, 2016

Can Ozcan and Xavier Quintana, "[Locating Turkey within outer space politics,](#)" *Turkish Weekly*, February 6, 2016

[\(Back to Contents\)](#)

NEW PUBLICATIONS

REPORTS/STATEMENTS/ MULTIMEDIA

[Report](#) of the 2nd ORF Kalpana Chawla Annual Space Policy Dialogue, February 24-26, 2016

[Keynote addresses](#), spotlight speaker sessions and individual panel discussions of the 2nd ORF Kalpana Chawla Annual Space Policy Dialogue, February 24-26, 2016

Frank Rose, Assistant Secretary, Bureau of Arms Control, Verification and Compliance, "[State of Play of the Outer Space Regime and U.S.-India Space Cooperation](#)," ORF Kalpana Chawla Annual Space Policy Dialogue, February 24, 2016

"[The Annual Compendium of Commercial Space Transportation: 2016](#)," Federal Aviation Administration, January 2016

Frank Rose, Assistant Secretary, Bureau of Arms Control, Verification and Compliance, "[Using Diplomacy to Advance the Long-Term Sustainability and Security of the Outer Space Environment](#)," March 3, 2016

"[Outer Space](#)," Report at the House of Commons Library, UK Parliament, January 13, 2016

"[Report on the United Nations/Japan Workshop on Space Weather](#)," International Center for Space Weather Science and Education, 15 February, 2016

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Jeremy Barnes, Ashley Elledge and Scott Patton, "A Shot in the Dark: Shedding Light on Exoatmospheric Situational Awareness

with Alternate Sensor Utilization," *Air & Space Power Journal*, vol. 30, no. 1, Spring 2016, pp. 46-60

Deganit Paikowsky, Gil Baram and Issac Ben-Israel, "Trends in space activities in 2014: The significance of the space activities of governments," *Acta Astronautica*, vol. 118, January-February 2016, pp. 187-198

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Narayan Prasad Nagendra and Prateep Basu, "Demystifying space business in India and issues for the development of a globally competitive private space industry," *Space Policy* (in press, corrected proof), March 2016

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Adam Steltzner and William Patrick, *The Right Kind of Crazy: A True Story of Teamwork, Leadership, and High-Stakes Innovation* (Portfolio: US, January 2016)

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[\(Back to Contents\)](#)