



Space Alert

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Traditional Space and NewSpace - Understanding the Growth Trajectories and their Potential for India's Space Economy

Narayan Prasad

With the increase in demand for space-based services in the country with a projection of 70 operational satellites needed in the country, the Indian Space Research Organisation (ISRO) is increasing its engagement with the space industry for both the production of satellites and launch vehicles.

Industry consortiums are being floated for the production of the Polar Satellite Launch Vehicle (PSLV) and the Indian Regional Navigation Satellite System (IRNSS) satellites. This brings along a unique opportunity for the first time in the Indian industry ecosystem to build up systemic capacity to be able to deliver end-to-end space systems for the first time in the country.

This development in the traditional space industry is based on a two-pronged approach. One to transition to a state where the industry can achieve the required volumes of satellites/launch vehicles under ISRO supervision while allowing ISRO to focus completely on novel technology development over a longer horizon period and second being possibly getting a leg up for the Make in India initiative. This is a welcome step in further maturing the capacity of the Indian industry while the industry has both the supervision as well as a customer in ISRO.

The effect of such increased trust in Indian industry by ISRO shall provide further confidence for the industry to invest into infrastructure that can deliver to ISRO's needs. The satellite AIT industry consortium

has already accounted commitments of Rs. 100-150 crore in investments to set up facilities that can support the operations required. In the current growth trajectory, Indian industry under the supervision will be equipped to deliver rockets and satellites by 2020.

While these developments are encouraging, India is now seeing a growing NewSpace phenomenon. Backed by private investors, Team Indus is the first Indian private company to sign a launch contract with ISRO. Bangalore-based space startup Astrome Technologies intends to launch 150 satellites into space by 2020 providing high-speed affordable internet to remote locations across the world. Astrome's technology and the use of satellite for internet can provide a significant boost for the government's aim to connect 2,44,729 Gram Panchayats (GPs) in the country.

Currently, the government is pursuing the National Optical Fibre Network (NOFN) plan of connecting the GPs through the optical fibre cable (OFC). According to recent reports OFC in 76,728 GPs and optical fibre in 64,599 GPs has been laid which allows significant room for satellite to contribute to Digital India.

Similarly, NewSpace is also having an effect on the downstream ecosystem. Companies such as SatSure are building analytics engines based on satellite and complimentary sensor data to help decision-making purposes by governments, insurance and re-insurance companies, banks, pesticide and seed companies as well as commodity trading firms. These are exciting developments in the space industry of India.

In order to understand the possible growth trajectories for traditional and NewSpace to

exploit their full potential in developing a scalable space economy in the country, it is important to understand the key underlying differences between the traditional and NewSpace approaches.

- Customer Landscape – Traditional space industry approach majorly depends on taxpayer funded requirements within the national demand framework administered by a space agency. This is a process that several countries have pursued in upgrading the capacity in the industry. NewSpace tries to build up B2B and B2C models which can scale both nationally and internationally without heavily leaning towards traditional space industry approaches for the majority of the business to stay afloat.

- Technology Landscape – NewSpace companies try to use novel approaches such as design using Commercial-Off-The-Shelf (COTS) components while trying to reduce the cost of the overall system while traditional space companies are dictated by legacy space agency based approaches. The idea is also to use the approach of fail-fast and iterate quickly to constantly scale. However, this also increases the risk of failure.

- Product/Service Development Landscape – Traditional space industry in India has typically been providing services of manufacturing according to the final integrator (ISRO) requirements at Tier-2/Tier-3 levels with the initial technology and knowhow itself has also been mostly borrowed from ISRO. Therefore, the traditional space industry will tend to gain more traction by working towards establishing a larger share in manufacturing/assembly of the systems as required by the customer (ISRO) as demand surges. This is the case with the industry led Assembly, Integration and Testing (AIT) of satellites and launch vehicles. NewSpace

companies such as Astrome are developing a completely end-to-end service where the enterprise has complete control on the design, development, fabrication and market delivery of the space system which shall provide the service.

- Financing Landscape – The traditional space approaches are based on Small and Medium Enterprises (SMEs) that have serviced the space agency with requirements growing systematically to upgrade capacity as the demand grows within the space agency. The scope of investment for such upgradation is based on performance/asset based guarantees with institutional investments limited to banks. NewSpace brings a high-risk, high-return scenario where traditional institutional financing such as banks are not an option rather attracts venture capital.

- Growth Landscape – Since traditional space industry approaches mostly depends on the space agency/national requirements mandated funds as a primary customer the ability to scale business limits to large orders moved to industry. NewSpace due to its diversified business model approach with possible scaling to international markets brings a high-growth potential. It should be duly noted that there are a large number of failures associated with the startup nature of NewSpace as well.

- Exit Landscape – Traditional space industry approach has exit scenarios are mostly via Mergers & Acquisitions (M&A) due to a spike in increased demand within the space agency/national requirements with interest from larger corporations to take over such opportunities. NewSpace brings along the possibility of M&A in consolidation and positive liquidation events for investors and entrepreneurs. A mature ecosystem is necessary for such exit scenarios.

From an Indian context, the argument is not Traditional vs. NewSpace for India rather than enabling the development of the space economy of the country by systematically enabling both these approaches to increase their capacity to deliver systems and services. Both these approaches have the potential to scale the capacity in the Indian industry which is still pre-mature in the ability to design, development, deliver a complete end-to-end space system or a space-based service.

NewSpace holds the potential of creating a multiplier effect on the space economy unlike the circulation of tax money that normally happens within traditional space industry approaches. Policy makers in the country need to support NewSpace in India to further catalyse the multiplier effect while steps are being taken to upgrade the capacity of the traditional space industry in the country.

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India-U.S. Collaboration in Outer Space

Victoria Samson

India and the United States have over 50 years of experience in cooperating on space efforts. This relationship has been beneficial, both in terms of enhancing scientific and technical achievements and also in bolstering the relationship between the two democracies.

The cooperative efforts have largely focused on civil space projects, however, so there is room for increasing the cross-cutting alliances between the two countries by expanding joint efforts to include those that affect security and stability. Furthermore, the two countries can work together in multilateral fora to encourage the development of norms of responsible behavior that will help make the space environment a stable and predictable one. While cooperation on security space issues can be complicated, it is entirely possible, given sufficient leadership and support from both sides.

Much of the cooperation between India and the United States in space has been the two countries' respective space agencies: India's Indian Space Research Organization (ISRO) and the United States' National Aeronautics and Space Administration (NASA). The two countries have also been looking to enhance their relationship when it comes to defense issues.

A [joint statement](#) released in June 2016 noted that "the U.S.-India defense relationship can be an anchor of stability, and given the increasingly strengthened cooperation in defense, the United States hereby recognizes India as a Major Defense Partner." This announcement also [acknowledged](#) that India and the United States had "reached an understanding under which India would

receive license-free access to a wide range of dual-use technologies in conjunction with steps that India has committed to take to advance its export control objectives." But even this statement kept the space cooperation to the civil side.

One new area for cooperation in space is satellite navigation. The United States has the Global Positioning System (GPS), which has been hugely important in expanding the use of space assets for benefits here on Earth. India has developed its own regional satellite navigation system, Navigation with an Indian Constellations (NavIC, formerly known as Indian Regional Navigation Satellite System or IRNSS), which could be used together with the U.S.' GPS system (and other satellite navigation systems) to expand the satellite navigation network so that positioning data can become even more accurate.

India has also been working on its GPS Aided Geo-Augmented Navigation ([GAGAN](#)) system, which is intended to help aircraft with improved navigation over the Indian subcontinent and surrounding areas by using satellites to augment data from GPS satellites and increase the accuracy of the aircraft's positioning data.

Both countries have strong incentives to want to improve domain awareness, so it should be a likely candidate for efforts to cooperate in space. The first is space situational awareness (SSA). The U.S.-India [Joint Statement](#) of September 2014 highlighted SSA (and collision avoidance in outer space) as an issue of potential interest. Frank Rose, Assistant Secretary, Bureau of Arms Control, Verification and Compliance, U.S. State Department, told a group in New Delhi in March 2015 that SSA sharing was one of several possible "[areas of concrete collaboration](#)" between the United States and

India. India has not signed an agreement with the United States yet on this issue, but its owner-operator data could prove very useful in increasing the reliability and accuracy of the U.S. space objects catalogue, which in turn could help protect Indian assets on orbit.

Another issue area that could be ripe for cooperation is using space for maritime domain awareness (MDA). Indian Minister of Defense Manohar Parrikar and U.S. Secretary of Defense Ashton Carter released [a statement in April 2016](#) that discussed, among other things, “new opportunities to deepen cooperation in maritime security and Maritime Domain Awareness.” Space for MDA is a natural outgrowth of this mission, particularly given the explosion in number of Earth observation satellites in recent years. With long shorelines necessitating aggressive vigilance and space assets in place to provide information about possible threats to those shorelines and/or national assets in the maritime domain, space-based MDA should be of interest to both India and the United States.

Cooperation in space does not have to limit itself to strictly bilateral discussions. Multilateral fora are possible venues for the United States and India to work together on space issues, particularly on solidifying agreement on norms of responsible space behavior. The most prominent venue for this is the United Nations’ Committee on the Peaceful Uses of Outer Space (COPUOS). It meets three times a year in Vienna, Austria, to discuss technical, legal, and general issues affecting the peaceful use of space.

VK Dadhwal, formerly of ISRO and currently director of the Indian Institute of Space Science and Technology, started his two-year tour as the chair of the COPUOS’ Scientific and Technical Subcommittee in February

2016. In addition, COPUOS has had a working group dedicated to creating voluntary guidelines for the long-term sustainability of outer space since 2010. India nominated members to the four expert groups that were charged with discussing and writing these guidelines.

India was in attendance at the June 2016 plenary of COPUOS and gave seven statements on various issues related to space, but not one on the long-term sustainability guidelines, which is a missed opportunity to demonstrate that these guidelines created in a multilateral forum dedicated to the peaceful use of space were fully supported by the government of India. This is particularly important, given that India is a leader amongst developing countries and there are some concerns about whether the guidelines will help or hurt them. It is hoped as discussions continue on the guidelines, India will use the opportunity to demonstrate its support of them.

To sum, there are many ways India and the United States can collaborate on space efforts and build off of a relationship that has already been in existence for many decades. By expanding it to include efforts to shore up stability and security (both on orbit and using space for stability on Earth), India and the United States can expect to see the benefits from cooperation far outpace the costs of doing so. This in turn can work towards the long-term sustainable use of space, which will positively affect all space users.

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The Need for India's Space Policy Is Real

Rajeswari Pillai Rajagopalan

India is yet to formulate an open national space policy. In the absence of a declared policy, India's approach to outer space affairs can be derived only through its statements within the parliament and multilateral bodies such as the United Nations and the Conference on Disarmament. India for a long time believed that it must maintain an ambiguous position and not clarify how it approached outer space in an open policy document. But this is no longer sustainable.

As India's power and influence grows, it is important that New Delhi spells out how India approaches each of the major domains including nuclear, cyber and outer space. Equally importantly, India's outer space policy must be driven and announced by the national political leadership rather than being left to the discretion of individual bureaucracies such as the Indian Space Research Organisation (ISRO) or Indian military services. Each organization will have its own interest, and these sometimes competing and even conflicting interests can only be shaped into a national policy by the political leadership.

India's outer space policy must be approached with three key drivers: international cooperation, space deterrent and commercial space market considerations.

India needs a fresh approach to international cooperation. India started its space programme with strong civilian and developmental roots, but its outer space requirements have grown enormously particularly in the military and security domain. India has to be able to respond to these requirements with certain boldness if

its interests are to be secured and this may require international cooperation. Even as India has the most advanced satellite fabrication and launch capabilities in Southern Asia, this may not last.

China has already emerged as a player in South Asia, launching a satellite each for Sri Lanka and Pakistan in 2013 and 2014 respectively. India with its established space capacities should have been able to respond to the needs of at least the friendly countries in the region. Prime Minister Narendra Modi's idea of a SAARC satellite is a good initiative although this is not progressing very well. But India can also go farther, and become liberal in regional space cooperation, such as by establishing satellite ground stations.

Another area India needs to focus on is in setting ground rules for international space cooperation, similar in principle to what exists in the nuclear arena. International cooperation that is totally unregulated can spur regional and international insecurities.

India also needs to seriously consider the issue of a space deterrence. Growing military space capabilities in the Asian neighbourhood have to be addressed both by beefing up India's capabilities and at policy levels. The Chinese anti-satellite (ASAT) test in January 2007 forced India in a new direction, leading to questions about how India should respond to the test and what capabilities India should develop as a deterrent.

The debate that followed did emphasise the need for India to develop and demonstrate an ASAT capability of its own because India should not see a repeat of the NPT-like situation playing out in the space domain, where India is locked out of a key technology regime because of political diffidence in demonstrating its capability before such

regimes become established. The Indian scientific and technical community has stated that India has the technological wherewithal to undertake such a demonstration but it is the political leadership that has to determine whether India should demonstrate such a capability or not.

India can do this much more responsibly than China, whose ASAT test created a huge space debris problem. The Indian political leadership therefore must lose no time in demonstrating its ASAT capability and prevent China from setting normative orders that lock India out, as it has done in the nuclear field.

Finally, on commercial space, India's launch capabilities are one of the most sophisticated and cost-effective ones in the world. This should give India a particular advantage in the commercial space market as it can offer these services to other developing countries in different regions, especially in South and Southeast Asia, Latin America and Africa. But until last year, India was doing on an average only four launches per year which was barely meeting India's own requirements.

In contrast, China was doing 20 launches a year on an average. India picked up the pace in 2016 launching a much higher number for India as well as foreign commercial partners but it has to sustain the pace in order not to lose the commercial space opportunities to other players such as China. India could become the destination for cheap and reliable space launches if it keeps up the pace. India has to step up its space launch infrastructure and investment if it has to grow into a competitive player in this space. India's space policy must outline this as an important driver pushing its approach in this sector.

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FROM THE MEDIA

ISRO's SAC to make satellite internet a reality soon

The first of the High Throughput Satellite to be launched in 2018 will beam data at speeds of 70 to 80 gigabits per second, faster than even the latest GSAT class communication satellites.

Source: [Times of India](#), October 5, 2016

ISRO gears up for critical crew rescue test

“While the overall aim is to master the technology that aims at rescuing the crew if a launch is aborted at any stage, the present test will try out the scenario of aborting a launch at the pad itself.”

Source: [The Hindu](#), October 7, 2016

ISRO gears up for launch of 3.3-tonne payload

“The satellite assembly and launching process of the GSLV Mk-III are in advanced stages. We are confident that SDSC will make yet another mark among the space-faring nations.”

Source: [The Hindu](#), October 8, 2016

ISRO to launch satellites in tie-up with industries

ISRO chairman A.S. Kiran Kumar said it plans to launch 10-12 satellites every year in "synergetic partnership" with the industry to make it a "win-win situation for both partners" and "boost India's great potential to capture a sizeable portion" of the business in the international space market.

Source: [Times of India](#), November 20, 2016

Centre to survey illegal mining through satellites

Developed under the Digital India programme, the mining surveillance system is a satellite-based monitoring system and is developed in coordination with the Bhaskaracharya Institute for Space Application and Geo-Information.

Source: [Times of India](#), October 16, 2016

ISRO has plans to go small with lighter satellites

The plan for small satellites is two-pronged and can range from 10 kg ‘micros’ to 300 kg-500 kg ‘minis’. A series of 350-kg ‘mini’ satellites, probably with high resolution cameras and innovative features, will be built in the near future for the ISRO’s own remote-sensing uses.

Source: [The Hindu](#), October 14, 2016

ISRO to soon launch record 83 satellites at one go

ISRO will be launching the 83 satellites, 81 being foreign ones, atop of a single rocket. The total payload would be around 1,600 kg. All these satellites will be put into a single orbit.

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

Team Indus gets slot on PSLV rocket for its journey to moon

Team Indus, the Bengaluru space startup that is aiming to send a lander and rover to the moon, has confirmed a slot on India's PSLV rocket for its mission in the last quarter of 2017.

Source: [Business Standard](#), November 2, 2016

SAARC satellite to be launched in March: ISRO

India's ambitious South Asian satellite, proposed by Prime Minister Narendra Modi for the benefit of SAARC members, will be launched in March next year, ISRO Chairman A.S. Kiran Kumar said.

Source: [The Hindu](#), November 8, 2016

ISRO's expenditure on Mars Mission wasn't even Rs. 450 crore

An austere Isro managed to save Rs 2.61 crore which it promptly returned to the Centre, reaffirming MOM to be the world's cheapest mission to the red planet, at a cost of Rs 447.39 crore.

Source: [Economic Times](#), November 18, 2016

ISRO adopts drought-hit Brahmasandra to help farmers

As part of its Corporate Social Responsibility activities, Antrix will implement the endeavour with help from the Bharatia Agro-Industries Foundation, for which it has earmarked Rs. 3.81 crore over a period of five years.

Source: [The Hindu](#), November 16, 2016

ISRO begins tests for Chandrayaan-II

ISRO has begun conducting simulation tests for its second moon mission, Chandrayaan-II, at its facility in Challakere, about 200 km from Bengaluru. "As of now, some landing tests have kicked off and the project is moving ahead."

Source: [Times of India](#), November 12, 2016

ISRO to include more crops for forecasting

"In terms of input for food security, the current use of space-based inputs wherein pre-harvest crop forecasting is given for eight major crops, will be improved to cover more number of major crops and some minor crops also," ISRO Chairman A S Kiran Kumar said.

Source: [Economic Times](#), November 8, 2016

Cabinet approves MoU between ISRO and United States Geological Survey (USGS)

The Union Cabinet has been apprised of MoU between ISRO USGS for Cooperation in the exchange and use of U.S. Land Remote Sensing Satellite Data. This MoU will enable ISRO to receive USGS's Landsat-7 & 8 in India and USGS to receive ISRO's Resourcesat-2 (AWiFS and LISS III) data of US region.

Source: [Public Information Bureau](#), December 14, 2016

Chronic capacity shortage sends ISRO searching for lease of overseas satellite

A chronic national shortage of communication satellite capacity has forced the Indian Space Research Organisation to search for a quick-fix lease of an overseas satellite in orbit, temporarily.

Source: [The Hindu](#), December 27, 2016

VSSUT team develops CanSat for Hirakud dam analysis

The rocket upon launching will reach a height of over 13000 ft in the sky and deploy the Can-satellite which will monitor the real time scenario of the dam. The CanSat will transmit data to the ground station before it is retrieved for reuse.

Source: [New Indian Express](#), December 27, 2016

China to launch world's first X-ray pulsar navigation satellite

X-ray pulsar navigation is an innovative navigation technique wherein periodic X-ray signals emitted from pulsars are used to determine the location of a spacecraft in deep space.

Source: [China Daily](#), October 10, 2016

China completes longest manned space mission yet

Two astronauts who completed China's longest-ever manned space mission returned to Earth safely Friday afternoon. Zhang Youxia, commander-in-chief of China's manned space program, announced that the Tiangong-2 and Shenzhou-11 manned flight mission, which lasted over a month, was a "complete success."

Source: [Space Daily](#), November 21, 2016

China "well prepared" to launch Chang'e-5 lunar probe in 2017: top scientist

China is well prepared to launch the Chang'e-5 lunar probe in 2017 to collect and bring back moon rock samples for scientific research, a leading Chinese scientist said Sunday.

Source: [Xinhua](#), October 24, 2016

Poland, China to jointly build satellites, boost space Cooperation

The two countries will jointly build a satellite, equipped with Polish instruments, that is to be launched in 2018. Under the plan, the new satellite is to be equipped with developed research equipment, and it will study the far side of the moon.

Source: [SpaceNews](#), November 3, 2016

China wins breakthrough contract for Thaicom telecommunications satellite

The contract, from Thaicom subsidiary International Satellite Co. Ltd., is valued at \$208 million covering the satellite's construction and launch, continuing a China Great Wall Industry Corp. practice of bundling satellite construction and launch contracts.

Source: [SpaceNews](#), October 28, 2016

China Launches Heavy-Lift Long March 5 Rocket for 1st Time

The Long March 5 is capable of lofting 27.6 tons (25 metric tons) to low-Earth orbit and 15.4 tons (14 metric tons) to the more distant geostationary transfer orbit, according to the China Aerospace Science and Technology Corp.

Source: [Space.com](#), November 3, 2016

Loverro: Defense is the best deterrent against a war in space

The U.S. must rely on defense rather than offense in deterring a space war, one of the Pentagon's top space officials said Friday. As a part of making satellites more resilient to attack, Loverro outlined six major areas the military needs to invest in, which he dubbed "D4P2."

Source: [SpaceNews](#), October 14, 2016

U.S. Air Force awards commercial space-surveillance contract

The Air Force awarded a contract Oct. 19 to Applied Defense Solutions, Inc., to provide space situational awareness services (SSA), part of the Pentagon's growing interest in private capabilities that could augment the military's own SSA.

Source: [SpaceNews](#), October 31, 2016

ULA debuts online pricing tool for Atlas launches

The [RocketBuilder](#) website is designed to let users select variables about their launch, including their desired orbit, payload mass, fairing size and desired launch date. The site then calculates the estimated price of the Atlas 5 rocket for that mission.

Source: [SpaceNews](#), December 1, 2016

Second SpaceShipTwo performs first glide flight

Virgin Galactic's second SpaceShipTwo performed its first free flight Dec. 3, a glide test that begins the next phase in testing of the commercial suborbital space plane.

Source: [SpaceNews](#), December 3, 2016

John Glenn passes away at 95

"Today, the first American to orbit the Earth, NASA astronaut and Ohio Senator John Glenn, passed away. We mourn this tremendous loss for our nation and the world," NASA Administrator Charles Bolden said in a statement.

Source: [SpaceNews](#), December 8, 2016

Spire to enter aviation tracking market

Spire Global, a company developing a constellation of cubesats to provide weather and maritime tracking data, said it plans to enter the aircraft tracking market by adding additional sensors to its future satellites.

Source: [SpaceNews](#), December 6, 2016

ESA: Mars lander crash caused by 1-second inertial measurement error

The European Space Agency said its Schiaparelli lander's crash landing on Mars followed an unexplained saturation of its inertial measurement unit, which delivered bad data to the lander's computer and forced a premature release of its parachute.

Source: [SpaceNews](#), November 23, 2016

Schiaparelli Crash Site in Colour

New high-resolution images taken by a NASA orbiter show parts of the ExoMars Schiaparelli module and its landing site in colour on the Red Planet.

Source: [European Space Agency](#), November 3, 2016

Full Ariane 6 rocket funding is unlocked by ESA

The European Space Agency has amended an August 2015 contract with Airbus Safran Launchers to unlock a further €1.7bn (\$1.9bn). This new rocket will replace the Ariane 5 but, crucially, aims to cut current launch prices in half.

Source: [BBC](#), November 9, 2016

Europe commits to the space station and ExoMars as part of \$11 billion in commitments to ESA

The 22-nation European Space Agency's member governments agreed to 10.3 billion Euros (\$11 billion) in new spending over the next three to seven years, including a commitment to the International Space Station to 2024 and the completion of the Euro-Russian ExoMars mission, to send a rover vehicle to Mars in 2020.

Source: [SpaceNews](#), December 2, 2016

Unmanned Federation spacecraft to be launched from Vostochny spaceport in 2021

The Federation spacecraft will be launched for the first time from the Vostochny spaceport in the Russian Far East in 2021 in an unmanned version with Android equipment onboard, head of Roscosmos state space corporation Igor Komarov said on Monday.

Source: [TASS](#), October 24, 2016

Eutelsat, Yahsat bouy Africa's broadband programme

According to the terms of the agreement, Broadband for Africa will use capacity on up to 16 Ka-band spotbeams on the Yahsat 1B satellite in order to roll out broadband services during the first half of 2017.

Source: [The Guardian](#), November 2, 2016

South Korea may rent Israeli satellite to spy on North — report

South Korea is reportedly considering using an Israeli spy satellite to peek at North Korea's military and nuclear facilities as it ramps up its defense capabilities in response to threats from Pyongyang.

Source: [Times of Israel](#), October 23, 2016

Gogo views network upgrades as bulwark against in-flight-connectivity newcomers

In-flight connectivity provider Gogo told investors that emerging aeronautical connectivity providers won't be able to catch up with its market position, especially once its next generation air-to-ground network is operational in 2018.

Source: [SpaceNews](#), November 4, 2016

Space agencies from BRICS sign cooperation protocol

Representatives of BRICS (Brazil, Russia, India, China, South Africa) space agencies discussed a draft document on joint use of data constellations from earth remote sensing satellites, and signed a cooperation protocol on the use and exploration of outer space for peaceful purposes.

Source: [Russia & India Report](#), November 2, 2016

UAE to facilitate sending tourists to space in future

"The regulations [for space sector] we are putting together now will have all required elements to prepare our sector for tomorrow. We are preparing an environment [that will facilitate] to send tourists to space," said Dr. Mohammad Nasser Al Ahbabi, director-general of the UAE Space Agency.

Source: [Gulf News](#), December 26, 2016

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Adam Minter, "[Why America Needs India's Rockets](#)," *Bloomberg*, November 1, 2016

Barack Obama, "[America will take the giant leap to Mars](#)," *CNN*, October 12, 2016

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Chen Yanbei and Guo Shuang, "[Interview: Space station as base for exploring new frontier, says renowned U.S. scientist](#)," *Xinhua*, October 20, 2016

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Jeff Foust, "[Expanding the space industry](#)," *The Space Review*, November 30, 2015

Narayan Prasad, "[How 2016 Heralded a New Kind of Race Into the Final Frontier](#)," *The Wire*, December 31, 2016

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NEW PUBLICATIONS

REPORTS/STATEMENTS/ MULTIMEDIA

Department of Space (India) released its Year End Review

<http://pib.nic.in/newsite/PrintRelease.aspx?relid=155958>

Space Security Index 2016 has been released. Copies can be purchased at

<http://spacesecurityindex.org/2016/11/>

Full text of white paper on “China's Space Activities in 2016” released by the country's Information Office of the State Council

<http://en.people.cn/n3/2016/1227/c90000-9159803.html>

ISRO Satellite Centre, Bangalore released its quarterly publication ‘Upagraha.’ Current Issue for Jul – Sep 2016

<http://www.isac.gov.in/publications/upagrah/pdf/UpagrahJuly-Sept2016.pdf>

JOURNAL ARTICLES

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