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The foundation of international cooperation in space, according to the Indian Space Research Organisation (ISRO), is 'aimed at intensifying space relations with traditional partners and establishing new relations with other nations in the peaceful uses of outer space. The activities include carrying out joint activities of mutual interest; sharing expertise in the applications of space technology and participation in international events dealing with space'.

According to Annual Report 2016-2017 of the Department of Space, ISRO has signed space cooperation documents with the space agencies of 39 countries and 4 multinational bodies.

The exploitation of space technology for international cooperation can be segmented into launch, satellite and ground segments. While the space launch services provided by India for foreign satellites are mainly on a commercial basis, they also provide opportunities to engage with the Global South.

## **Satellite Systems & Rockets**

ISRO is collaborating with the French Space Agency (CNES) and NASA on the development of satellite systems, and working with Russia on the establishment of a liquid propulsion (N<sub>2</sub>O<sub>4</sub>) production plant in India. CNES, with the 50-year long history of cooperation with ISRO, is probably the biggest international collaborator today. The evolving partnership between France and India ranges from sounding rockets to discussions on the exploration of the solar system.



Image: GSLV-I | ISRO

One of the notable missions whose data has provided immense value is the ISRO-CNES joint satellite "MeghaTropiques". According to recent developments, both agencies have agreed to extend the validity of 'MeghaTropiques MoU' by four years, until December 2020, which may lead to some of the scientific instruments flown on MeghaTropiques to fly in a future ISRO mission. ISRO is working with NASA on realising NISAR (NASA-ISRO Synthetic Aperture Radar), a joint microwave remote sensing satellite for Earth Observation (EO). This mission shall be particularly interesting from a planet processes and climate change perspective.

## Satellite Communication

A major stride toward using space for diplomacy as part of the Neighbourhood first policy, Prime Minister Narendra Modi mooted the idea of a South Asian Association for Regional Cooperation (SAARC) satellite during the 18th SAARC summit in Nepal (2014). The SAARC satellites shall provide communications and meteorology support from geosynchronous orbit, serving the needs of SAARC member nations.



ISRO will shoot GSAT-9 into its designated orbit, India will set an example of regional space collaboration like never before. | Image Credits: ISRO

The SAARC satellite provides an opportunity to extend a range of satellite telecommunication and broadcasting applications such as Direct-To-Home (DTH), Very Small Aperture Terminals (VSATs), tele-education, tele-medicine and [disaster management support to SAARC member nations](#). The satellite is slated to be launched in March 2017 using ISRO's Geosynchronous Satellite Launch Vehicle (GSLV).

## Satellite Data & Disaster Management

Cooperation among space-faring nations in international disaster management has been a long-standing tradition and India is an active participant in various such forums, including the Sentinel Asia Programme of Asia-Pacific Regional Space Agency Forum (APRSAF), the UN Economic and Social Commission for Asia and the Pacific (ESCAP), and the [UN Platform for Space-based Information for Disaster Management and Emergency Response \(UN-SPIDER\)](#) among others. According to the Annual Report of 2016-2017 the Department of Space, ISRO has facilitated data request for 16 disasters in 9 nations in the Asia Pacific region under the Sentinel Asia Programme and has provisioned data on 222 requests globally under the International Charter.

One of the other major components of disaster management is the cycle of search and rescue operations. ISRO has been active in participating in the Association of South-East Asian Nation's (ASEAN) space cooperation project and the COSPAS-SARSAT (COSPAS: Space System for the search of Vessels in Distress; SARSAT: Search And Rescue Satellite Aided Tracking) a search and rescue system that uses both polar and geosynchronous satellites and provides distress alerting and location information to search and rescue services for aviation, maritime and land users.

In both, the case of the COSPAS-SARSAT system and ASEAN, ISRO supports search and rescue operations and shares data from Indian satellites with member nations for a variety of applications including disaster management support.

## Satellite Navigation

With the Indian Regional Navigation Satellite System (IRNSS) popularly known as 'NAVIC' now being deployed with a full regional service constellation of seven satellites with a footprint extending about 1500 sq km around India, several services such as terrestrial and marine navigation side for hikers and travellers, and visual and voice navigation for drivers can now be extended to India's immediate neighbourhood.

## Interplanetary and Space Science Missions

Given the growing interest in interplanetary and space science missions in India, backed by the first time successes of missions such as Chandrayan and Mangalyan, ISRO is now on a path towards the expansion of complex space science missions by building a rover that shall land on the Moon, revisiting Mars with a second spacecraft and pursuing its first mission to study the Sun.

CNES and NASA are also clearly emerging as India's larger partners in space science missions as Indo-Russian cooperation on Chandrayaan-2 could not be fulfilled due to technical problems on the Russian side. ISRO and NASA have established a new Joint Working Group to explore cooperation possibilities in Heliophysics in an effort to the study of the Sun and the interaction between the Sun and Earth and are working on possible cooperation on Mars exploration. ISRO and CNES have established a Planetary Exploration Joint Working Group to explore possibilities of cooperation in future planetary exploration missions such as a mission to Venus

## **Human Spaceflight**

Human spaceflight has been on the ISRO radar for over a decade with the systematic development of technologies necessary to put a human in space. However, there is no government backing for a large-scale concerted effort in the development of a full-fledged human spaceflight programme in the country. While NASA has invited India to join some of its efforts in human spaceflight-related activities, it seems unlikely that there will be any political will in support of such efforts in near term. The focus for the next 3-5 years seems to be on the expansion of satellite systems and services in aiding utilisation of space technology to the immediate needs of the society.

## **Capacity Building**

Part of its capacity-building efforts, ISRO conducts short-term and long-term courses throughout Indian Institute of Remote Sensing (IIRS) and the UN-affiliated Centre for Space Science and Technology Education in Asia and the Pacific (CSSTE-AP) at Dehradun. According to the Annual Report of 2016-2017, more than 1600 beneficiaries from 52 countries have benefited from ISRO sharing its facilities and expertise in the application of space science and technology.

With the growing New Space phenomenon and the potential of exploiting small satellite platforms to create scientific capacity building programmes as part of its international cooperation efforts. This can help several of the developing countries trying to build capacity by bridging their capabilities in upstream and downstream space technology and applications.

## **Global Rule Making**

While ISRO continues to be an active participant at the Scientific & Technical Sub-Committee of the United Nations Committee on the Peaceful Uses of the Outer Space

(COPUOS) with India currently chairing the Scientific & Technical Sub-Committee (for the year 2016), there are several important issues that need global deliberation. The most pressing of these are the crowding of Low Earth Orbit (LEO) by several thousand planned satellites for communication services, the mitigation of space debris, the development of capacity in space situational awareness, and the advancement of international space law (especially in the realm of non-state actors pursuing activities such as space mining and tourism).

### **Local Developments in a Global Context**

With over 70 satellites being built and launched by 2020, ISRO's roadmap provides an unprecedented opportunity for the expansion of space-based services. This expansion of space-based capabilities is mainly due to the bottom-up requirements by several of the ministries and departments of the government of India expressing their will to use space technology in support of their missions. ISRO has identified 160 projects across 58 ministries/departments in the areas of natural resource management, energy and infrastructure, disaster and early warning, communications and navigation, e-governance and geospatial governance and societal services.

These projects encompass applications across a wide range of domains including Earth Observation, communications and navigation, technology development, meteorology, asset mapping and mobile applications among others. Several of these applications are mandated to support flagship programmes of the government such as the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), the Smart Cities project, the Pradhan Mantri Krishi Sinchai Yojana (PMKSY), and the Digital India project. The realisation of these projects provides an excellent foundation for extending several of space and service capabilities within the regional and larger international context.

### **Conclusion**

The Indian Space Research Organisation began the enhancement of India's space capabilities via international cooperation that today has matured to developing a partnership with peers in challenging and complex space missions. The long-standing relationship with space agencies such as CNES, ROSCOSMOS and NASA is now being complemented by new cooperative agreements with JAXA (Japan) and UAESA (UAE) among others.

International cooperation has mainly been driven by institutional engagement, peer space agencies or international/ regional forums. While there is a considerable number of

international and regional forums where ISRO's capacity are being explored for international cooperation, such as ASEAN, APRSAF, there is still no clear overarching diplomatic strategy in such engagements.

With several of the thematic ISRO satellite systems coming into play in the next 3- years and the step towards the greater evolution of Indian industry into integration roles for both rockets and satellites being taken, there is an evident opportunity to explore the exploitation of satellite systems/service capabilities under 'Make in India'. this can, in the long run, create an ecosystem towards the creation of trade (via Special Purpose Vehicles or Joint Ventures) where the technological foundation created within ISRO can be utilised for commercial satellite services (both locally and internationally).

Due to the targeted exploitation of space capabilities, evidenced by the South-Asian satellites and the maturation of navigational services through the NAVIC satellite systems, India is now in a position to flex its muscles in regard to space technology and applications and has reached a diplomatic vantage point.

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