Regulating Satellite Remote Sensing

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The freedom of operations in space and of remote sensing by satellites has been globally accepted through different UN Conventions. Satellite imaging provides unrestricted access to areas transcending international borders and its commercialisation has resulted in the irrelevance of these borders even for distribution of data as commercial entities seek a larger and more diversified customer base. Availability of such information commercially is enabling and influencing worldwide scientific, technological, social and economic advancements. However, its dual use potential that could provide disproportionate strategic and military advantages has raised concerns regarding the distribution. Differing interests have made regulating the sector a complex task. Nations that possess the capability want to strike a balance between their national security interests and foreign policy concerns, on the one hand, and commercial interests, on the other. At the same time, all nations remain apprehensive about the distribution of information about their area without their knowledge or consent.

The Early Years

The 1967 Outer Space Treaty (OST), ratified by most nations of the world, had legitimised satellite travel over any point on Earth. Hence,

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with capabilities in space, no nation was immune to being observed. Early uses of space were majorly limited to the two superpowers and most remote sensing being done by them was for strategic and scientific purposes, thereby eliciting little interest worldwide. Even as other nations joined the space bandwagon, remote sensing continued to be considered the exclusive domain of national governments. It mainly served the security and scientific (till then mainly government supported) domains and its limited socio-economic applications were also mainly for the public good, once again a government prerogative.

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Commercial remote sensing using space-based assets commenced with the launch of the first Landsat satellite by the United States. The low resolution of the imagery restricted its strategic and military usefulness and, hence, there were little security apprehensions. On the other hand, there were not too many takers also for the high priced, low resolution raw data that more often than not required specialised interpretation. The US, the only commercial player of the satellite remote sensing sector at that time, in a bid to set the stage for commercialisation of data from the satellite, followed a policy of non-discriminatory access. It also used provision of data as a means to influence the foreign policy of nations. In July 1984, the US Congress passed the Land Remote Sensing Commercialisation Act that established the process for licensing and regulating the commercialisation of land remote sensing satellites. This Act was the first of its kind that set the stage for further commercialisation of remote sensing data across the world. Subsequently, in its effort to expand the user base, in 1985, the US government signed a 10-year deal with the Earth Observation Satellite (EOSAT) Company, a joint venture

of RCA Corporation and Hughes Aircraft Company, to operate the Landsat satellites and market the resulting data.[1]

Meanwhile, there was an ongoing debate in the Legal Subcommittee of the United Nations Comittee on Peaceful Uses of Outer Space (UNCOPUOS) regarding access to satellite imagery that became more pitched with the advent of commercial imagery. There were two opposing views that highlighted the growing division between technologically advantaged and disadvantaged nations. The first view was presented by the US and some other developed countries that advocated unrestricted use of satellites for remote sensing and freedom of distribution of satellite imagery. The second view, advanced by the Soviet Union and its allies, as also some developing and some developed countries stressed for the right of prior consent of the sensed state for acquisition and distribution of satellite imagery.[2] They also sought the right to review and possibly withhold data about their territories. Reconciliation was achieved in 1986 when the UNCOPUOS passed a Declaration of Principles Regarding the Remote Sensing of Earth from Space (UN Principles). The UN General Assembly adopted the resolution containing the principles unanimously. There was no mention of prior consent in the resolution but its Principle XII recognised the rights of the sensed state. It stated: "As soon as the primary data and the processed data concerning the territory under its jurisdiction are produced, the sensed State shall have access to them on a non-discriminatory basis and on reasonable cost terms. The sensed State shall also have access to the available analysed information concerning the territory under its jurisdiction in the possession of any State participating in remote sensing activities on the same basis and terms, taking particularly into account the needs and interests of developing countries." So while the nations being imaged could do nothing to stop the imaging, they were entitled to purchase the data as well as any analysed information concerning their territory from the source country. [3]

While the UN resolution tried to establish a balance of interests of both the sensing and sensed states, the varied interests of individual nations have resulted in successive national policies that have, to some extent, been at variance with these principles. The United States was the pioneer of commercial remote sensing and has since then been a very strong player. US developments in this domain have had an impact on technology and policy the world over. While most space-faring nations have keenly followed the US practices for formulating their policies, making distinctions based on their interests, the US policy itself has varied over the years, reflecting both the desire to maintain a strong market share in supplying data and an attempt to control proliferation of technology and data for security reasons.

During the time that the UN Principles related to remote sensing were adopted by the UN General Assembly (UNGA), more nations were making satellite data available commercially and the emphasis was shifting to garnering a bigger share of the emerging market. France had established the SPOT (Le Systeme Pour l'Observation de la Terre) image organisation in 1982, that started marketing panchromatic and multispectral images of the Earth to a global customer base from the first SPOT satellite, years before its actual launch that took place in February 1986. Radar imagery with 15-metre(m) resolution from the Almaz satellite became available in 1991, making the Soviet Union the first nation to launch an operational radar satellite serving commercial users. A Soviet firm, Soyzkarta, also initiated limited sale of archival 5-m resolution Kosmos panchromatic imagery, thus, initiating a "resolution race."[4]

In the subsequent years, there was a number of events and trends that affected the remote sensing sector. The end of the Cold War lowered the threat perception for most nations, resulting in easing of export controls. The US had been following a policy of limiting access to high resolution satellite imagery but this was proving to be detrimental to its commercial interests. The French did not have such restrictions and sales from the

SPOT satellites had surpassed those by the Earth Observation Satellite (EOSAT) by 1989. By 1992, Russia had announced availability of 2m resolution imagery. The launch of the Indian Remote Sensing (IRS) satellites by the Indian Space Research Organisation (ISRO) in 1988 and 1991 brought home the realisation of proliferation of technology. In 1991, during the first Gulf War, Landsat imagery was used by the US to complement that obtained from military satellites in pursuance of its military objectives. Nations watched closely as satellites contributed to the effectiveness of the US forces and this led to exciting of the global demand for satellite imagery.

In 1992, the US Congress, recognising the shortcomings of Landsat commercialisation efforts, and faced with huge expenditures associated with operation of remote sensing satellites, passed the Land Remote Sensing Policy Act which cleared development and operations of privately owned remote sensing space systems. There had been reports of the use of commercial imagery by Iraq during its invasion of Kuwait in August 1990 and also during the earlier part of the Gulf War. Therefore, security concerns continued to dominate the thinking of the decision-makers and the Act put restrictions on the sale of data. It also retained the right to curtail the use of any imaging data or system sold by a US firm to a foreign purchaser if it decided that its national security interests would be affected.

In 1994, the Presidential Decision Directive (PDD) 23 sought to "support and enhance US industrial competitiveness in the field of remote sensing space capabilities while at the same time protecting US national security and foreign policy interests." The PDD 23 did not impose a specific resolution limit for marketing imagery and eased sale of low resolution data. It also allowed provision of some components and products as a means to discourage other countries from pursuing their own remote sensing capabilities.[5] This was an attempt to sustain US dominance in the sector and, consequently, help its industrial base. Concerns over

the imagery landing up in the wrong hands led to other restrictions that specified case-by-case review of remote sensing licence applications and restricting US firms to offering imagery that was no better than what was already available or planned for availability by foreign sources. The US government, in order to address the national security concerns, came up with a policy called "shutter control", wherein the licences issued for commercial remote-sensing satellites contain the provision: "During periods when national security or international obligations and/or foreign policies may be compromised, as defined by the Secretary of Defence or the Secretary of State, respectively, the Secretary of Commerce may, after consultation with the appropriate agency(ies), require the licensee to limit data collection and/or distribution by the system to the extent necessitated by the given situation."[6] Shutter control has since then been an integral part of all US regulations related to Commercial Remote Sensing (CRS).

Not only were such policies unable to control the proliferation of technology or data, some of the restrictions caused more harm to the US commercial efforts as companies faced stiff competition from an increasing number of space-faring nations whose governments had fewer limitations on data sale. However, the directive did enable granting of licences allowing commercial US systems with a resolution of one metre to be built and flown.[7] US IKONOS, launched on September 24, 1999, was the world's first high resolution commercial imaging satellite with a ground resolution of 0.82m. It began marketing its data in January 2000. This approval for sale of high resolution data provided the much needed boost to the sector by stimulating similar changes in the CRS industry worldwide.

Increased interest in satellite remote sensing and fear of arbitrary control over data led other countries to invest in indigenous remote sensing capabilities to gain from the high resolution satellite data. As a result, there was an increasing number of market players with similar

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capabilities in terms of resolution, quality, and availability of electro-optical imagery but with differing ideologies and interests, pursuing a larger piece of the global remote sensing market. The US government continued to be under pressure to support the commercial space industry in its quest for gaining market leadership. The Commercial Space Act of 1998 was adopted by the US government to stimulate the US commercial space industry (which, among other activities, included CRS). Subsequent to this, the US Commercial Remote Sensing Space Policy (CRSSP) of April 2003 (also known as NSPD-27), came out in support of commercial space operations by declaring that the US government would "rely to the maximum practical extent on US commercial remote sensing space capabilities for filling imagery and geospatial needs for military, intelligence, foreign policy, homeland security and civil users", using governmental systems only for "meeting needs that cannot be effectively, affordably, and reliably satisfied by commercial providers."[8] Such proclamations gave credence to the already prevalent use of commercial satellites and data therefrom for military purposes and further led to universal acceptance of the dual use nature of these systems. The control of data sale, however, did not lose its importance as the policy continued to emphasise on the 'shutter control' principles. Other countries have enacted similar provisions in their national laws/ policies.

Decade of Transformation

The last decade has been the most vibrant for the sector mainly because of the large strides in technology leading to better resolutions and better computing systems that have enabled provision of images onto desk tops and even mobiles. Governments are provisioning much more

data and most of it is to meet national security requirements. Operators are vying at supplying near real-time multispectral data of the highest spatial resolution. Data availability is stimulating the existing sciences and technologies as well as inspiring development of new methods of employability. Advanced sensors for hyperspectral imaging and Synthetic Aperture Radar (SAR) are enabling innovative applications among a number of sectors for remote sensing data. The graduation of the Global Positioning System (GPS) industry from a government controlled asset to a universal application has also enabled complete geolocation of products and solutions. Enhanced interest has led to an increase in the number of nations with a remote sensing satellite to 26 and by 2019, more than 40 nations are expected to have such capability.[9]

Realising the commonality of the consumer base and applications, satellite and aerial imaging companies are merging or joining hands to provide integrated data. Commercial operators looking at options to ensure growth are integrating with Geographic Information System (GIS) companies to provide complete data enabled information products and geoinformation solutions – rather than just raw data – that have a wider consumer appeal. There is, consequently, an increased number of companies that have interests in developing these services and expanding distribution networks across a varied consumer base. Data availability on desktops and mobiles and the associated applications like Google Earth and other location-based applications have put remote sensing into the public domain. The number of stakeholders in the CRS policy issues has, thus, increased manifold.

Unfortunately for the private operators, this has not transformed into substantial earnings. The recent global economic slowdown and the ensuing governmental budget cuts have further added to the woes of the sector. Such setbacks have precluded more private initiatives. The commercial satellite remote sensing sector meanwhile has seen many acquisitions and mergers, the most recent being:

- The German Rapid Eye programme involving a five-satellite constellation filed for bankruptcy protection in 2011 before being acquired by Canada's RapidEye Blackbridge Ltd.
- In February 2009, the US government approved the EnhancedView project, a public-private partnership between the National Geospatial-Intelligence Agency (NGA) and DigitalGlobe and GeoEye, both US-based companies. Set up in 2010, it was intended as a 10-year programme to complement the US government capabilities. However, subsequent budgetary cuts affected the programme and in June 2012, it was reduced to just one company, DigitalGlobe. GeoEye was subsequently acquired by DigitalGlobe in 2013.

Remote sensing satellites also contributed to the global information revolution and transparency by providing global communication networks, geographical location capabilities and remote sensing. Earlier, the information from satellites was related more to trans-border happenings and, thus, suited to strategic issues. Nations could suppress information or resort to selected disclosure to serve their international political objectives. Today, information is being made available to the media, non-governmental organisations, humanitarian and environmental monitoring groups, and now through desktop applications, to any networked individual across the world. As events in the Arab Spring highlighted, such information availability now has ramifications for the internal dynamics of a nation too. The efficacy of this capability was seen last year during the Arab Spring revolution which also saw a number of reported incidents of jamming of satellite broadcast signals in the region,[10] in an effort by local governments to quell unrest and the ability of citizens to coordinate protests. What was equally interesting was that no longer could the nations of the world manipulate the news or nuance their response based on perceived national interests or friendliness of the regimes. In this instance, the shared awareness influenced world opinion

like never before, compelling appropriate action by the world powers.

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Challenges at Regulation

Issues related to commercial remote sensing have been highly complex, leading to a lack of standardisation in development of national policies related to remote sensing. There are other factors that are making it difficult to have a comprehensive international approach to regulation of technology and data, some of which are given below.

- **Ownership:** Countries follow different arrangements of ownership of remote sensing satellites and data. Satellite systems require huge capital inputs and infrastructure support and data from them is inextricably linked to national security while also having geostrategic implications. Countries, thus, treat their space systems as national strategic assets and most maintain ownership of satellites while following varying methodologies with respect to their products. Some space-faring nations like France, Russia and India have established state-owned entities organised like private corporations to market or distribute data from government owned satellites.[11] Other countries are increasingly looking at some form of public–private initiatives as a means to share the costs as well as risks, with individual differences in implementation. In most such cases, satellite ownership continues to be with the government, with the private sector making contributions to the project and handling marketing of data.[12] Very few have purely private companies owning and operating satellites and marketing data from these ventures. Private operators and even companies in public-private initiatives are heavily dependent on government and military

data purchase contracts and a variety of government subsidies to remain financially viable. They are also dependent on government funded research and development. Therefore, there are no truly private remote sensing companies in the world.

- **Dual Nature of Data:** As discussed earlier, there is little to distinguish between provisioning of data for civil or military purposes. Nations have differing perceptions on this dual nature when it comes to policy-making. Some countries, such as Italy and France, have formal policies defining the use of their systems for civil as well as military usage and access to them and the data by defence entities.[13] Some other countries, on the other hand, freely use data from their national systems for strategic and military purposes while continuing to emphasise that these assets are for peaceful purposes only. Once data is sold to a country, there is no way to verify the purpose for which it has been obtained or employed. Dependence of more militaries worldwide on the commercial space industry for intelligence has ramifications for space security by making commercial space assets susceptible to attack in case of hostilities.
- **Definitions:** In the absence of any standardised definition, each nation is free to interpret the prevailing regime based on its technological development and geostrategic interests. This impacts the development and application of laws related to remote sensing. For example, there are inconsistent national definitions of common terms like "private" or "commercial". In Europe, the term "commercial" means to generate revenue and it applies to any entity that does so, regardless of by whom. In the US, the term "commercial" means a private sector activity, and in general, is not applied to government activities. The Canadian remote sensing law highlights the increasing difficulty in distinguishing what "commercial" means by requiring both government agencies and companies to obtain operating licences. [14]
- **Ambiguity in International Laws:** The UN Principles are applicable

to nation states and there is ambiguity on how these would apply to commercial operations. Companies are responsible to their parent state through national regulations. However, companies could shift base to foreign locations to avoid stringent laws or tax regimes, thereby complicating efforts to control or regulate their activities. Companies from different countries coming together to form consortia or companies registered in different states handling different stages of space operations or data handling and processing would further complicate the situation.

- **Regulations versus Technology:** Regulations are usually reactive and, thus, do not reflect the level that technology and its applications have reached. In the recent times, this gap has become larger because of the sheer pace of technological advancements. Also, technology develops without boundaries whereas legal and policy frameworks, confined by national borders, do not develop in a consistent way.[15]
- **Business Interests:** Private companies continue to lobby hard for relaxation of restrictions as well as a favourable business environment to help increase their market penetration. The easing of norms by the US government to make its companies competitive in the global market has had a positive effect on the sector worldwide. Such measures, however, work against technology and data control.
- **Data Protection:** This has become a prime concern among companies as proliferation is hampering the companies' efforts to recover their investments. Currently, there are no provisions in international laws to protect data obtained from commercial remote sensing. Further transformation of data into value added products and applications by private or even foreign entities is increasing the complexities.
- **Accessibility:** There is a potential of misuse of commercial imagery that is accessible to non-state actors and this continues to be a major concern. The conventional deterrent measures that are sufficient to dissuade nation states from misuse of information have little relevance

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against rogue elements that cannot be targeted in the same fashion.

National Laws

Most established space-faring nations that had little or no declared national policy on remote sensing till about a decade ago, have been establishing national laws, regulations and policy. They have also been joined by the emerging space-faring nations that are seeking increased participation in global efforts and international regulations. However, there is relatively little formal law, and till now, policies have been considered sufficient for remote sensing and legislations have not been considered necessary.[16] National security concerns have continued to dominate governments' policy, resulting in efforts at export controls and other restrictive legislative and policy mechanisms, fundamentally relating to two issues—the type of data that can be sold and to whom it can be sold. The former mainly relates to the resolutions for non-discriminatory access and is mostly an objective listing. However, nations differ on the spatial resolution of the data that can be provided. For example, US laws allow non-discriminate marketing of imagery up to 0.5m resolution while in India, the Remote Sensing Data Policy (RSDP)–2011, lays the limit at one metre (earlier 5.8 m). Each country has mechanisms laid out to deal with requests for data that is finer than the stipulated limit, mainly referred to as high resolution data (there is no universal acceptability of what constitutes high resolution data).

The latter mainly relates to countries keeping the option of blocking access to high resolution data. This is subjective and would depend on

the individual nation's varied interests. Most nations have policies akin to shutter control that allow governments to curtail data sales to suit national interests. Recent global developments have made intent an important factor of transactions and more countries are looking at the "who and why" of demands. Screening procedures have been put in place by countries to process individual demands for high resolution data on a case to case basis to ensure that a sale will not harm its security and foreign policy interests.

Indian Satellite Remote Sensing

In India, the government is the sole and exclusive owner of the satellites as well as the data collected from the remote sensing satellites of the Indian Space Research Organisation (ISRO). The National Remote Sensing Centre (NRSC) at Hyderabad, an organisation under ISRO, has been nominated as the nodal agency for satellite remote sensing data reception, archival, processing and dissemination in India. Presently, data from Cartosat-2, Cartosat-1, Resourcesat-1, and Oceansat-2 is being offered. Antrix Corporation Limited, was incorporated in September 1992 as a private limited company owned by the Government of India and under the administrative control of the Department of Space (DOS), as a marketing arm of ISRO. NRSC and/ or Antrix Corporation Ltd., are responsible for the acquisition and distribution of foreign satellite data in India. The Antrix Corporation Ltd. (of DOS) is vested with the authority for distribution of Indian Remote Sensing (IRS) data outside of India. Both organisations collaborate for integrating data from aerial remote sensing and for providing value added services.

Indian policy is not at much variance from prevalent national laws and policies around the world. As per the RSDP 2011, satellite image data up to one metre spatial resolution is provided to all users on a non-discriminatory basis. For data of higher resolution, a screening process has been defined. Also, the government reserves the right to impose control

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over imaging tasks and distribution of data in any country when it is of the opinion that national security and/ or international obligations and/ or foreign policies of the government so require. Critics point out that the national laws that enact unilateral application of restrictions purely on the basis of exclusive national interests to restrict sale of data to a sensed state of its own territory are contrary to the 1986 UN Principles Relating to Remote Sensing of the Earth from Outer Space.[17] The effectiveness of such measures is also suspect as the list of nations with which business cannot be done would vary from country to country. No single nation, regardless of its size or market share, can by itself curb access to high-resolution satellite imagery.

While the last decade was revolutionary for technology, the pace of advancements is only going to increase in the coming years. The potential of commercial markets for applications related to remote sensing and geo-location as well as for value added products is immense. The costs of the imagery in the past had been high because of the high capital input. New age technology is bringing these down substantially and microsatellites with ever improving capabilities are set to revolutionise the domain. Decreasing data cost has resulted in a disproportionate increase in data usage, thereby creating higher revenue opportunities. The newest trend is 'free data'. A company called Urthecast is in the process of setting up high resolution video cameras on the International Space Station (ISS) from which it is promising free near real-time streaming on its website. PlanetLabs, a US company, launched a 24- satellite constellation from the International Space Station recently, through which it intends to supply near real-time imagery of the world, with 3-5m resolution, free of cost,

for socio-economic benefits. Companies are expecting that wider availability of cheap or free data would enable more applications and foster demand. More such projects are in the offing. However, this also has a bearing on nations' concerns regarding transparency.

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There has been a growing clamour in recent times to revisit the international laws and policies related to space and this includes the 1986 Principles Relating to Remote Sensing of the Earth from Outer Space. This is in view of the vast transformations in the geopolitical and technology environment from the times that these had been enacted. Technology proliferation has significantly increased the number of nations having these capabilities and there is a bigger script being played across the world where developing nations are seeking equitable participation in all domains. Commercial imperatives have already seen an increasing relaxation of accuracy controls of the GPS and provision of imagery of ever finer resolution on a non-discriminatory basis. Countries that do not have a substantial presence in space are seeking more coherent international policies as well as regulatory frameworks that would prevent the space-faring countries from denying information arbitrarily. There are some who want the UN Principles to evolve into a treaty so that they may become more implementable. At the same time, the established space-faring nations would legitimately want to restrict data availability to favour national interests. These nations are apprehensive that any new treaties could restrict the freedom of action and relative dominance that they enjoy in the domain. They fear that negotiations could reopen old discussions on the matter, for instance, the need of a previous consent to sense the territory of a country or the previous consent of the sensed country to sell images obtained in its territory.[18] So these nations would support only progression of laws and not favour revisiting discussions

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on the existing regime. What is clear is that technological and commercial interests would force nations to the negotiating table in the near future to make appropriate modifications to the existing laws or for debating new ones for most matters related to space. It would be a complex task to continue balancing the commercial interests against the security ones. It is essential that all current as well as potential non-government operators be engaged while devising these regulations to make them implementable. While totally opening up of the sector would be desirable, too much easing of regulations could be a sure recipe for disaster.

Notes

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