**MINI SATELLITE REMOTE SENSING – A CONVERGENCE OF INNOVATION AND POLICIES**

Kyaw Tin[[1]](#footnote-1)

**KEY WORDS:** Nanosatellites, Commercialization, Big Data

The policies for the commercialization of remote sensing data can be traced back to The United Nations Principles of Relating to Remote Sensing of the Earth From Space (“UN Principles”).[[2]](#footnote-2) The UN Principles were adopted by consensus on December 3, 1983 and have influenced national laws on remote sensing.

Drafted during the Cold War, the UN Principles reflect a give and take between the superpowers, and developing nations. Since satellites then were mostly the exclusive domains of the superpowers and others in the developed world, the less developed countries pushed to include provisions “for the benefit and in the interests of all countries, irrespective of their degree of economic, social or scientific and technological development, and taking into particular consideration the needs of the developing countries.”[[3]](#footnote-3) In return, permission was not required to capture data from a sensed state. This was despite concern that “though remote sensing takes place in outer space, its effects are terrestrial and affects sovereign interests of States.”[[4]](#footnote-4)

The promise of technology sharing with developing countries envisaged by the UN Principles was not realized. Indeed, the UN Principles drove technologically advanced countries to invest in remote sensing programs but the cost of operating a remote sensing system was prohibitive, and the industry remained the sole domain of rich countries.

Although the UN Principles set forth limitations on data dissemination namely, nondiscriminatory data dissemination principles for the sensed state, the extent to which these principles apply to the private sector is unclear. Principle XIV states that “nongovernmental entities” are within the scope of the principles *“[i]n compliance* with article VI of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies”.[[5]](#footnote-5) Some scholars note that since the Treaty relates to “national space activities”, private businesses and private data disseminators are not covered.[[6]](#footnote-6)

The disruptive convergence of affordable remote sensing mini satellites[[7]](#footnote-7) and Big Data means governments and private entities now have an unprecedented opportunity to enter a potentially lucrative market. Although governments are encouraging the commercialization of mini satellites and data analytics, many regulatory hurdles remain hampering innovation in the industry. Building an ecosystem of mini satellites and powerful data analytics will require streamlining the regulatory process, liberalizing data usage rules and encouraging private participation.

**National Policies on Private Sector Remote Sensing**

Since the UN Principles, governments have increasingly encouraged private enterprise involvement in the remote sensing sector. The impetus for this is twofold. First, budget cuts to space programs meant that scarce funds were allocated to more glamorous projects. Second, governments’ realization that they alone could not take advantage of a sector that was experiencing disruption on a large scale. Presented here are some national policies that aim to foster their respective industries.

Some of the many innovations in the secondary uses of remote sensing data are from the US due to affirmative and transparent policies as outlined by the US Commercial Remote Sensing Policy.[[8]](#footnote-8) The policy states its goal as to “enhancing the U.S. remote sensing industry” and pursuant to this, the US has acted to lower resolution limits on private satellites, and make licensing easier for satellites.[[9]](#footnote-9) For example, the US recently allowed commercialization of data sharper than 50 centimeters per pixel.[[10]](#footnote-10) Under the Land Remote Sensing Policy Act of 1992, remote sensing systems must be licensed.[[11]](#footnote-11) Privately funded remote sensing programs have to provide only unenhanced data in accordance with reasonable commercial terms and conditions, and to the sensed state.[[12]](#footnote-12) Unenhanced data means remote sensing signals or imagery products that are unprocessed or subject only to data preprocessing . . . does not include conclusions, manipulations, or calculations derived from such data, or a combination of such data with other data.[[13]](#footnote-13) US rules require notification of foreign data, control, and investment contracts in US-licensed systems no later than sixty days prior to concluding the agreement.

The Canadian Remote Sensing Space Systems Act is similar to US laws and additionally specifies access profiles for raw data and remote sensing products by class of persons, by region imaged, by residency of the End-User and by latency.[[14]](#footnote-14)

Japan sets policies on a satellite-by-satellite basis rather than having a comprehensive policy.[[15]](#footnote-15) Nevertheless, the policies seek to “promote private business activities”.[[16]](#footnote-16) The Government shall also take necessary steps to promote private space business by *inter alia* establish[ing] taxational and financial measures to facilitate investments by private operators.[[17]](#footnote-17) These businesses should also be encouraged to provide not only space-related products but also problem solving (providing solution) services.[[18]](#footnote-18) Private sector entities may procure satellites with private funds while the government would provide user fees to a company as an anchor tenant.[[19]](#footnote-19)

The European Union is still debating a comprehensive policy, and European nations maintain individual satellite imagery-export policies.[[20]](#footnote-20) However, the EU has comprehensive data protection rules that may impact processing of remote sensing data.

According to third-party research, neither China nor India have comprehensive regulations but provide that data usage for low-resolution remote sensing systems, although the definition of “low-resolution” varies, is controlled by the data provider’s contract.[[21]](#footnote-21)

**Building an Ecosystem with value-added data**

Technologies such as cloud computing and data aggregation are transforming the way remote sensing data is used to make decisions affecting the environment, economy, and society. The sharing of computing resources through cloud computing allows the vast trove of data generated by sensors to be analyzed often in real time. Value is added to the sensor data by pulling in data from other sources such as global navigation satellite systems, aerial surveys using photographic cameras, digital cameras, sensor networks, radar and LiDAR. This is also known as Big Data.

In its report on Big Data, McKinsey Global Institute estimates that location data level stood at one petabyte in 2009 and had a growth rate of 20% a year.[[22]](#footnote-22) Even a nanosatellite generates over a terabyte of data per day.[[23]](#footnote-23)

Notwithstanding the lower resolution, powerful algorithms such as pattern recognition can unlock valuable information even from coarser raw data. Some mini satellite remote sensing systems operate with optical resolution of ninety centimeters – a scale that allows measurement of a tree canopy and other data sets of commercial value.[[24]](#footnote-24) Data aggregation can also fill in the holes. By building an ecosystem combining the dynamics of cheaper, high-volume, mini satellites with powerful computing, companies are promising sensing of event-driven activities, and opening up a market for competitive intelligence.[[25]](#footnote-25) Examples of these events include measuring traffic at a shopping mall, number of vehicles parked at a lot, number of fuel tankers servicing aircraft at an airport etc. Even the release date of Apple’s new iPhone can be predicted.[[26]](#footnote-26)

**Falling cost of payload launches**

In the past, the greatest barrier for satellite commerce was the high cost of launching a satellite. However, the launch industry is abuzz with innovation that could bring down the cost to US$200/kilo.[[27]](#footnote-27)

There are now several options available for launching mini satellites. About twelve countries have satellite launch capability. Around twenty private companies are also active in the launch industry. Some are developing new rocket propulsion systems while a few are experimenting with air-launched systems that will use commercial jets to carry a rocket that launches mini satellites. Due to the small weight profiles of the mini satellites, some are even piggybacking off launches for large satellites.

**A Proposal for Private Participation**

Creating the right environment to encourage private participation will require a balanced model of regulatory oversight and liberal policies. Since a government may consider remote sensing a strategic asset, or to comply with international agreements, a regulatory framework will likely encompass activities such as registration of satellites and ground stations, or shutter controls. But this must be calibrated with liberal data policies to drive innovation and investment in the sector. Analysis of the various legal regimes reveals the following policies to be have a positive effect: 1) streamlined and transparent licensing process, 2) liberal commercial secondary data usage policies, and 3) public-private partnership or private enterprise.

*1. Less burdensome regulations for mini satellites*

Generally, international treaties and laws underlie the decision of most countries to regulate remote sensing satellites. These include requirements for launch permits, debris mitigation, and assignment of radio frequencies. In addition, national security reasons dictate strict national regulations for remote sensing platforms with powerful sensors. For instance, the US laws impose restrictions on the resolution of commercial sensors. Data protection and privacy concerns further impose on remote sensing increasing the burden. Countries considering drafting policies should carefully consider the implications of overarching rules versus a more nuanced approach.

Primarily, there should be less burdensome regulations for mini satellites. Sensors on mini satellites typically are less sensitive than on larger satellites and do not approach the prohibited resolution imposed by certain countries. Once their useful lives are over, mini satellites are likely to burn up in Earth’s atmosphere, reducing the risk of debris. Understandably, there should be some restrictions including radio spectrum allocations, satellite orbit information, and data protection.

Some countries appear to recognize that the licensing system should be streamlined. Reforms have cut application times for new satellites.[[28]](#footnote-28) One encouraging model requires only a single license for a “flock” of nanosatellites.[[29]](#footnote-29) Another is to lower liability insurance for mini satellites.[[30]](#footnote-30)

While these changes are welcomed, challenges remain with overlapping regulatory authority or competing regulatory bodies. Radio spectrum allocation generally involves a license from several government agencies and the International Telecommunications Union (ITU). Instead of applying for licenses from disparate agencies, a one-stop service for obtaining the required documentation would drastically simplify the process.[[31]](#footnote-31)

*2. Liberal commercial secondary data usage policies*

The flexible use of data captured by mini satellites will drive investment and innovation in the industry. It is therefore imperative that the analysis, manipulation, sharing, and commercialization of data are permitted with few restraints. With these liberal policies in place, the industry should experience more competition such as lower barriers to entry, efficiencies, and growth.

Many countries with relatively mature mini satellite industries have data dissemination rules that are primarily contract-based. These rules do not, at face value, impose restrictions on secondary processing of raw remote sensing data. However, in practice, export controls, reporting requirement for foreign contracts, and other restrictions hinder the free trade of data. According to Canadian law, customer access profiles that would define what quality of data or product could be released to what class of customer and how quickly.[[32]](#footnote-32) In Japan, the policies may be set on a satellite-by-satellite basis. Moreover, privacy, and intellectual property laws may “chill” any commercial derivative use of the data. Under US laws, foreign contracts for “distribution arrangements” of data must be reported to the regulator sixty days prior to concluding the agreement. Therefore, the inquiry has been to move away from considering what kind of data is being requested to who is requesting it, and why.[[33]](#footnote-33)

Since many of these restrictions were intended for the control of high-resolution data, the coarser resolution data captured by the mini satellites do not warrant the same scrutiny. It is also impractical for companies wishing to benefit from a Big Data ecosystem since advantages of the ecosystem are greatest when there is freedom to share and make derivative use of the information. For mini satellites that capture low-resolution data, the inquiry should still focus on what kind of data is requested. A contract-based approach free from requirements for permits provides the best flexibility for commercialization of data. However, parties contemplating a contract are only able to balance the risks if there is transparency of the laws governing the provisions. Additionally, the dynamism of e-commerce means that contracts must be easily concluded online. Customer access profiles, if implemented for example as database tables, instead of static documents requiring input from the regulator, may allow fast contract drafting. Finally, contracts must be able to delineate derivative use of data such as ownership of IP and third party transfers.

*3. Public-private partnerships or private enterprises*

The disruption of mini satellites and Big Data will have the most impact on nimble and innovative companies. It is not a coincidence that many of the nascent companies are based in innovation centers such as Silicon Valley. Private companies are finding willing financing because although the cost of entry is higher than for some other technology companies, the potential for value-added data is bright. Private technology companies are able to focus on dynamic market needs and staff with the necessary skillsets may be acquired from other tech-focused companies. The trend is also for national governments encouraging commercial enterprises to operate in the space that the state no longer has the funding or the desire to be involved. Wholly private-run operations may also avoid the data dissemination obligations of the UN Principles.

Alternatively, at the onset, a government may desire to retain some oversight of remote sensing activities for reasons including national security to human resource development. It is undeniable that operating a satellite, no matter the size, still requires specialized knowledge that may not exist in the private sector. Indeed, many existing space agencies are government-affiliated, if not wholly controlled. The capabilities for satellite technology may also exist within state universities. Concomitantly, the private sector has far more capabilities for Big Data services. As with private ventures, public-private partnerships should be encouraged to commercialize their work. This will mean relinquishing some control over data. An arrangement where the government entity controls satellite operations with private partners providing data analysis is a likely option. Under this structure, the private partners must be assured of data from the satellites, and a clear delineation must be in place to define intellectual property rights.

**Conclusion**

Mini satellites, cheaper launches and the potential of an ecosystem build around Big Data are providing governments and private companies unprecedented opportunities to enter the remote sensing field. Policies most likely have to a positive effect are streamlined and transparent licensing process, liberal commercial secondary data usage policies, and public-private partnership or private enterprise.

1. Legal Counsel, Myanmar Peace Center. [↑](#footnote-ref-1)
2. U.N. Principles Relating to Remote Sensing of the Earth from Space G.A. Res. 41/65, 42 U.N. GAOR Annex (95th plen. Mtg.) at 2 U.N. Doc. A/RES/41/65 (1987). [↑](#footnote-ref-2)
3. Id. [↑](#footnote-ref-3)
4. U.N. Doc. AI AC. IOS/C. 1 /WG. 4JL. 6 and Add. 1-10 (28 November 1975). The results of an earlier survey conducted by the Secretariat are set forth in U.N. Doc. AI AC. lOS/C.lIWg. 4/CRP. 2 and Add. 1~6. A synopsis of the replies prepared by the COPUOS Secretariat appears in U.N. Doc. AI AC. 105/C lIWG. 41L. 11 (21 February 1974). [↑](#footnote-ref-4)
5. Supra note 1. [↑](#footnote-ref-5)
6. Von der Dunk, F., United Nations Principles on Remote Sensing and the user, retrieved on September 1, 2014 at <http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1016&context=spacelaw>, .p. 39 [↑](#footnote-ref-6)
7. Mini satellites as the term is used here include nanosatellites, Cubesats, Picosats, PocketQubs etc. [↑](#footnote-ref-7)
8. US Commercial Remote Sensing Policy, April 25, 2003, retrieved on September 1, 2014 from http://www.whitehouse.gov/files/documents/ostp/press\_release\_files/fact\_sheet\_commercial\_remote\_sensing\_policy\_april\_25\_2003.pdf. [↑](#footnote-ref-8)
9. Id. [↑](#footnote-ref-9)
10. Foust, J., Commercial remote sensing industry wins change to resolution limits, retrieved on September 1, 2014 from http://www.spacepolitics.com/2014/06/11/commercial-remote-sensing-industry-wins-change-to-resolution-limits/. [↑](#footnote-ref-10)
11. 15 CFR 960. [↑](#footnote-ref-11)
12. 15 CFR 960.11(b)(10). [↑](#footnote-ref-12)
13. 15 CFR 960.3. [↑](#footnote-ref-13)
14. Justice Law Website, retrieved on September 1, 2014 at http://laws-lois.justice.gc.ca/eng/acts/R-5.4/. [↑](#footnote-ref-14)
15. The National Center for Remote Sensing, Air, and Space Law at the University of Mississippi School of Law, The Land Remote Sensing Laws and Policies of National Government: A Global Survey, retrieved on September 1, 2014 at <http://www.spacelaw.olemiss.edu/resources/pdfs/noaa.pdf>, p. 8. [↑](#footnote-ref-15)
16. Article Sixteen of Japan’s Basic Space Law, retrieved on September 1, 2014 from http://www.spacelaw.olemiss.edu/library/space/Japan/34jsl471.pdf. [↑](#footnote-ref-16)
17. Aoki, S., Current Status and Recent Developments in Japan’s National Space Law and Its Relevance To Pacific Rim Space Law and Activities, retrieved on September 1, 2014 at <http://www.spacelaw.olemiss.edu/jsl/pdfs/articles/jsl-35-ii-aoki.pdf>, p. 389. [↑](#footnote-ref-17)
18. Id. [↑](#footnote-ref-18)
19. The National Center for Remote Sensing, Air, and Space Law at the University of Mississippi School of Law, The Land Remote Sensing Laws and Policies of National Government: A Global Survey, retrieved on September 1, 2014 at <http://www.spacelaw.olemiss.edu/resources/pdfs/noaa.pdf>, p. 19. [↑](#footnote-ref-19)
20. Selding, P., U.K. Blocks Bid To Create Common European Imagery Policy, January 30, 2014, retrieved on September 1, 2014 from http://www.spacenews.com/article/civil-space/39328uk-blocks-bid-to-create-common-european-imagery-policy. [↑](#footnote-ref-20)
21. The National Center for Remote Sensing, Air, and Space Law at the University of Mississippi School of Law, The Land Remote Sensing Laws and Policies of National Government: A Global Survey, retrieved on September 1, 2014 at <http://www.spacelaw.olemiss.edu/resources/pdfs/noaa.pdf>, pp. iv – vii. [↑](#footnote-ref-21)
22. Manyika, J., Big data: The next frontier for innovation, competition, and productivity, May 2011, retrieved on September 1, 2014 from http://www.mckinsey.com/insights/business\_technology/big\_data\_the\_next\_frontier\_for\_innovation. [↑](#footnote-ref-22)
23. Technology, retrieved on September 1, 2014 from http://www.skyboximaging.com/technology. [↑](#footnote-ref-23)
24. Skybox,Data Sheet, retrieved on September 1, 2014 at http://www.skyboximaging.com/uploads/10/08/imageryandvideospecsheet.pdf. [↑](#footnote-ref-24)
25. See e.g. Products, retrieved on September 1, 2014 from http://www.skyboximaging.com/products. [↑](#footnote-ref-25)
26. Kim, A., Skybox can predict iPhone launch using satellite imagery, Retrieved September 1, 2014 from http://www.macrumors.com/2014/06/16/skybox-iphone-satellite-imaging/. [↑](#footnote-ref-26)
27. Nanosats Are Go!,The Economist, retrieved on September 1, 2014 at http://www.economist.com/news/technology-quarterly/21603240-small-satellites-taking-advantage-smartphones-and-other-consumer-technologies. [↑](#footnote-ref-27)
28. As fast as 7 days in the US but must approve or deny a license within 120 days. See https://docs.google.com/viewer?url=http%3A%2F%2Fmstl.atl.calpoly.edu%2F~bklofas%2FPresentations%2FSummerWorkshop2012%2FRobinson\_NOAA.pdf. [↑](#footnote-ref-28)
29. The US may already have adopted this approach. See Flock 1 Private Remote Sensing License, September 26, 2013, retrieved on September 1, 2014 from https://docs.google.com/viewer?url=http%3A%2F%2Fwww.nesdis.noaa.gov%2FCRSRA%2Ffiles%2FFlock%25201%2520Public%2520Summary.pdf. [↑](#footnote-ref-29)
30. Response of UK Government to the consultation on Outer Space Act (OSA) reform, December 6, 2013, retrieved on September 1, 2014 from https://docs.google.com/viewer?url=http%3A%2F%2Fwebarchive.nationalarchives.gov.uk%2F20121212135622%2Fhttp%3A%2F%2Fwww.bis.gov.uk%2Fassets%2Fukspaceagency%2Fdocs-2013%2Fgov-response-osa-consultation.pdf. [↑](#footnote-ref-30)
31. Currently, the US requires approval from the National Oceanic and Atmospheric Administration (NOAA) and the Federal Communications Commission. [↑](#footnote-ref-31)
32. Scott Simms on Remote Sensing Space Systems Act, October 4, 2005, retrieved on September 1, 2014 from https://openparliament.ca/debates/2005/10/4/scott-simms-2/only/. [↑](#footnote-ref-32)
33. Id. [↑](#footnote-ref-33)