Dual-Use Satellite Technology

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1. Introduction

The Union of Concerned Scientists' (UCS) satellite database records 1,381 operating satellites currently in orbit around the Earth[1]. The number of states, and even commercial firms, intending to or already intensively engaged in space activities are only continuing to grow, further congesting the already congested commons. Earth observation satellites, weather satellites, communication and navigational satellites provide a wealth of information that strengthen the technological autonomy of a state. It acts as an enabler. It provides valuable applications for economic growth and development in civilian sectors. Global Navigation Satellite Systems (GNSS) provide accurate timing for uses in banking, stock market transactions and power grids. GNSS and Earth observation satellites provide accurate positioning and velocity for uses in surveying land resources, environmental monitoring, precision agriculture and for aircraft landing. Several nations have developed and continue to develop an autonomous global satellite navigation system to counterweight the American military-owned Global Positioning System (GPS). Russia's Glonass system, Europe's Galileo system and China's BeiDou/Compass system are examples of this.

2. Force Multiplier

Aside from its civil application, space technology increases a state's war-fighting capabilities. Operation Allied Force in 1992 in Serbia, Operation Enduring Freedom between 2001-2002 in Afghanistan and Operation Iraqi Freedom in 2003 utilised satellite technology as a force multiplier to improve precision-guided munitions[2]. Here its force-enhancement capability was employed at a tactical level. Also deployed in Iraq, the Blue Force Tracker continues to provide the whereabouts of friendly force vehicles using GPS. This vehicle-tracking system provides military forces with situational awareness and visibility, reducing the fog of war on the battlefield. Today the deployment of precision-guided munitions in military operations is often utilised to increase precision and reduce civilian casualties. In fact, the lack of a full-scale deployment of Russian KAB-500S precision-guided munitions in

[1] Union of Concerned Scientists, UCS Satellite Database, Feb 25 2016, www.ucsusa.org/nuclear-weapons/space-weapons/satellite-database#.Vvf9wOIrKM8
[2] Joan Johnson-Freese, 2013, *Space as a Strategic Asset*, Columbia University Press, pp.96

Russian air strike operations in Syria has garnered much criticism and has been deemed morally irreprehensible and technologically deficient.[3]

3. Satellite Imagery

Satellite images captured through reconnaissance satellites are regarded as visual evidence and referents of the truth that bear geopolitical implications[4]. In the past, they have legitimised policy decisions of inspections, warnings and sanctions. The Cuban Crisis ensued amid images captured by reconnaissance satellite Corona and U-2 aeroplanes of instalments for intermediate-range nuclear missiles in Cuba. Cited as justification for Operation Iraqi Freedom, satellite images were used for arms control verification and revealed activity at known weapons sites which bolstered suspicions of the regime's possession of nuclear weapons[5]. Recent satellite images of North Korea's Sohae Satellite Launching Station published by 38North acted as an early-warning system. It captured higher levels of activity a month prior and 6 days ahead of the Kwangmyongsong-4 satellite launch[6].

4. Dual-Use Technology

Technologically valuable in both a military and civilian capacity, satellite technology is considered dual-use. As such, the conundrum of space-related dual-use technology presents itself when an estimated 95% of space technology can be considered dual-use[7]. For example, the panoptic surveillance capabilities from satellite remote sensing and imaging can be optimised for civil use through Earth resource observations but through reconnaissance systems it can also be optimised for military intelligence applications. In fact, the Israeli EROS-A Earth observation satellite's development which was based upon the designs of Israeli reconnaissance satellite Ofeq-3[8] demonstrates this technological intertwine. With this in mind, whether a space asset's primary raison d'être is explicitly for civilian purposes can then be difficult to determine.

The military capability of dual-use technology provides a strategic advantage. The state does not want its adversary to obtain the same advantage or reach technological parity. In this regard it is seen as a zero-sum game, in the competitive

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[3] Paul Mcleary, Putin's smart bombs aren't that smart, Foreign Policy, Oct 14 2015, http://foreignpolicy.com/2015/10/14/putin-smart-bombs-arent-all-that-smart/

[4] See David Shim, Seeing From Above: The Geopolitics of Satellite Vision and North Korea, GIGA Working Paper, No.201, August 2012,

[5] Dominic McGoldrick, *From '9-11' to the 'Iraq War 2003': International Law in an Age of Complexity*, Oxford:Hart Publishing, 2004 pp.267

[6] 38North, ''Countdown to Launch: New Activity at the Sohae Horizontal Processing Building'', February 3, 2016, http://38north.org/2016/02/sohae020316/

[7] Johnson-Freese, 2013, pp.30

[8] Robert L. Pfaltzgraff, Space and U.S. Security: A Net Assessment, Jan 2009, The Institute for Foreign Policy Analysis, Pp.47

space industry the military gain of one state is a loss for its adversary. Thus, dual-use technology is considered to be sensitive technology. This rings true for the U.S. where stringent US export-controls on dual-use technology are governed by the same export controls that regulate weapons sales so as to confine the technological bleed and preserve its military advantage. Satellite technology and its related components are classified under category XV, Spacecraft Systems and Associated Equipment, of the U.S. Munitions List. Even the computing power of some Apple products are subject to export controls on the chance it may be manipulated for military end-uses, such as in the ‘‘design, development, production or use of nuclear, missiles and chemical and biological weapons and technology’’, as stated in Apple's Global Trade Compliance[9].

5. Restrictive Export Policies

Restrictive export policies have shown to impede the U.S.' influence in shaping the satellite launch market[10]. Today European Ariane launchers dominate the commercial communication satellite launch market. Since the International Traffic in Arms Regulation (ITAR) categorised satellites and satellite-related components under the munitions list in 1999, the U.S. space industry lost its defacto lead in global satellite manufacturing. In fact, licensing requirements for all U.S. components used led to foreign aerospace competitors, such as EADS, Morotta and Surrey Satellite Company, designing and advertising their components and satellites as ITAR-Free (free from U.S.-made components and so not subject to ITAR) – the more desirable option of the two[11]. Recognising the damage dealt, the 2013 National Defence Authorisation Act approved satellite export control reforms. Certain satellite technology, such as commercial communication satellites without anti-jam capabilities and antennas and lower-performance remote sensing satellites, were eased from the U.S. munitions list and onto the Commerce Control list[12]. Time will tell whether this slight manoeuvring will allow the U.S. to regain its market share in the commercial satellite industry.

6. Consequences

As states such as North Korea have shown, if a state wants a technology it can acquire it. Restrictive export policies have the consequence of states acquiring or indigenously developing space capabilities outside of the export regime. India's

[9] Apple, Global Trade Policy, http://www.apple.com/legal/more-resources/gtc.html

[10] Johnson-Freese, 2013, pp.162, pp.254

[11] Committee on Science, Security, and Prosperity; Committee on Scientific Communication and National Security, Beyond Fortress America: National Security Controls on Science and Technology in a Globalized World, The National Academies Press, 2009,

[12] Hugo Meijer, Trading With The Enemy: The Making of US Export Control Policy Toward the People's Republic of China, pp.330

development of space technology is a prime example of this. Following a cryogenic rocket–engine deal, a technology transfer, between Russia and India, India faced U.S. sanctions for violating the Missile Technology Control Regime and then again after India's nuclear tests in 1998. India not only withstood U.S. strong arm tactics to limit the spread of dual-use technology but has launched several satellites and developed its launch capability independently since. Its commercial satellite launch vehicle, Polar Space Launch Vehicle (PSLV) has successfully launched foreign satellites – the Indonesian microsatellite LAPAN-A2, Canadian nanosatellite CanX-2, 3 British DMC-3 satellites and including 4 American LEMUR nanosatellites. [13] [14] It is quickly garnering itself a reputation as a global competitive provider.

6. North Korea – Civilian/Military

Acquisition outside of the regime makes it difficult to ascertain whether the technology is being developed towards scientific or economic development or missile development. The complexity of dual-use technology, whereby nuclear and missile capabilities can be disguised as civilian activity or offensive systems disguised as defensive, conditions an environment of suspicion. This then triggers an action-reaction state of affairs that has an escalatory effect.

The geopolitical and strategic implications on regional security of this pursuit and the technological ambiguity afforded to space technology has been and continues to be demonstrated quite clearly in the Korean peninsula. North Korea's satellite ambitions are problematized as a source of instability in regional and global politics. On February 7 2016, North Korea successfully launched the Kwangmyongsong-4 Earth observation satellite with a space rocket into orbit, a direct violation of U.N Security Council resolution 2087 (2013), 1718 (2006) and 1874 (2009) that prohibits the use of long-range missiles and restricts North Korea from engaging in all activities related to its ballistic missile technology. North Korea's satellite launches are widely perceived as a cover to develop its long-range ballistic missile capability. A month prior, on January 6 North Korea broke the de-facto moratorium on nuclear testing by conducting an underground nuclear test at its Punggye-ri site, which has accommodated nuclear tests in the past. Whilst state media had claimed the underground test was of a miniaturised hydrogen bomb, it was met with much scepticism. Registering a 4.85 magnitude with an explosive yield estimated at 6-8 kilotons, it was consistent with North Korea's 2013 test that yielded an estimated 6-9 kilotons[15]. A hydrogen blast would have produced a greater explosive yield. On March 10 the South Korean military reported two short-range ballistic missiles

[13] Indian Space Research Organisation, Department of Space, http://www.isro.gov.in/launcher/pslv-c30-astrosat-mission
[14] Sharing Earth Observation Resources, Satellite Missions Database, https://directory.eoportal.org/web/eoportal/satellite-missions
[15] Greg Thielmann, ''North Korea's Nuclear Threat: How to Halt Its Slow But Steady Advance, *Arms Control Association*, February 19 2016

launched from Hwanghe Province into the sea, another on March 17 and an apparent failed missile launch on 15 April. The subsequent ballistic missile launches are perceived as attempts to test and develop the technology to be more reliable. Whilst North Korea has not developed the capability to miniaturise a functioning hydrogen bomb yet, the concern is they would swap the satellite payload with a nuclear one and the recent nuclear tests do not alleviate such concerns.

Launching a satellite into orbit requires the use of space launch vehicle technology which by design closely resembles long-range missile technology. In fact, ballistic missiles have in the past been modified as satellite launch vehicles. The decommissioned U.S. Atlas missiles were transformed into a series of space launch vehicles. Similarly, the Soviet Union developed the SL-8 Kosmos from the SS-T IRMB and the U.S. Jupiter missiles were transformed into space launch vehicles Juno[16]. Whilst the dynamics and orbital mechanics are similar, they diverge when it comes to the operational requirements. In the same way, aircraft navigation and precision-guided munitions technology rely on similar parameters but diverge on primary technical differences. The North Korean Unha satellite launch vehicle is inadequate for its use as a ballistic missile[17]. Whilst feasible, the Unha-3 rocket used in the launch is not optimised for military use, it would require additional modifications and flight-testing before its conversion into an ICBM[18]. For instance, it is often the case that ballistic missiles require solid fuel whilst satellite technology requires liquid fuel[19]. Michael Elleman, details the differences between the ICBM/long-range missiles and space launch vehicles more generally. Satellite launchers fly on different trajectories to that of ICBMs[20]. He stresses the Unha-3 rocket's flight trajectory and the second stage of the modified Scud missile and low-thrust engines, are by design consistent with a satellite launch and device intended ''to achieve the radial velocity needed to sustain the orbit''. If the Unha rocket was really intended as an ICBM, it would need to be modified with high-thrust engines and a heat shield to protect the payload'' from the vulnerabilities associated to re-entering the Earth's atmosphere[21].Of the two long-range missiles Musudan and KN-08 that North Korea does possess, a reliable operational status of ICBM development can only be determined after the system has been successfully flight-tested, which North Korea have yet to do. As such, the status of North Korea's ICBM

[16] Robert E. Dundervill et. al. Defense Conversion Strategies, March 2013, Disarmament technologies, Vol.9, Springer Science Business Media

[17] Michael Elleman, ''North Korea's Satellite Launch Does Not Further its Long-range Missile Programme, *ISS*, February 10 2016.

[18] Greg Thielmann, 2015, *Understanding the North Korean Nuclear Threat*, May 12 2015, Arms Control Association, pp.3-5

[19] Kelly K. Shang, ''Tresspass to Airspace: How to Deter North Korea From Its Space Ambitions?, 6(1) Journal of East Asia & International Law (2013), 221.

[20] David Wright, 2012, Union of Concerned Scientists, April 9 2012, http://allthingsnuclear.org/dwright/trajectory-of-satellite-launch-vs-icbm-launch

[21] Michael Elleman, ''North Korea's Satellite Launch Does Not Further its Long-range Missile Programme, *ISS*, February 10 2016.

programme still remains underdeveloped and unreliable until the system has been flight-tested as an ICBM.

7. THAAD – Offensive/Defensive

The series of events and subsequent reactions have had a destabilising effect on the Korean peninsula and on wider security interests, especially in the realm of space security. Much to the dismay of China and Russia, there have been discussions on the possible U.S. deployment in South Korea of terminal high altitude area defence (THAAD), a missile defence system capable of intercepting ballistic missiles, as an additional reassurance for its allies South Korea and Japan. The missile defence system Patriot, a lower altitude hit-to-kill system, already operates in South Korea and a THAAD battery already operates in Guam[22]. In an effort to counter the growing threat North Korea poses, THAAD provides a greater probability of defence coverage against possible ballistic missile attacks. However, the coverage of THAAD system's ground-based radar detection range reaches beyond North Korea and so poses as a security concern for China and Russia who regard such technology in close proximity as offensive rather than defensive[23].

8. Conclusion

Owing to its civilian and military value, satellite technology is considered dual-use, especially concerning the use of space launch vehicles which warranted the U.S. to categorise such technology as 'sensitive' and subject to stringent US export laws. This effort to circumvent the space capabilities of its adversaries has had the unintentional consequence of states developing such capabilities outside of the export regime, indigenously or through technology transfers via other states.

What's more, the capacity to distinguish between defensive and offensive, civil and military use of space technology still remains underdeveloped and subjective. The dual-use nature of space technology, specifically the technological proximity between space launch vehicles, usually leads to over-estimations in military gains. The development of the space launch vehicles in itself is treated as increasing confidence of possessing the technical prowess to convert space launch vehicles into ICBM rocket launchers. The dual-use potential of satellite technology conditions an environment of suspicion and the potential space capability of a state is perceived

[22] Lockheed Martin Corporation, Next Battery Up: Third THAAD Battery Deploys to Guam as Sister Unit Returns Home, March 9 2015, http://www.lockheedmartin.co.uk/us/news/features/2015/mfc-030615-thaad-battery-deploys-guam.html

[23] Matthew Cottee, Between a ROK and a THAAD Place, ISS, March 4 2016, https://www.iiss.org/en/iiss%20voices/blogsections/iiss-voices-2016-9143/march-71d7/between-a-rok-and-a-thaad-place-f193

as an imminent threat which produces enmity and further heightens existing security dilemmas as demonstrated by current events in the Korean peninsula.