Militarisation of Outer Space: Threats, Challenges and Way Forward for Sri Lanka

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Abstract— *With the rapid development of the three dimensions of modern warfare (land, air and sea), many nations have commenced to concern towards space, as fourth dimension of future warfare. Outer Space is considered globally for deployment of weapons: both offensive and defensive. Militarisation of outer space would be an opportunity, for developed countries like US, China and Russia but would be a huge challenge for many under developed countries like Sri Lanka. At present there is a debate at United Nations level, whether outer space should be weaponised, only allowed to placement of defensive weapons, or kept free from all type of weapons. Presently, there are approximately sixty countries that are active in utilizing space for various purposes. The country which controls space has a real time presence and persistence over the globe with a definite edge and dominance in the battlefield as well. The future battle field will be very unimaginable without an effective interface from space-based technology. Space based assets can be used indirectly and directly, and targeting an adversary's space assets through anti-satellite (ASAT) weapons could be a key feature of future warfare. ASAT weapons, Directed Energy Weapons (DEW) would be considerable trends of space militarisation. Successful military operations on ground, air and sea would depend heavily on how efficiently space resources are exploited.*

Keywords—**Outer Space, Satellite, Militarisation of Space, Weaponization of Space, Anti-Satellite (ASAT) weapons**

I. INTRODUCTION

Earliest signs of space exploration began in 20th century as the United States and USSR began their race to dominate the space frontier. Military applications of space technology were researched and surveillance, navigation, reconnaissance, weather forecast, etc… were found to be force multipliers in modern wars (Deblois et al., 2003). Missile and space technology showed great potential of being a war winning factors. According to the Sheehan and Bormann (2012) militarisation of space is not limited to weapons only and can include placement and development of military technology for other tasks as well. Unimaginable dividends of ultimate high ground made outer space a must avenue for contemporary militaries around the globe to be exploited (Lalitendra, 2010).

Weaponization and militarisation of space are two different concepts, weaponisation means deployment of weapons in space where as militarisation is a broader term dealing with all kind of use of space for military purposes i.e. use of satellites for communication, navigation or reconnaissance (Rathgeber et al., 1999).

Foregoing in view, analyse the progress made so far in militarisation of space by the contemporary countries in general while highlighting the related threats and challenges for Sri Lanka with a view to recommend viable way forward.

II. RESEARCH QUESTIONS

1. What is the progress made in militarisation of space by contemporary countries?
2. What is the progress of space programmes in South Asia?
3. What is the viable way forward for Sri Lanka to remain relevant?

III. TAXONOMY OF SPACE

It is important to develop an understanding of taxonomy of space before focus on militarisation of space.

A. Outer Space

Outer space, or just space, is the expanse that exists beyond the earth or outside of any astronomical object. Outer space does not begin at a definite altitude above the Earth's surface. However, the Kármán line, an altitude of 100 km (62 miles) above sea level, is conventionally used as the start of outer space (Sharp, 2017).

B. Militarisation of Space

Militarisation of space involves the use of space and related technology to support military operation (Jaspal, 2008).

C. Weaponization of Space

Weaponization of space is development and deployment of weapons to be used in and from space for defensive or offensive purposes, thus turning space into a conflict zone (Mowthorpe, 2004).

D. Satellite

In the context of spaceflight, a satellite is an artificial object which has been intentionally placed into orbit. Types of Satellites with respect to their application are given below:

1) Communication Satellites: It is a satellite that transmits the signals such as telephone, television, radio, internet signals over long distances using light signals or electromagnetic waves. Communication satellites are of two types: active satellites and passive satellites (Liu et al., 1999).

2) Navigation Satellites: It is a constellation of satellites which indicates/identifies geographic location of ships, aircrafts or any other object on earth or in space and thus help in navigation. The United States Global Positioning System (GPS) is operational since 1978 and globally available since 1994, GPS is the world's most utilised navigation system (Ahmed, 2002).

3) Earth Observation Satellites: Earth observation satellites are mainly used to observe the earth from its orbit. These satellites detect the changes in the earth vegetation, ocean colour and radiation from the earth surface. These satellites are also used to map the terrain (Gary, 2007).

4) Astronomical Satellites: An astronomy satellite is basically a really big telescope floating in space. Astronomical satellites are used to observe the distant galaxies, stars, planets, natural satellites, and other objects in the space. Astronomical satellites are mainly used to find the new planets, stars and galaxies (Neugebauer et al., 1984).

IV. PURPOSES OF SATELLITES

Using the Union of Concerned Scientists (UCS) update 2019, the main purposes for the operational satellites are shown in Table 1.

Table 1: Main purposes for the operational satellites

Ser	Satellites	Number
1.	Communications	777
2.	Earth observation and science	735
3.	Technology development / demonstration	223
4.	Navigation / positioning	137
5.	Astronomy	85
6.	**Total**	**1957**

Although, it should be noted that some of the satellites have multiple purposes. These satellites are shown in Table 2.

Table 2. Satellite users

Ser	Used By	Number
1.	Commercial users	848
2.	Government users	540
3.	Military users	422
4.	Civil users	147
5.	**Multiple uses**	**279**
6.	**Total**	**1957**

V. PROSPECTS OF OUTER SPACE MILITARISATION

A. Communication Satellite

Besides civil applications of communication satellite, these are also used for military communications. The communication satellite provides the capacity for instant, secure, hardened and survivable communication between operational forces and their national command authorities (Whalen, 2002). Hence communication satellites are extensively used for strategic applications to gather information for military support missions.

B. Battle Space Awareness

Due to following applications of remote sensing satellites, they are effective in improving battle space awareness of forces:

i. Intelligence, surveillance and reconnaissance.
ii. Target identification and analysis.
iii. Terrain analysis.
iv. Mapping of military assets.
v. Monitoring new military developments.
vi. Detects disposition of forces.
vii. Battle damage assessment.
viii. Illegal border crossing & ship detection.

C. Navigation

Global navigation satellites systems like GPS (US), BeiDou (China), GALILEO (European Union), GLONASS (Russia) and IRNSS (India) provide following benefits to the user countries:

i. Missile guidance.
ii. Coordination and navigation of military troops.
iii. Target tracking.
iv. Reconnaissance.
v. Nuclear detonation detection system.
vi. Anti-ballistic missile systems.
vii. UAVs/ military aviation.
viii. Search and rescue of downed pilots.

D. Anti-Satellite Weapons (ASATS)

These space weapons can incapacitate or destroy satellites for strategic military purposes. There are two approaches i.e. kinetic kill and disabling satellites without

destruction like energy/ laser directed weapons. Countries like US, Russia, China and India possess this technology.

VI. MILITARISATION OF SPACE BY CONTEMPORARY COUNTRIES

According to United Nations Office for Outer Space Affairs (UNOOSA), there were 4987 satellites orbiting the planet at the start of year 2019 including 1957 operational satellites (Union of Concerned Scientists, 2019). Only twelve countries (USSR, USA, France, Japan, China, UK, India, Russia, Ukraine, Israel, Iran and North Korea) and one regional organisation (the European Space Agency, ESA) has capability to launch satellites on their own indigenously developed launch vehicles. Six government space agencies i.e China National Space Administration (CNSA), European Space Agency (ESA), the Indian Space Research Organisation (ISRO), Japan Aerospace Exploration Agency (JAXA), National Aeronautics and Space Administration (NASA) and Russian Federal Space Agency (RFSA or Roscosmos) have full launch capabilities. These include the ability to launch and recover multiple satellites, deploy rocket engines and operate extra-terrestrial probes. Thirty-one satellite launch sites are operational worldwide (Andy, 2019). Summary of space programmes of contemporary countries are shown in Table 3.

Only three currently operating government space agencies in the world (NASA, RFSA and CNSA) are capable of human spaceflight. Currently there is only one manned space station orbiting the earth known as International Space Station (ISS). It is a multi-national project which is continuously evolving. Its basic structure was completed between 1998 and 2011 and has been occupied since November 2000. As of March 2019, 230 individuals from 18 countries have visited the International Space Station. Top participating countries include the United States (145 persons) and Russia (46 persons). The ISS includes contributions from 15 nations. World government expenditures for space programmes are shown in Figure 1.

World's space nations can be classified into advanced, space faring and emerging countries considering their space budget, satellite launch capabilities, space stations, moon bases and inter planetary travels, etc. as shown in Table 4.

Table 4: Space nations

Ser	Classification	Country
1.	Advanced	USA, China, Russia
2.	Space Faring	Brazil, France, Germany, Italy, India, Iran, Israel, Japan, South Korea, UK
3.	Emerging	Algeria, Argentina, Bangladesh, Egypt, Mexico, Nigeria, Pakistan, Philippines, Turkey, Saudi Arabia, UAE, Vietnam

Source:

VII. SPACE PROGRAMMES IN SOUTH ASIA

A. India

India initiated her space program in 1962 with setting up Indian National Committee for Space Research (INCOSPAR). During the following decades India has progressed tremendously in space technology (Isro.gov.in., 2019). Indian space program touched its peak in 2017 when she made a record of most satellites launch in one mission by launching 104 satellites (including 101 foreign satellites, one each from Kazakhstan, Israel, Netherlands, Switzerland, United Arab Emirates (UAE) and 96 from United States of America). While with the success of anti-satellite (ASAT) missile test which was named Mission Shakti on 27 March 2019, India now has registered its military presence in space. The militarisation of space by India through establishing credible space deterrence has posed new threat to peace in the region and has a potential to initiate a new arms race in space.

B. Pakistan

Pakistan's space program is fairly wide-ranging and diversified. It covers many fields of space science, technology and their applications. Pakistan's space programs are being implemented through its national space agency, Pakistan Space and Upper Atmosphere Research Commission (SUPARCO). It is mandated at furthering research in space science and technology by enhancing capabilities and capacities in the related fields for achieving the ultimate objective of self-reliance and

Table 3: Summary of space programmes

Ser	Capability	USA	RUSSIA	China	UK	India	Israel	Turkey
1.	Space programme started	1958	1950	1959	1959	1962	1982	2005
2.	1st Satellite Launched	1958	1957	1970	1971	1980	1988	2011
3.	1st Human flight	1961	1962	2003	No	No	No	No
4.	Satellite Launch capability	Yes	Yes	Yes	Yes	Yes	Yes	No
5.	Total active Satellites	830	150	280	12	47	12	10
6.	Military Satellites	168	104	100	10	3	6	8
7.	Space Budget in 2016 (USD Mn)	35957	3182	4909	743	1500	155	110
8.	Earth observation spatial resolution	0.31m	1m	0.8m	6m	1m	0.5m	2.5 m
9.	Nav sys, accuracy	GPS 1-5 ms	GLONASS 4.5-7.4 ms	Beidou 0.1 – 10 m	No	IRNSS 10 m	No	No
10.	ASAT cap	Yes	Yes	Yes	No	Yes	No	No

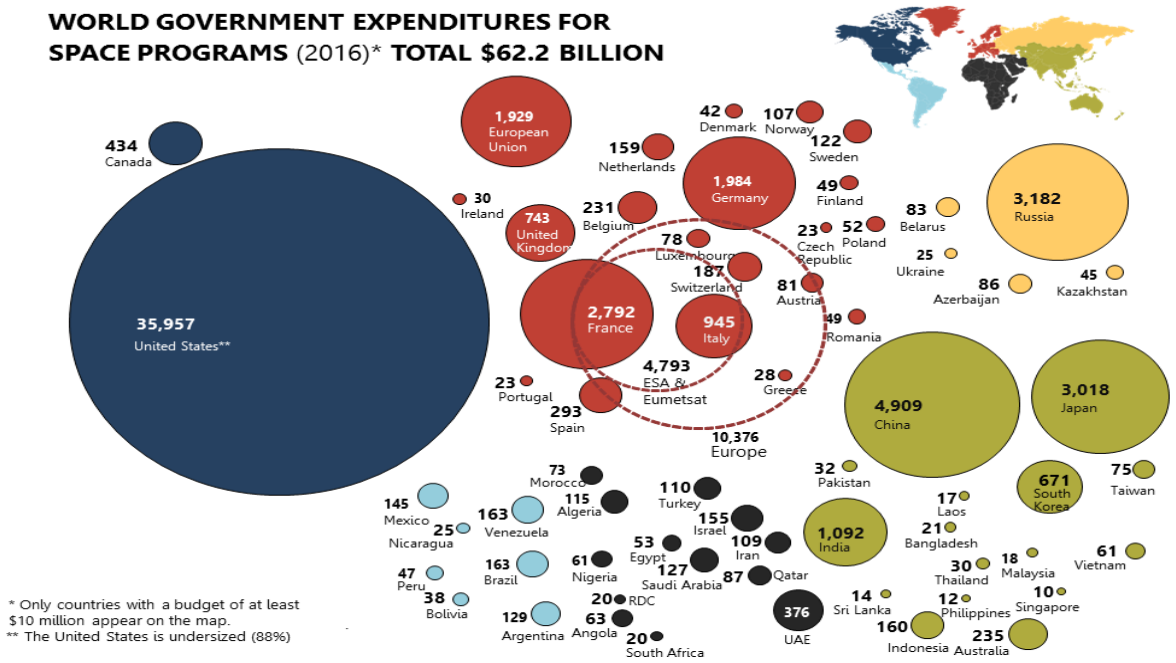

Figure 1. World government expenditures for space programmes
Source: http://euroconsult-ec.com

socio-economic development of the country (Albatross, 2012). On 07 June 1962, first sounding rocket Rehbar-I was successfully launched by SUPARCO. With this launch Pakistan had the honour of becoming the third country in Asia and the tenth in the world to conduct such a launching. Pakistan's Space Program 2040 is a satellite development and launch program of SUPARCO. Under this program five geosynchronous earth orbit (GEO) (35,786 kilometres above earth) satellites and six low earth orbit (LEO) satellites will be launched between 2011 and 2040.

VIII. WAY FORWARD FOR SRI LANKA

Struggling economies coupled with limited capacity in space development like Sri Lanka, cannot afford to indulge in this expensive arms race. Therefore, Sri Lanka must ardently support the initiatives of banning all sorts of military activities in outer space. However, at the same time, Sri Lanka cannot afford to remain aloof of developments taking place in domain of space militarisation. Hence, proposed way forward for Sri Lanka are as follows:

A. Global Partnerships

Sri Lanka will require considerable time to be mature in the field, till then reliance on global partners will have to be resorted to. Turkish model of collaborating with space faring countries and simultaneously developing own public and private sector expertise for space is recommended to be adopted. Following recommendations are proffered to garner support from global partners:

i. Use of an alternative Navigation System. Sri Lanka currently operates only on US GPS navigation system, which can be unreliable in times of dire need. Therefore, as a short-term measure to ensure reliability, it is recommended to use another system such as GLONASS or BEIDO.

ii. Sri Lanka should use its diplomatic and scientific institutes for propagating their own space program in order to gain support and investment in space domain. In this regard can gain support from USA, China, India, Pakistan and other technologically advanced countries like Turkey.

iii. India is known to have inducted a large number of experts from Russia, Yugoslavia and Czech Republic. Sri Lanka should also adopt a similar assistance by hiring foreign experts for its space program.

iv. Collaboration with Chinese Academy of Sciences (CAS), Indian and other Chinese universities in training and educating future Sri Lankan space scientists and researchers.

B. Awareness Programmes

Awareness about space in the country is found wanting and requires a deliberate effort at all levels. Following recommendations are proffered in this regard:

i. Government Level

(1) National media and social media networks should be harnessed to promote

awareness about space applications amongst the masses.

(2) Dividends of adopting space sciences as a professional career be made public to attract more people joining the profession.

(3) Government must plan to create a Space Park with the aim of creating awareness and encouraging students and private sector.

ii. Armed Forces Level. Followings are recommended to create awareness on the subject in Armed Forces:

(1) At Security Force Head Quarters level, study periods and symposiums be organised to create awareness about militarisation of outer space.

(2) Topic of outer space militarisation be introduced to all types of training establishments.

(3) At Command & Staff College, followings are recommended:

(a) Militarisation of outer space be introduced as a subject in future warfare package.

(b) A tutorial or tutorial exercise should be introduced on the subject in final term.

(c) More number of specialist guest speakers be invited to deliver talks on different avenues of space militarisation.

C. Policy Initiation

Dedicated organisational structures are being created in order to efficiently utilize the space-based capabilities in support of military operations. i.e. China's New Strategic Support Force (SSF), Integrated Space Cell (ISC) of India etc. These organisational arrangements assist in specific management and integration of space-based data, technologies & services on singular platforms. Effective system architecture would help Sri Lanka to shape the security environment, protect critical infrastructure, borders and coastlines. Following steps are recommended in this regard:

i. Organisational Framework. A higher policy level forum may be formed at Ministry of Defence with reps from Arthur C. Clarke Institute, Centre for Research and Development, Resource personals from Universities & tri-services for formulation of Space Power doctrine that enumerates various active and passive measures to minimize the emerging threat to national security along with a tangible plan for enhancement of Sri Lanka's space programme through program level objectives.

ii. Expansion of Arthur C. Clarke Institute. It is required to be expanded this valuable organization by introducing new fields which are essential to create credible space workforce.

D. The Doctrine

Main pillars of the doctrine recommended to be formulated are as under:

i. Sustained Government Support. Government needs to display its sustained support to the concept through adequate funding and acceleration of the process. In order to achieve this, a strong support to the socio-economic development process through space-based technologies, information and services is mandatory. This would not only resolve one of the core impediments i.e. the funding issue but will also generate a broader support and acceptance of Space Power in public sector.

ii. National Acceptance. Attainment of Space Power requires immense acceptance as a national objective and wide acceptance amongst masses. Basic know how of the subject must begin from the school level and important topics in the field of space technology to include satellites basic functioning principles and laws involved in the flight of missile. At higher level more details be added, thus, making it a progressive learning process about the field.

iii. Establishment of Space Science Faculties in Universities. A dedicated space science faculty in each university is suggested to be established, initially at national level and subsequently at other training institutes to increase the indigenous expertise in space sciences.

E. Miscellaneous

i. Budget Allocation. Sri Lanka needs the basic technological wherewithal to further its space program; however, budget constraint is one of the main impediments. To help resolve this issue, private sector like local TV and radio channels, communication networks can be motivated to invest for developing an indigenous satellite.

ii. Cost Efficiency. Sri Lanka needs to accelerate research and development and focus on minimizing the cost of space programs. It will increase international relevance of its space program and attract international investment. It is recommended to research on Nano satellites, which are cost effective and be replaced quickly to ensure continuous operations. Indian capability of cheap satellite launching facility is a case in point.

iii. Miniaturisation of Satellites. Sri Lanka must not follow the previous designs of military satellites as they

carry colossal price tags. Instead, smaller and cheaper satellites must be worked out which has the potential to be replaced quickly.

iv. Passive Countermeasures. The application of camouflage, concealment and deception to hide military forces and to obstruct the overhead viewing of other strategic assets will provide some protection against satellite reconnaissance. During peacetime the important radars, weapons and communication systems should be provided camouflage and concealment with adequate radiation absorption materials. The innovative camouflage/concealment techniques need to be adopted to conceal strategic facilities, like stealth plates, IR shields and camouflage paint.

IX. CONCLUSION

Initially, space programs and technologies were used for communication, reconnaissance and navigation but due to changing patterns of future wars, the use of space for military purposes is exponentially expanding. Countries like USA, Russia, China, India and numerous others are committed to enhance their sphere in outer space including its military applications. Militarisation of space is an emerging trend which is likely to be used immensely in future conflagrations. South Asia, home to two nuclear armed nations is also witnessing progress in militarisation of space. Therefore, Sri Lanka should initiate its space programme with the collaboration of friendly nations in order to remain relevance with emerging trends in militarisation of space.

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