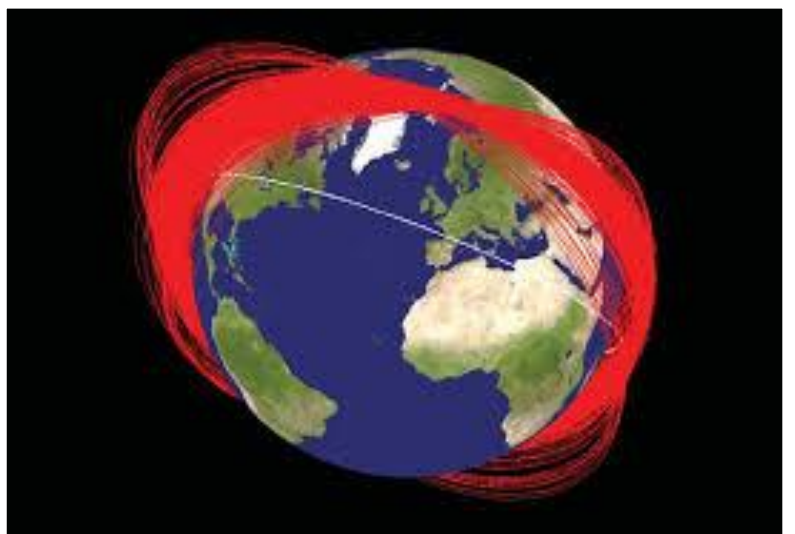


Anti Satellite Weapons: A Likely Future Trajectory



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About the Author



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Lt Gen Saxena is a former Director General of the Corps Army Air Defence. The officer, as a Scholar Warrior, is a distinguished member of the country's strategic community, and is a prolific writer on military subjects. He has authored 5 Books, two on Air Defence, two on United Nations and one on Combat Leadership.

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Anti Satellite Weapons: A Likely Future Trajectory

Anti Satellite Weapons (ASAT) weapons, as the name goes, are the space weapons that are capable of destroying space assets of the opponent for the purpose as may be intended by the attacker. My case in this piece to flag the point, that such class of weapons, in the hands of the leading space faring nations are growing at a feverish pace. And the irony is that the current body of legalese in the form of Space Laws are incapable and/or impotent in checking the menacing upward growth of such weapons. If we continue at today's unforgiving pace, it will not be an act of fancy to imagine a war of adversaries in the space out to destroy each other and one another's satellites (and collaterals, sic) and thus crippling a whole mankind for what they depend so hugely on today. A world unimaginable without communications, smart phones, navigation, internet, GPS, global connect, planetary data share and more, may be closer to reality than one thought.

The Mother of ASATs: ASATs have not suddenly appeared from nowhere; the concept of ASAT weapons has evolved over time as a logical progression from the mother concept of Anti Ballistic Missiles (ABM) or its more recent coinage, the Ballistic Missile defence (BMD) - a Missile-based defence against the adversary's threat of Ballistic Missiles. How and when the BMD ushered in the ASAT, is an interesting metamorphosis

The Three Era. Along the tide and time, three specific eras are detectable in coming of age of the ASATs through the BMD kernel.

- The first era belongs to 1950s and 60s, when, in the midst of the Cold War fever, the then two space faring Nations, i.e. the US and erstwhile Soviet Union, thought of countering the adversary's ballistic missiles by putting nuclear tipped interceptors atop their ICBMs. Those were the exciting times of the 'show of mighty force'. One heard of the US Spartan, Nike, Sprint, and Sentinel while the Soviet counter power was carried on the likes of Griffin, Galosh. Gazelle and Gorgon ICBMs
- The impracticality of exploding huge nuclear warheads in space for the cause of BMD, the danger of collateral spread of catastrophic radiations and the sheer inaccuracy of nuclear tipped monsters in killing something as precise as an incoming ballistic missile (probably

only a residual stage or a warhead section), actually caused the death to the idea and the practice of nuclear-tipped monsters as BMD arsenal.

- This NO GO scenario ushered the next era of non-nuclear hit-to-kill interceptors based on Kinetic kill. Somewhere around this time in Mar 1983, came the bright idea of Strategic defence Initiative (SDI). It promised the next level of technology to kill the adversary's incoming ballistic missiles. One heard of the grandiose plans to deploy high-powered lasers, orbiting X ray lasers, particle beam weapons and 'brilliant weapons'.

President Bill Clinton, later finding the SDI unrealistic and carrying the danger of destabilising the Strategic Offensive Doctrine based on Mutually Assured Destruction dissolved it and set pace for its successor organisation, called the BMDO (Ballistic Missile Defence Organisation). BMDO aimed to put in place, a missile defence regime based on the concept of layered-and-tiered deployment. In this, weapons were fielded for different layers of altitude, viz Lower Tier/Upper Tier and Strategic Tier. Cumulatively, these systems aimed to take on the incoming ballistic missiles of the adversary in various stages of their incoming flight from the boost to mid-course to the terminal phase. We are in these current exciting times when the science and technology is trying to inch forward to take on multiple challenges to kill the adversary's incoming missiles as early as possible (post launch) in their journey to their targeted destinations. Some of these challenges include the boost phase interception/ taking on MIRVs prior to re-entry/ linking up space based surveillance assets with ground and air based sensors/ placing soft powered interceptors in space for ready kill of incoming missile threats, et al.

Enter ASAT. Actually ASATs as a concept, never made any dramatic (never before) entry in the above BMD growth cycle. ASAT as an idea, grew alongside BMD and initially manifested as BMD systems taking on satellites instead of incoming missiles. Initial systems were based on kinetic kill, later on other more technologically enabled avatars of ASATs appeared. The ones based on laser or particle beam weapons or as micro satellites capable of co-orbital killings. This threatening trend of ASAT development is growing menacingly with China in the forefront. That is the issue.

A Snapshot on ASAT Weapons^{1,2}

Without clogging the main argument with avoidable factuals, here is a snapshot of ASAT weapons in the hands of the leading space faring nations.

USA. US has been through it all and cutting edge research continues:

ASAT development started in fifties (1958-59) with the nuclear tipped Air Launched Ballistic Missiles (ALBMs) atop strategic bombers (initially B 47 later B 58). The weapon was tested on the American satellite Explorer VI. The Interceptor passed 6.4 Km of the satellite. A huge success.

In early sixties, a Direct ascent interceptor was developed. It used a ground ballistic missile tipped with a nuclear warhead (Programme 505). It was tested in early sixties, several times. The weapon could successfully intercept a designated point in space at 100 miles. Later, higher range missiles were introduced taking the capability to target satellites as high as, 1300 km (Programme 437).³

In eighties, an F 15 aircraft was used to launch AGM 69 Short Range Air to Surface Missile as a launch vehicle that carried a Miniature Vehicle (MV) as the payload (ASM 135 ASAT). The MV used an IR sensor to home on the target satellite. Taken through five tests, the weapon destroyed a US P-78-1 spectroscopy satellite at 285 km.

In 2008, Aegis Missile system employing a ship-fired RIM 161 Standard Missile 3 was used to destroy a US spy satellite USA 193 at an altitude of 247 km.

The higher versions of the Aegis missile system having the range capability between 1450-2350 Km are under development. This capability will virtually encompass all the operational satellites in Low Earth Orbit (LEO) that includes 100 Chinese and Russian Satellites. The system was to start testing in 2015 and was to be operational in 2018.

¹ [http:// www.en.wikipedia.org/wiki/anti-satellite weapon](http://www.en.wikipedia.org/wiki/anti-satellite_weapon)

² [https://www.thespacereview.com.article.through-a-glass-darkly-chinese-american-and-Russian-anti-satellite-testing-in-space;Page1,page2,Page3](https://www.thespacereview.com/article.through-a-glass-darkly-chinese-american-and-Russian-anti-satellite-testing-in-space;Page1,page2,Page3)

³ [https://www.forum.nasaspaceflight.com>Anti-Sat Weapons \(Programme 437 \(US Nuclear ASAT system](https://www.forum.nasaspaceflight.com>Anti-Sat_Weapons_(Programme_437_(US_Nuclear_ASAT_system)

Apart from hard kill, US is known to have the capability of soft kill (Counter Communication Systems) having a capability to interfere with adversary's use of a satellite (Jamming/ Radio frequency interference techniques et al).

Soviet Union/Russia:

Unlike the US, Russia and China preferred a co-orbital ASAT weapons. The first system in this category (Istrebitel Sputnikov or fighter satellite consisted of a kill vehicle and a launch vehicle based on an ICBM (R 36). After being placed in the orbit, the kill vehicle would manoeuvre to intercept the target satellite and detonate on-board explosives. It was tested successfully several times in sixties, seventies and eighties on Cosmos series of satellites. Over time, targeting altitudes were increased (up to 2000 km) and reaction times to sync with the target satellite were reduced (number of orbits required by the ASAT to home on to their target).

As years rolled, another rocket based hit-to-kill system (Naryad System) with a capability to go up to tremendously high altitudes (40,000 kms) as an upper stage of a satellite vehicle was developed. Once in orbit, the rocket system had the capability to independently manoeuvre and home in on multiple target satellites before exploding.

In response to the US ASM 135, Russians developed a direct ascent ASAT system (Kontakt System) using a Mig 31 D fighter mated with a 33 ft long interceptor (it reached a maximum altitude of 1500 km into space). Accurate tracking of target satellite was ensured by a ground based laser optical locator. This ASAT was capable of destroying up to 36 satellites in less than 24 hours.

Open sources reported the testing of the new Russian ASAT missile called Nudol on 18 Nov 2015. Nudol is a direct ascent missile system with a capability to take on target satellites in kinetic kill mode. Reportedly, Nodol may be a part of Project Samolet - M , a project to upgrade the Moscow missile defence.

Russia's 2010 Military Doctrine emphasises space as a crucial component of its defence strategy which gives high priority to conduct of ASAT research and employment of satellite jammers. Russian President has stated in open media that Russia is following China in

building state-of-the-art-weapons that would guarantee the fulfilment of space defence tasks for the period until 2020.^{4,5}

China.⁶

Open sources report that among the various space faring nations, China is developing its ASAT capability at the most feverish pace. Reportedly, Chinese ASAT weapons are under development ever since 1964 (Programme 640). The initial aim was to develop an ABM missile but around 1970, it started an ASAT programme.

Three types of ASAT systems are under development, namely, Direct Ascent Systems, Soft Kill Systems and Micro satellites.

Direct Ascent Systems feature a land-based missile that is directed against the target satellite as a kinetic kill vehicle. The launch of SC 19 Missile on 11 Jan 2007 to kill the ageing FY -1C polar orbit satellite of the Fengyun Series was the apt demonstration of this capability. Though the above was a land-based launch, open sources report of a similar capability having been created to launch SC 19 class of missiles from Lin class of submarines. That 2007 ASAT test has been classified as the highest man-made debris generation event in the history so far, is another huge concern.

Another SC 19 Missile destroyed an MRBM (CSS-X-11) in 2010. Though the act was of ABM defence, it was also seen as a reinforcement of the ASAT capability demonstrated in 2007.

In the soft kill capability, China is reportedly developing high power laser and microwave weapons that can either disrupt or electrically damage a satellite. One such high power laser is under development since 1995 and was tested on an orbiting US satellite 2006.

In 2008, the two astronauts on board Shenzhou 7 reportedly released a microsatellite that flew at a relative speed of 17000 mph and passed dangerously close (27 Km) to the International Space Station (ISS). At such relative speeds, a possible collision could have destroyed both the objects.

⁴ <http://www.nationalsecurity.news/russia-now-testing-anti-satellite-weapon>.

⁵ <http://www.natonalinterest.org/get-ready-america-russian-and-chinese-have-space-weapons>.

⁶ [https://www.en.m.wikipedia.org/wiki> asat-program-of-china](https://www.en.m.wikipedia.org/wiki/asat-program-of-china)

In May 2013, the Dong Neng 2 (DN -2) ASAT interceptor test kicked up quite a storm in expert circles of space-faring nations. It launched an object on a high sub-orbital altitude more than 18600 miles. While China claimed it to be scientific payload to study the upper ionosphere, analyst described it as a ASAT system with a capability to enter deep space and threaten target satellites across the entire altitude bracket of geo-centric orbits (Low Earth Orbits or LEO - up to 2000 km, Medium Earth Orbits or MEO - 2000 km to 35786 Km and High Earth Orbits or HEO - higher than 35.786 Km). Mystery still surrounds this test.

According to a 2015 Report by the US-China Economic and Security Review Commission, PLA assesses that US satellites are critical to the country's ability to sustain operations globally. Destroying or capturing satellites and other sensors will deprive the opponent, the initiative on the battlefield and will make it difficult for them to bring their precision-guided munitions into full play.

Open sources reported that above was followed in Oct 15, with another test of an Exo-atmospheric vehicle (DN-3) based on the principle of catastrophic kinetic kill. The Report of Chinese building space warfare arsenal at a fast pace have been rife all along in the early months of 2016.

India.⁷

Open sources have gone this far as to talk about the ASAT capability of India? Mercifully, the expert opinion is stopping at the capability and not any further. Intentions could be any.

Mention is being made of 5000 km Agni V that travelled up to 600 kms in space during its last parabolic trajectory. This capability is being mated with the kinetic kill vehicle of the Indian BMD Programme (Programme AD) to produce an Exo-atmospheric kill system.

Normally an ASAT weapon is to reach about 800 km into space. The current capability can be easily enhanced since that will be a function of propulsion boost only.

⁷ <https://www.ibcworldnews.com>indian-defence's-new-target:Anti-Satellite-Weapons>

I will stop this here without any comments. Let open sources keep the ambiguity alive - capability/possibility/intention?

The So-What Question. Facts as above, actually, mean only a pot-pouri collection of data unless it leads to the big picture. The answer to the 'So What question'. Towards this, I present the following :-

- What is the emerging position?
- Are the ASAT tests legal? If not, can the proliferation of ASAT be controlled?
- The Bottom-line

Emerging Position.

Where is the doubt that that the ASAT idea was born with the dawn of space age itself. Its precursor was the ABM defence. ABM/BMD to ASAT is a smooth/seamless and logical transition. For a brief time period at the height of Cold War, when the national space systems of the main players became an increasingly important part of the National Technical Means of Verification (NTMV) for various Arms Control Agreements, the interest in ASAT weaned, but with the demise of Cold War, the pace picked up tremendously.

It is an open secret that all the leading space-faring nations are actively pursuing counter-space capabilities which broadly include Direct Ascent Anti Satellite Missiles, Co-orbital Anti Satellite Systems, Computer Network Operations, Ground Based Satellite Jammers, and Directed Energy weapons.

If we go by the open source, then China seems to be leading the ASAT race with Russia in a close tow. These are capable of directly threatening the US space lifeline in any future conflict. Though many a lamenting voices are being heard on US strategic vulnerabilities, on how the Congressional cuts in space funding is putting US at a strategic disadvantage, this analyst believes that no one is any less. If you nearly control the global open source, you tell less about you than others. However, a discerning mind knows that there is more than what meets the eye. I say this in context of US though some of their SOS cries are viable.

The technology revamping up the ABM capability from the terminal to mid-course interception has come as a shot in the arm for the ASAT capability that has got a quantum range-altitude boost, especially in the category of hit-to-kill ASAT weapons. In fact, all midcourse Ballistic systems have inherent ASAT capabilities.

There has been a self-defeating effort on the part of US to create a duality between the midcourse BMD systems (say SM 3) and the direct ascent Kinetic energy interceptors (like the Chinese SC 19). By calling the former as low-altitude direct ascent interceptor and the later, as kinetic energy weapon. It is like calling the Peter, Pam when both are same. The typical Mine OK yours Not OK syndrome. It doesn't really carry.

The race to acquire ASAT capability is going on unabated. One nation setting a challenging pace and putting the others in a vicious merry-go-round.

Are ASATs legal?

Before seeing the legality, let me put the weaponisation and militarisation argument to rest. How does it sound when I say that with all the humdrum at the global level of using the outer space - the 'province of mankind' for 'peaceful purposes', the same, technically speaking, long stands weaponised, what to talk of its militarisation, that happened ab-initio. That is the truth, as I will unfold in technical terms in due course.

Moreover, putting legality aside, the ASAT tests of the leading space-faring Nations are going unhindered- Chinese ASAT test in January 2007, 2008, 2013, 2016...US ASAT tests 2008, 2010.. Russians ASAT tests 2010, 2014 ,2015.... The world is crying hoarse over the debris issue causing an EXISTENTIAL THREAT to the common asset of the humanity on which the entire Planet has come to depend LIKE NEVER BEFORE Who cares?

Why? The Big Question. Why it is happening unabated? Why nobody can crack a whip. Sample this commentary:-

The OST, 1967 or more formally, 'The Treaty or Principles Governing the Activities of States in Exploration and Use of Outer Space, including Moon and Other Celestial Bodies', not only forms the basis for International Space Laws, but also, has the widest acceptability in the world community (as of Sep 2015, 104 countries are a party to the treaty, another 24 have signed but not completed the ratification).⁸

In its essence, the OST lays down (only relevant portions quoted) the following:-

It bars the States Parties from placing nuclear weapons or any other weapons of mass destruction in the orbit of earth, installing them on Moon or any other celestial body or to otherwise station them in space⁹.

It exclusively limits the use of Moon and other celestial bodies to peaceful purposes and explicitly prohibits their use for testing of weapons of any kind, conducting military manoeuvres or establishing military bases, installations and fortifications.

It forbids any government from claiming a celestial resource such as Moon or a planet. It forbids natural opportunities of outer space, including Moon and other celestial bodies.

A State Party to the Treaty which has reasons to believe that any activity or an experiment planned by other State Party in outer space including the Moon and other celestial bodies, would cause potentially 'harmful interference' with activities on peaceful exploration of outer space including the Moon and other celestial bodies may 'request consultation' concerning the activity or experiment.

The above provisions have glaring inadequacies. For instance:

- The treaty does not prohibit the development, placement and testing of conventional weapons in the outer space.

⁸ <https://www.en.m.wikipedia>wiki>outer-space-treaty>

⁹ <http://www.State.gov>...>current-treaties-and-agreements>

- It does not prohibit a ground based weapon making a direct/ indirect ascent into outer space and killing an orbital body.
- It also does not prohibit a space based weapon (Kinetic Energy or Directed Energy) to kill another satellite or orbital target in outer space or to kill ballistic missiles transiting outer space in the post boost/re-entry phase.
- By implication, military activities in outer space are allowed unless specifically prohibited by any Treaty.
- Also, there are glaring definitional inadequacies in the legalese of the OST. Some examples :-
 - What constitutes space or a space weapon is not defined.
 - Accepted demarcation of the boundary between the air space under national sovereignty and outer space has not been defined.
 - What constitutes 'peaceful use of space' (by exclusion, what is not peaceful?) What the US understands it as 'non aggressive' while the Russians see it as 'wholly non-military' is actually not specifically accepted/defined.
 - What constitutes 'harmful interference'; is shrouded in ambiguity.

The Treaty, adopted through the UN process, is non-binding and devoid of any enforcement mechanism. Responsibility towards discharge is only 'assumed'.

In fact, under the garb of 'peaceful use' and 'scientific research for peaceful purposes', as enshrined in the OST, US, China and Russia have put a perfectly legal cover over their hectic development of space technologies capable of military applications.

Judging against the above loopholes, the ASAT tests of China, US and Russia would appear to be perfectly legal. That is however not the whole truth as the same could be faulted under Article IX of OST, as also, under Liability Convention.

This is how Article IX of OST mandates the State Parties to conduct activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other State Parties to the Treaty.

It forbids them from conducting such activities which would cause 'harmful interference' with activities of other State.

State Parties are also to avoid harmful contamination and adverse changes in the environment of the Earth resulting from the introduction of 'extra-terrestrial matter' (in outer space)¹⁰.

A Sample Case.. Let's talk about one sample case--the Chinese ASAT test of 2007 which as I said, has been classified as the highest manmade debris generation event in the history so far¹¹. Sample this:-

- As of September 2010, the US Space Surveillance Network (SSN) has picked a total of 3037 pieces of debris greater than 10 cms, 97% of which have remained in the orbit¹².
- Scientists estimate about 1,50,000 debris particles in altitudes between 200-4000 kms, 79% of which will remain in orbit for 100 years¹³.
- The debris has spread throughout the entire orbit resulting in a cloud of debris around earth. This is the largest debris cloud ever generated by a single event in the orbit.
- As of January 2007, there were 2864 active or inactive satellites in LEO out of which 1899 pass through the region now affected by Chinese debris.
- In April 2011, debris of the Chinese test passed close to the 'International Space Station'¹⁴.

¹⁰ [http://www.Unoosa.org/oosa/space laws/outer spt. html](http://www.Unoosa.org/oosa/space%20laws/outer%20spt.html)

¹¹ Orbital Debris Quarterly News' Volume 14 Issue 4 Oct 2010. [http://www.orbitaldebris.jse.nasa.gov/news letter/news letters.html](http://www.orbitaldebris.jse.nasa.gov/news%20letter/news%20letters.html).

¹² Dr Ranjana Kaul, "Space Security' Legal Implications p-207 carried in Ed. Ajay Lele, Gunjan Singh, "Space Security and Global Cooperation", Academic Foundation New Delhi.

¹³ Brig Rajat Jairath, "Quest for Space : The Indian Connect", KW Publishers Pvt Ltd, New Delhi.

¹⁴ NASA Monitoring Space Junk near International Space Station CNN Apr 5, 2011.

- In January 2013, a Russian nano satellite [Ball Lens in The Space (BLITS)] was destroyed by the debris¹⁵.

The Illegality Continues. The illegality of the Chinese ASAT lays bare not only in the gross violation of Article IX of the OST, but also, a potential threat to the space assets of other State Parties for decades ahead. Similar is the story of US and Russian ASAT tests.

Liability Convention. Also, under the Liability Convention 1972 (The Convention on International Liability for Damage Caused by Space Objects), a State Party is responsible for all the objects launched from its territory into space and is full liable for the damage that may arise from that object. The damage (done/likely) from the Chinese ASAT must also therefore rest equally on their shoulders.

Other Legalese Also Ambiguous. While the other space laws like the Rescue Agreement 1968, the Registration Convention 1975, the Moon Agreement 1979 and International Space Laws governing disbursement of finite GEO slots by the International Telecommunication Union (ITU) are all full of crippling inadequacies, the space constraints prohibit the author from a detailed commentary on each one of the above.

A Revisit. Though mentioned in passing earlier, lets revisit the technicalities in militarisation/weaponisation from the point of view of a legal argument.

Militarization. As per the definition, militarization of space simply implies the placement and deployment of weapons and military technology in the outer space. By this definition, the Space was militarized ever since the earliest communication satellites were launched, since that implied the deployment of military communication technology in the Space. Today, militaries all over the world rely on satellites for command, control, communication, monitoring, early warning and navigation with GPS. Peaceful uses of outer space thus include military uses. This includes even those satellites which are not

¹⁵ <http://www.the-diplomat.com/2013/09/the-rise-of-chinese-space-junk/2/>

at all peaceful such as using satellites to divert bombing raids or to orchestrate a 'prompt global strike' with a view to control any situation or to defeat any adversary across the range of military operations. With more than 90% of all satellites dedicated to military use, truly speaking militarisation of outer space occurred with the first satellite¹⁶.

Weaponisation. Talking of Weaponisation, the same is generally understood to mean the placement in orbit of space-based devices that have a destructive capability. What about millions of pieces of space debris created by the deliberate acts of the countries (ASAT tests) which have tremendous destruction capability for the space assets of other countries? What about the ongoing cutting-edge research on the 'kinetic kill' or 'Directed Energy kill weapons' placed in space orbits, ready to take on incoming ballistic missiles in their post-boost phase, when these missiles are transiting the outer space. These dual use weapons, taking on a Ballistic Missile could as well take on the space assets? The bottom line is that the weaponisation of outer space is now a reality. In fact the same is fast fuelling the global arms race¹⁷.

The examination of the above legalities thus brings out the following :-

- The current regime of Space Laws have glaring inadequacies, both in the ambivalence and ambiguities of the legalese, as well as, the non-specificity of the rules-of-the-road.
- Though the ASAT tests by China, US Russia and others have been executed, these are not only illegal in terms of the OST 1967, but also, the same have created a near permanent existential threat to the space assets of other nations.
- While militarization of outer space happened with the first satellite the outer space is fast being weaponised leading to a crippling and self-defeating arms race in the future¹⁸.

¹⁶ <http://www.reachingcriticalwill.org/resources/fact-sheets>.

¹⁷ <http://www.globalissues.org/Issues/Articles/militarization-and-weaponisation-of-Outer-Space>.

¹⁸ <http://www.stratfor.com/the-real-danger-from-space-weapons-feb-2016>

And now the bottom-line:

- TECHNICALLY, THE ASAT TESTS ARE ILLEGAL.
- NOTWITHSTANDING, THESE ARE LIKELY TO CONTINUE UNABATED.
- IN THE COMING YEARS, ASATs ARE POISED TO GROW, CAUGHT IN A DUBIOUS AND SELF-DESTRUCTIVE ARMS RACE.
- AS FUTURE TECHNOLOGY MAKES MORE AND MORE COUNTRIES TO AFFORD AND LAUNCH SATELLITES, WORLDWIDE SATELLITE VULNERABILITY TO ASATS WILL CONTINUE TO GROW.
- EVER INCREASING SPACE DEBRIS HAS REACHED A TIPPING POINT. THIS GROWING MONSTER IS PLUNGING THE SPACE ASSETS OF THE PLANET IN A CRIPPLING EXISTENTIAL THREAT. (This is a vertical demanding separate analysis)

Like someone said:-

WORLD WAR III IN SPACE?

IT IS CLOSER THAN YOU THINK.....

THE DRAGON LEAPS TO NEW HEIGHTS, OTHERS CHASE...

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