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Impediments to the Exercise of Space Power

The exercise of the full range of space power is impeded by many factors, ranging from specific characteristics of space itself and modern space operations all the way through national and international issues. However, each of these limits is itself subject to amelioration through technological and policy development. Progress in each of these areas can lead to significant enhancement in a nation's ability to exploit space power.

The most obvious limitation on space operations is cost. In recent decades, little progress has been made in reducing the transportation cost per pound of placing payloads into orbit. This factor has distorted every other feature of space operations by limiting the size and number and accessible orbits of space objects. As a result of astronomical transportation costs, payloads must be optimized for weight and lifetime, which then drives up their price.

Associated with the cost factor is the narrowness of the bottlenecks through which space operations pass. Not only launch facilities but also equally crucial ground control facilities exist in limited number, often with no redundancy. This creates both vulnerabilities to loss of function and severe upper limits on surge capacity for expansion or replacement of in-space assets.

The second limiting factor is the nature of the space medium and of operating in it. Deployed space assets are subject to a harsh natural environment as well as to the characteristics of space (high velocities, no blockage to line of sight, etc.) which can be deliberately exploited to damage or destroy specific vehicles. This makes these assets uniquely fragile, which in turn makes them uniquely tempting targets for the application of force by unfriendly players.

Next, efficient exploitation of space power is constrained by general societal attitudes and specifically by the immature experience base of the people whose responsibility it is to gain maximum national advantage from these significant national investments. Popular culture contains many major themes connected with “space power,” and most of them are unrealistic, even “anti-realistic.” For example, consider the pernicious terminology of operating satellites. Operators say that they “fly” satellites; the press reports that satellites are “maneuvered”; and the informed public is left with the vision of something like aircraft or other terrestrial vehicles. Hollywood shows satellites pointing and zooming in on individual scenes anywhere in the world, at any time, permitting an impression of omnipresence. Satellites, and asteroids, are exploded, but the consequences of the debris cloud thus created is never shown. The more meaningful attributes of space power don’t fit within those impressions, hampering the leader who attempts to use space power to support national interests, based on the knowledge gained by being immersed in the culture.

Accumulating, retaining, and accessing usable lessons for space power application is a formidable challenge for policy makers in the United States. Creating the organizational mechanisms through which maximum individual creativity and leadership can be exercised—in theoretical, tactical and strategic scenarios—is hindered by both the widespread presence of misconceptions and by a lack of real-world experience. The next best thing, realistic simulation, is presently inadequate concerning space power in action.

Another constraint is in the diplomatic and legal realm. Operating in space means operating on a global theater with international legal and diplomatic concerns. For more than 30 years a body of “Space Law” has accumulated. A wide variety of motivations, some explicit and some covert have impelled these treaties. They have become confused or outpaced by the extreme rapidity of technological progress, which makes terminology and concepts obsolete even as they achieve the venerable status of “tradition.” In many cases, original intent has long withered away and even original meaning—as well as current meaning—is no longer clear. Despite this (and sometimes because of this), in many aspects of space power, diplomatic considerations provide significant constraints on the full exercise of potential national advantages.

Launch Costs

High transportation cost is the primary inhibitor of expanded commercial, private, and even governmental activities in space. To some degree, however, this cost itself is a threshold, a barrier to easy access to space by second and third-tier players, whether governmental or non-governmental, whose presence would at the very least complicate, and at worst endanger, current activities. As this barrier lowers, there will be both good news and bad news for the United States.

On a global scale, the gradual trend toward cheaper space launch technology will open the gates for several dozen more nations (or even corporations, institutes, or other associations) to acquire their own minimal orbital launch capability. Combined with advances in lightweight materials, electronics, and warheads, these capabilities will mean that within a few years, there will be dozens of players in low earth orbit capable of duplicating anything accomplished by the United States and the USSR in the 1960s. This includes manned spaceflight, unmanned earth observation payloads, communications relays and eavesdroppers, co-orbital antisatellite weapons, and even fractional or multiple orbit bombardment systems (both nuclear and conventional). For any nation wishing to wield a dominant role in the exercise of space power, the proliferation of players in space—with a much wider array of intentions and with much less predictable agendas—may be unpleasantly costly.

The issues connected with the technologies of spacelift capacity will be discussed in detail in an appendix to this chapter. These details are peripheral to this book’s core themes on the nature of space power and its exploitation, so that appendix is not required reading for later chapters.

Bottlenecks

Unlike the sea or the air, which is accessible from practically anywhere on the coast or the surface, space is in practical terms reachable only through extremely narrow channels.

In terms of launch sites, an interesting theoretical discussion has gone on for years about the importance of the global antipodal points (or conjugate points) of each launch site, and of the feasibility of emplacing direct-ascent antisatellite weapons at these points. Any object placed into low orbit would pass across the antipodal point about half a revolution later. But the challenge of characterizing and targeting a launch in such a short time remains daunting, especially since the antipodal points are far from the best US space tracking assets. Furthermore, if needed, space objects can perform post-launch burns that throw themselves into much higher orbits before reaching these points. Whatever their contemporary significance, antipodal points will decline in importance as the number of launch locations, land, sea, and air, proliferates from a dozen or two, to hundreds, and then to infinity, in coming years.

Over the next decade or two, the arrival of a multiplicity of players on the orbital stage will coincide with a long-overdue widening of current physical bottlenecks for space access. Currently, some of Earth’s most advanced space launch systems have as few as one or two operational launch pads, making them vulnerable to interruption—natural, accidental, or deliberate. Other elements of many space systems—from manufacturing through launch through control—similarly lack any redundancy at all.

In recent years, the operational technologies to overcome this limitation have begun to appear. Air-launched rockets with satellites weighing up to 500-800 kg are now routinely launched commercially from ordinary airfields in California, Florida, and Virginia, and once from the Canary Islands. The Russians have launched small satellites using mobile ICBMs parked near minimal ground support equipment, and in 1998, they orbited a small satellite on a missile launched from a submarine. Small American commercial launchers such as the Taurus are nominally capable of being set up and launched from almost anywhere, without significant ground support.

Larger mobile satellite launch systems are also in advanced commercial development. The most impressive of these is the “Sea Launch” system, which uses ocean-going facilities to launch Ukrainian / Russian “Zenit” boosters capable of placing up to 15,000 kg in low earth orbit. The United States has also considered using operational ICBMs and SLBMs for satellite launchings with payloads in the 500 to 2,000 kg range.

Many space power related functions can be performed by small satellites which soon will be able to reach orbit from widely-scattered bases. However, the US government has continued to rely on a small number of heavy geostationary satellites, which can only be launched from a very few large ground complexes at the edge of US coastal borders. Until this policy changes, bottleneck vulnerabilities will remain and, in fact, become even more worrisome as the threat array broadens.

One unexpected unpleasantness, for example, may be associated with the future ability by some nations to orbit spacecraft from the polar regions (primarily the Arctic, with its sea as well as air access) where direct line of sight observation from geosynchronous satellites is impossible due to horizon geometry. Tactical advantages gained from achieving orbit undetected could be crucial in future space conflict scenarios.

Vulnerabilities

Outer space is a naturally harsh environment, and hazards can be exacerbated by hostile actions. Survivability of space assets is a fundamental unanswered question, especially under conditions of deliberate attack.

The issue of the vulnerability of ground-segment bottlenecks also applies to space systems, particularly those which exist only in small numbers, even only as single vehicles.

In terms of the natural environment, the conditions which damaged and even destroyed satellites in the past are now fairly well understood. Vacuum has a bad effect on some kinds of moving mechanical parts. Space dust can erode solar cells and viewing windows. Radiation, both from the Sun and from cosmic rays, can upset electronic signals and even damage components. Static charges can build up and do similar damage when they discharge. Through prediction and hard knocks, space engineers have learned how to tolerate such effects.

Worldwide space activities create their own hazards to themselves, mostly through the proliferation of “space debris.” Although the raw number of objects is intimidating, space is still very large, and the number of credible space-to-space collisions resulting in damage can be counted on the fingers of one hand. Still, for larger vehicles (the space station, a larger antenna, a solar array system, a large optical system, a solar mirror, or solar sail), the statistics are persuasive that more damaging impacts will occur. Damaging impacts are particularly likely from the population of debris objects that are too small to reliably track but are too large to shield against.

An often-overlooked vulnerability to the function of a space system can be its limited sensor range and its predictable flight path. For observation satellites, the best view is as close to the target as possible. But a satellite in low earth orbit moves so rapidly that viewed from the surface target location the satellite “rises,” crosses the sky, and “sets” in only a few minutes. Many activities of interest to the observation satellite can simply be rescheduled to avoid the brief intervals every day when the satellite is capable of seeing them.

Overcoming this predictability and consequent avoidability might require some degree of stealth (either nondetectability, or mistaken characterization). Alternate or additional solutions include using higher orbit with much longer visibility times (requiring much more advanced sensors to avoid loss of resolution), or simply using sheer numbers of randomly-orbiting small sensor platforms for which an avoidance strategy can’t be devised.

Specific types of missions occasionally tend to cluster satellites into relatively narrow regions of space. The most striking example of this is the geostationary belt, the ring of several hundred satellites around Earth’s equator at an altitude of about 35,800 km. Although there often is some variation in position—perhaps a few hundred kilometers swaying back and forth every day—the overall impression is one of beads on a string.

The geostationary orbital belt may be a ring-shaped basket, but an awfully lot of eggs are in it. In the not too distant future, there will be some interesting techniques by which a relatively small spacecraft could achieve rapid and stealthy access to the entire arc, one satellite after the other. It would then be able to perform whatever function it desired with relation to them, whether inspection, surveillance, interference, or destruction.

An interesting and useful analysis of threats to space assets is contained in a 1997 Center for Naval Analyses report, "Space Control Issues: Plausible Threats and Assurance Strategies,"[16] by Dr. Bruce Wald. He discusses the potential points of attack, the forms such attacks may take, and the specific vulnerabilities of various elements to each form of attack.

Wald lists four points at which a space system can be attacked: the in-space segments, the space-to-ground links (he calls them the "telemetry, timing, and control" functions), the ground segments (often located in forward areas), and the mission itself.

The space segment is broken down into the space vehicle, its payload, and its signals. Attacks on space segments can be in the form of kinetic energy ("hit-to-kill"), radiation/EMP bursts (both by nuclear weapons and other means), directed-energy weapons, signal jamming ("brute force" electronics warfare), and signal spoofing ("deceptive" electronics warfare). These have different levels of effectiveness against different components of the space segment.

Similarly, attacks on the space-to-ground links can be directed against physical facilities, against the telemetry downlink, and against the command uplink. The ground segments, more numerous and often more exposed than the main command and control system, have similar susceptibilities to attack, plus the added threat of what Wald calls "Cyberwar." Wald defines "Cyberwar" as the "denial of service attacks as well as deception and usurpation," perhaps through sabotage, special operations, or flaws in the network protection software.

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16 Wald, Bruce. "Space Control Issues: Plausible Threats and Assurance Strategies." Center for Naval Analyses, CAB/January 1997, Annotated Briefing, Alexandria, VA.

Lastly, there are "mission attacks," which Wald writes "include diplomatic interference with the ability of a nation to acquire space services from others." He notes that since the United States has most or all the resources it already needs, "it is less likely to be successfully attacked by these methods than it is to employ them." (One example was the USSR's attempt in the mid-1980s to get Chile to deny the United States access to Mataveri Airport on Easter Island for space shuttle aborts on missions from California, which would have seriously constrained the kinds of polar orbits the shuttle could reach.) Further, he continues, "Even when the targeted country has acquired capabilities, diplomatic and political pressures can sometimes constrain the overt use of these capabilities." In particular, he notes that "US use of space is constrained by several treaties, and to some extent by world and domestic political opinion."

Next, Wald assesses the rationale that could lead a party to undertake an attack on space assets. He lists five criteria for the assumed-to-be rational decision making process: effectiveness, controllability, affordability, safety, and covertness.

- "Effectiveness" is the likelihood of achieving the desired effect
- "Controllability" is the ability to make short-notice attacks with precise, predictable, and preferably reversible effects
- "Affordability" is the party's ability to pay for the desired capabilities
- "Safety" is the likelihood the attack will not bring devastating retaliation
- "Covertness" is the ability to conceal the fact of the attack or the identity of the attacker

Wald's analysis suggests that no destructive (or even disabling) attack on a US-owned space segment is "safe," although other analysts are far less certain that an attack on a piece of space hardware would necessarily lead to US military counterstrikes elsewhere (this is not a technical issue in any case). But he did conclude that "soft kill" of broadcast services is not only much safer, but potentially "quite effective."

Balancing all criteria against all threatened components of a space system, Wald concludes that the most plausible threats are jamming and cyberwar. He writes: "Both are affordable, controllable, and relatively safe. Jamming is likely to be quite effective, and cyberwar can be effective if access is possible and other defenses are weak." Jamming broadcasts, especially from an elevated site, is effective, particularly against GPS and UHF communications in general. Jamming payloads is also affordable, siting is easy because of relatively large terrestrial footprints, and effective against most communications and imaging satellites. Jamming uplinks, and wider aspects of cyberwar, are also affordable, effective against unprepared targets, and also "deniable" (covert usurpation may be possible).

Moderately plausible threats include physical attack on ground nodes (an intentionally ambiguous origin of the attack may forestall retaliation), electronics warfare against ground nodes from nearby access, and political, diplomatic, and economic attacks on the mission.

Wald concludes that in the current absence of a peer competitor, "destructive attacks on space segments are considered implausible." He bases this on the lack of safety from retaliation and on the expense.

However, other analysts take a much less sanguine view about the vulnerabilities of US space assets to physical attack.

Writing in "Space Policy" in 1995, Allen Thomson[17] noted that the use of space assets in the Gulf War "has prompted states which might find themselves in conflict with the USA in the future to develop countermeasures against US space-based reconnaissance."

The first step is to develop an effective space surveillance and space object identification capability. Technological advances in sensors and information systems mean that these capabilities do not require a country to match the existing US and Russian space tracking networks. The United States does not release orbital data for US active low-orbit military vehicles, but much of it is available from amateur groups via the Internet. When supplemented by deliberate visual observations from around the world (perhaps at embassies, or at sea), and by telescope-mounted CCD sensors (which can observe satellites even in daylight), this data can provide useful initial targeting

17 Thompson, Allen, "Space Policy." February 1995. Vol. 11, No. 1, pp. 19–30.

information. It is even conceivable that players planning an ASAT mission would utilize existing US radar sensors (or even commercial TV broadcasts) in a bistatic mode, such as surreptitiously piggybacking on the NAVSPASUR radar fence.

Additional information for identification of objects can be obtained from short-exposure CCD imaging through fast-tracking telescopes, which can provide resolution of 30–100 cm in low earth orbit. Development of adaptive optics systems, possibly in conjunction with legitimate astronomical research projects, would improve resolution even further. Within a decade, optical interferometry will allow many countries to link distant telescopes and provide imaging resolution as good as 10 cm even out to GEO.

Once a target is identified and its position predicted, an attack can be made with fairly small (by current standards) missiles. The ability to carry a few hundred kilograms to a few hundred kilometers with reasonable accuracy is a capability that dozens of countries and even some non-governmental groups already have or will have over the next decade.

Thomson stresses the rapid commercial progress in electronic and electro-optical devices for the civilian marketplace, and their potential application to ASAT functions. He writes: “The crucial part of direct ascent ASAT systems—the terminal engagement guidance and fuzing mechanisms—is dependent on the same very rapidly and proliferating technologies mentioned above, with the same implications for US planners. Moreover, the low cost of the boosters needed, the probable low cost of the associated guidance mechanisms, and the independence from fixed launch facilities makes it likely that an aspiring ASAT power will think in terms of multiple engagements against a single target, possibly using salvos of ASATs fired from different locations over time.” Such capabilities could be acquired quickly, concealed successfully, and then utilized without warning, Thomson fears.

The last threat to the function of space systems—and perhaps the most serious one, because it already has been occasionally effective—is simply the short-sightedness of potential users. The most sophisticated satellite in the world is a waste of metal and plastic if its services are not properly utilized. It could be functioning perfectly yet ultimately fail in its mission if potential users fail to exploit it.

There are a wide variety of reasons why a space system's services could be inadequately exploited. Perhaps the potential users are simply uncomfortable with the technology and are uncertain how to rate the service's accuracy and reliability. Perhaps potential users are skeptical of the system's availability when really needed. Often a system's best capabilities are realized and developed in real time when end-users have operational control, but if they are treated merely as passive recipients of services, their creative inputs may be overlooked. Or perhaps some player deliberately casts doubts on the system's products via a disinformation or cyberwar campaign.

That last possibility brings us out of the realm of technology and squarely into the realm where efficient space power related exploitation of space systems remains most uncertain and most brittle: the human element.

People

To understand the awesome power of the socio-political constraint on exercising space power, simply consider the question of nuclear power—for heat, electricity, or propulsion—on space vehicles. At the beginning of the Space Age, it was unanimously considered obvious and inevitable that nuclear power plants and nuclear engines would quickly become the mainstay of space operations, both civil and military. Yet it didn't happen, and current cultural conditions show it is unlikely to happen for a long time to come.

The difficulties were not technological but social and political, in that "nuclear" became—both on Earth's surface and in space—a term unavoidably associated with "explosion." How and why that happened is a topic for another thesis, but the fact that it happened is undeniable.

It is not merely the marginalized handful of anti-nuclear activists picketing a space launch in Florida, or of mainstream environmental lobbying groups throwing roadblocks in front of space nuclear projects using criteria that if fairly applied would also rule out all alternative power sources as well. It's the entrenched nervousness of national decision makers, made gun shy by decades of pressure from activist cadres, that under existing conditions have in practice imposed an across-the-board ban on what otherwise would have been some very attractive—and very safe—technologies for space applications.

For the sake of opening future options, such socio-political constraints need to be countered on their own terms, through education, outreach, and research.

Other constraints are internal to the space community. So far, the experience base for exercising space power is extremely limited. People who are responsible for gaining maximum advantage from these significant national space investments have a lot of routine space operations experience but have rarely if ever confronted deliberate deception or hostile intentions. So it is a formidable challenge to accumulate and retain and access the usable lessons for space power application.

The International Environment

A user's "space power" does not exist in isolation. The exercise of space power is influenced by many external factors, ranging from enhancement through trans-national alliances to constraints by international treaties.

Applying analogies with past international agreements concerning the high seas and Antarctica, diplomats and "space lawyers" have attempted to establish a legal regime for human activity in space. Furthermore, building on a long tradition of 20th Century arms control agreements, diplomats have specifically excluded certain weapons-related activities (although they rarely made the hardware itself illegal). The result is a series of treaties which constrain both space-related activities on Earth as well as activities in space.

As is familiar to any serious student of previous international treaties dealing with technological questions, treaties usually persist long after the technological assumptions or specific crises behind them have become obsolete. Thus the reinterpretation of ambiguous wording based on unanticipated technical developments can lead to the existence of a set of "shadow treaties" which diverge from the original in different directions depending on the interpretations and intentions of the different parties involved. Because of the rapidity of revolutionary change in space activities, treaties can age extremely quickly and can become ambiguous and asymmetrically restrictive within only a decade or two.

In addition, current in-force treaties affecting space activities reflect the prevailing situation at the time of their development, a bipolar and antagonistic international climate. Major metamorphosis has already begun towards a multi-polar environment with shifting and often obscure interests. How well the old treaties "fit"—or can be made to appear to "fit"—the new and very different situation is bound to baffle space planners for decades to come.

One value of international treaties to the exercise of space power lies in their ability to modify behavior of potential competitors and adversaries so as to allow concentration of energies on the most promising lines of effort. Other international agreements merely regularize the allocation of limited space resources, such as geosynchronous positions or radio frequencies, and provide administrative remedies to compel compliance. International treaties also serve domestic political purposes, such as attempting to "lock in" certain public policies for as long as possible.

But in general, long-term reliance on treaties to control behavior in space is problematical due to the still unresolved incompatibility between a discipline based on precedent (law) and an unprecedented activity in which most earthside analogies are misleading (space). And whereas maritime law developed only after many, many centuries of maritime activity, space law is being set in place often prior to the very activities it is intended to govern. Since space lawyers have no special talents in prognostication, their guesses are no better than those of other space experts, with one exception: when their guesses (expressed as treaties) are off base, their work threatens to distort what otherwise would have been the natural development of space activities.

As an example of the dangerous inadequacies of imposing earthside legal regimes on space, consider the simplest question of boundaries. Even after decades of space activities, there is still no legal definition of where "space" begins and national sovereignty ends.

Although maritime national boundaries tended to originally be defined by the range of naval gunfire, the ability of several nations to attack low-orbit objects has not led to an extension of national sovereignty to those altitudes. However, some states are now expressing an interest in limiting space activities above their territories. France has stated that commercial satellite owners should not take pictures of France for customers other than the French government. It has declared that satellites are potentially subject to French law if they can be viewed from French territory. This follows decades of debate over whether images of territory within any particular nation can be released to a third party without that nation's approval—and the US has recently endorsed that principle regarding commercial space-based imagery of Israel. In a similar vein, several Eurasian nations have objected to "cultural aggression" from Western-owned television satellites whose signals can be picked up accidentally in nearby nations, but no serious calls for in-space counteractions have yet been made.

Originally by precedent, and now by long habit, the de facto limit of sovereignty is based on a physical feature of orbital flight; it is considered to be below the altitude of the lowest possible short-term stable orbit (about 160 km), while being above the altitude of the highest aircraft and balloons (about 30 km). For numerical aesthetics, a figure of exactly 100 km has long been discussed but not officially accepted. The USAF, for example, uses 80 km as the altitude required for the award of the "Astronaut Rating." Soviet delegates to the United Nations repeatedly called for a figure of "110 km or less." During ascent to orbit, NASA's space shuttles complete their main engine burn at an altitude of about 84 km, and NASA uses 400,000 ft (122 km) to define "entry interface" when returning shuttles first begin to encounter aerodynamic forces. Descending space shuttles have passed above other nations (such as Canada) at altitudes of 80 km or less without asking permission.

While most commentators postulate an unrestricted right of orbital overflight and activities above this still-undefined boundary, there have been some other attempts to partially extend national sovereignty higher. For example, ownership of particular longitude bands of the geosynchronous arc, where commercial communications satellites can be stationed, has been assigned segment by segment to nations 40,000 km directly below. In 1983, a touring Russian space official floated a suggestion that "only satellites have the legal right to overfly other nations, but this imposes certain restrictions on their activities." This "Ulan Bator Doctrine" (the location of the speech) was scrupulously ignored by everyone else and the Soviets never suggested it again.

Attempts at establishing a legal regime for space began very soon after the first space flights. The first major international agreement on space activities was the so-called Outer Space Treaty of 1967, signed by representatives of the United States and some 90 other countries (expanded to over 100 by the adherence of the Soviet successor states). Outer space activities were to be subject to international law. The exploration and use of outer space is to be carried out for "benefit and in interests of all countries" and shall be "the province of all mankind."

According to the treaty, the use of space for peaceful purposes and the passage through space and across celestial bodies must be free from interference. Both the emptiness of space and the natural bodies it contains cannot be subjected to the sovereignty of any country. On the other hand, the man-made objects in space are the property of the country which paid for them, and are the responsibility of the country which registered them or whose government authorized their launch by commercial entities. Furthermore, space is open to exploration and peaceful exploitation by all countries.

Warlike activities are forbidden in space and on celestial bodies, save in self-defense or the defense of allies. Military personnel and military-use satellites are not warlike in and of themselves; data collection by military satellites is legal under the treaty. However, the Moon and other celestial bodies are to be used "exclusively for peaceful purposes." Adherents to the treaty agree not to place nuclear weapons or other "Weapons of Mass Destruction" in earth orbit (although the treaty does not ban the passage of nuclear weapons through space to some other destination), or station them elsewhere in space or on celestial bodies.

States conducting activities in outer space must notify the United Nations, the public, and the scientific community of the nature, location and results of such activities. However, there were no prescribed penalties for a failure to report or for providing wrong information. Finally, the treaty requires that all activities that "would cause potentially harmful interference" with other nations' activities in outer space or on celestial bodies be immediately reported to the United Nations.

In a 1994 survey of arms control treaties, "Jane's Strategic Weapons Systems" gave this assessment of the 1967 treaty, "The treaty was rapidly agreed to, with little or no argument, but this was largely due to the absence of definitions for the constraints that it imposed. It does not, for example, define "weapons of mass destruction" (which is, however, defined elsewhere), "peaceful purposes," or even "outer space." Later in the text, it is stated that "such ambiguities are common in treaties, which rely more on their intentions of good will than on substance to achieve their aims."

A good example of how even the most explicit and clear treaty requirements can be reduced to uselessness is the reaction of space lawyers and diplomats to the USSR's Fractional Orbit Bombardment System (FOBS) in the late 1960s. Notwithstanding the treaty prohibition against placing weapons of mass destruction into orbit around Earth, the Soviet system was designed to do exactly that. By using a low orbital altitude instead of the high lob of a typical ICBM non-orbital flight path, the thermonuclear warhead could hug the curvature of the planet and approach its target from any direction to a much closer range before detection (if ever) by radar.

The Soviets simply lied about the test program, calling the objects "Kosmos" scientific satellites. American treaty specialists went through excruciating gyrations in reinterpreting what had looked like clear-cut meanings of precise words, in order to excuse the Soviet activities as not being in violation of the treaty or at least not demonstrating clear intent to violate the treaty whenever convenient.

It was argued that the objects were never "in orbit" because they did not complete one revolution (a full orbit of Earth) before firing braking rockets and heading back to the surface. This was a deliberate ad hoc alteration of the original meaning of the technically unambiguous term "in orbit." Even the Soviets knew the FOBS had been "in orbit" because they had given each weapon test a counterfeit cover name of a "Kosmos" scientific satellite, reserved ONLY for objects which are “in orbit.” Furthermore, the FOBS warheads followed a flight path very similar to that used by Yuri Gagarin when in 1961, he became the first human in orbit around the Earth even though he, too, did not complete one FULL revolution around the Earth.

Such examples of ex post facto alteration of space treaty terms in order to justify practically any actual activities create a justified level of cynicism and distrust of these measures, in that the very same clauses seem to restrict the US side far more than they restrict other sides.

Various US/USSR strategic arms limitation treaties prohibit each side from interfering with the “national technical means of verification” of the other side. This is in order to allow each side to use its resources, such as reconnaissance satellites, to verify the compliance of the other side with the treaties. However, the United States also assumes that the application of space assets for other military purposes is not similarly protected, making them legitimate targets in the event of limited conflict. Nor do the treaties protect third-party observation satellites. It would be an interesting exercise to see if the United States, France, or any other country wanted to temporarily declare certain geographic regions as “no spy zones.” All unsanctioned observation satellites over a declared “no spy zone” might be subjected to ground-based laser illumination at levels high enough to damage active optical systems, but not powerful enough to damage a spacecraft’s outer surfaces. The status of such a threat in terms of space law is almost ambiguous enough to require a precedent to establish or forbid the practice.

The US Congress has imposed certain constraints on the testing of space systems as part of an ongoing process of evaluating compliance with existing space law, or negotiating new treaties or new interpretations. Recently, Congress passed a limited-duration restriction on the testing of the Mid Infrared Advanced Chemical Laser (MIRACL) and its optical system against any object in space. In the mid-1980s, Congress had invoked several constraints on US testing of antisatellite weapons, under the interpretation that the USSR had declared a moratorium on testing its own “killer-satellite.” The authenticity of the ambiguous Soviet pledge, however, was dubious at best, since Prime Minister Yuriy Andropov's actual promise was that the "USSR would never be the first to introduce weapons into outer space." This was promised even though years of testing of Soviet killer-satellite systems had already done exactly that. The official Soviet position was that such tests had never taken place, and therefore, there was nothing the USSR had already done in space that it would have to stop doing. Andropov's pledge was useless as a real constraint on the USSR, but very useful in eliciting an asymmetrical constraint on the United States.

Brief descriptions of other space-related treaties are found in Appendix 2 to this chapter. Even the briefest scan of that text shows that it doesn't require a space lawyer to see that these treaties leave certain questions unanswered and fail to address circumstances unforeseen at the time of their drafting.

For example: If the citizens of a number of countries jointly own a satellite, which state is responsible for it? This is a particularly difficult question to answer in a case when two or more of the possessors' countries would be at war.

Would the deployment of means to track and destroy space debris or to remove errant or defunct satellites violate the ABM Treaty?

Some governments allied to the United States have stated that they would not consider an attack on American satellites to be an attack on the United States. Do such declarations free the United States from reciprocal obligations? Given the right to defend allies with space-based systems enunciated in the Outer Space Treaty, do such declarations prevent the United States from taking such defensive actions?

If a third-party-owned satellite is used to provide intelligence to one of two belligerents, could that be considered an act of war? If that satellite performed other beneficent functions such as environmental monitoring or weather forecasting, could its beneficiaries consider an attack on that space platform to be an attack on their national interests?

When and why is it in the interest of nations to make and abide by such treaties, and as deemed necessary, withdraw from such treaties (with or without notice)? In one way, it is easy to answer these questions according to an old Roman proverb: "Salus rei publicae supremus lex est"—"the health of the republic is the supreme law." In other words, regardless of treaties or rules, governments will do whatever they can to preserve the sovereignty and well being of the state they rule.[18]

However, as the American entries into the War of 1812 and World War I illustrate, when the leaders of a state do whatever they must to win a war for survival, they can provoke neutral states into joining the conflict against them. Given the growing importance of space systems for economic, national security and environmental purposes, damaging or destroying them could trigger widespread violence on Earth.

And as analysis has indicated, the players who may comprise the greatest threat to the exercise of US space power in the next decade or two (in particular, the most likely source of attacks on US space systems) are not and never have been involved in the big-power treaty process. Whatever the emotional "feel-good" value of the treaty process, it appears increasingly irrelevant to short- and mid-range US security interests.

The conclusion from Jane's 1994 report on treaties may be an appropriate last word: "The evidence appears to be that the public feels that treaties are, of themselves, good things because they bring nations together, if only to talk. At the same time, students of the treaty process appear correct in their analyses that agreements are sometimes militarily counterproductive. This leaves, as residual value, the contentment that the treaty process itself brings; as this relates a forum of understanding, it may be sufficient to justify the effort involved."

Summary

Clearly, the exercise of space power is not purely a technology-limited question. That is, just because it is feasible or even desirable to do something does not mean that a spacefaring nation will actually do it. Factors of cost—primarily launch cost but payload cost and operations cost as well—dominate initial planning. The robustness of

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18 Sullivan, Dr. Brian R. March 1998. *Tomorrow the Stars.* (Working title of a draft for US Space Command.

a proposed system against threats, natural, accidental, and deliberate, must also be considered. Lastly, the human element, both the skills of the system's operators and the social, political, and diplomatic milieu in which they must perform, can often be a limiting factor in attaining the maximum benefits of the potential capabilities of space systems.

Thus a strategy for enhancing a nation's space power, and for maximizing the efficiency with which that nation can exploit its space advantages, must include a wide array of developments. Improving technological capabilities is at the core of such a strategy, but it is not sufficient by itself. Finding adequate funds for unavoidable expenses while seeking ways to reduce space operations cost is critical. Understanding and forestalling threats to the missions are critical. And sustaining a supportive cultural environment and a sympathetic (or at least not antithetic) legal environment are both critical as well.

Only when a complete and cohesive national understanding of the mutual interdependence of these factors is in place can a country fully reap the benefits of space power.