Chapter 7

Comparative Evaluation of ASAT Policy Options

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POLICY OVERVIEW

ASAT Policy Choices

Over the next 5 years, the United States will have to make key decisions regarding research and development programs for anti-satellite weapons and countermeasures and for ballistic missile defense (BMD) systems. In addition, the United States must also consider whether it wishes to seek agreement with the Soviet Union to halt or limit the development of certain weapons that would operate from space *or* against space objects. This chapter analyzes the relationships between offensive and defensive weapons programs and arms control. In so doing, it utilizes the technology discussions contained in chapters 3 and 4 and the discussions of arms control found in chapters 5 and 6.

As discussed in chapter 6, those regimes which require negotiated arms control agreements could be either of limited or unlimited duration. Opponents of developing BMD systems might prefer an agreement of unlimited duration. Agreements of limited duration–perhaps 5-10 years—might be attractive to proponents of advanced BMD research if they could be fashioned so as not to interfere with plans to develop and test prototype BMD weapons. Such agreements would have the added benefit of temporarily constraining the development or testing of advanced .ASAT weapons which could attack space-based BMD system components.

Alternative Legal/Technical Regimes

This chapter considers possible arms control provisions, ASAT postures, and counter-measures together as packages in order to exan~-ine their interaction. Since there are many conceivable packages, it is necessary to select a limited number for analysis. These packages have been constructed so that each will have at least one advantage over the others considered and so that each contains elements which might reasonably be expected to coexist in the same proposal. Consideration of these regimes is intended to facilitate assessment of the effectiveness and desirability of different combinations of ASAT and BMD technology development, satellite survivability, and arms control.

The seven regimes considered in the remaining sections of this chapter are[1]:

1. Existing Constraints. The first regime is defined by treaties and agreements presently in force. The ways in which this legal regime would affect technology developments designed to protect U.S. satellites or to place Soviet satellites at risk will be examined.
2. A Comprehensive Anti-Satellite and Space-Based Weapon Ban. Regime two could be established by adhering to treaties and agreements presently in force and, *in* addition, agreeing to forgo the possession of deliberate anti-satellite weapons, the testing—on Earth or in space—of any deliberate ASAT capability, the testing in an " A SAT mode' of systems with inherent ASAT capabilities, and deployment—on Earth or in space—of any ASAT weapon.
3. An ASA'T Weapon Test Ban and a Space-Based Weapon Deployment Ban. The third

[1]These regimes might usefully include elements not discussed here. For example, regimes 2, 3,4, and 5 *might also* include a "no-use" provision which would prohibit the parties from destroying or " rendering inoperable" each others satellites.

[2]Testing in an "AS. AT mode" would include tests of land-, sea , air-, or space-based systems against targets in space or agai ns t points in space

regime could be created by adhering to treaties and agreements presently in force and, in addition, agreeing to forgo testing in an "A SAT mode" and the deployment of any weapon in space. This regime differs from regime 2 most importantly in that it would not ban possession or testing–on Earth-of deliberate ASAT weapons.

4. A "One Each/No New Types" Regime. Regime 4 includes arms limitation provisions which would permit the United States and the Soviet Union to test and deploy their current ASATS but would prohibit testing of more advanced systems. Advanced systems prohibited would include those capable of operating or attacking targets at higher altitudes and those that would be deployed in space. For the purposes of this assessment, the U.S. MV will be considered to be the only deliberate "current" U.S. ASAT.
5. Rules of the Road. The fifth regime illustrates the advantages and disadvantages of establishing "keep-out zones' around individual, high-value satellites.
6. Space Sanctuaries. Regime 6 would provide high-altitude sanctuaries where satellites could operate but where the testing or deployment of weapons would be forbidden.
7. A Space-Based BMD Regime. The seventh regime might result from U.S. or Soviet withdrawal from the ABM Treaty followed by the deployment of space-based BMD systems.

As table 7-1 demonstrates, the regimes discussed here can be characterized both by the extent to which they rely on negotiated arms controls and by the extent to which they allow or encourage ASAT development. With the exception of the "Existing Constraints" and the "Space-Based BMD" regimes, all other regimes involve some type of arms control. With the exception of the "Comprehensive Anti-satellite and Space-Based Weapon Ban, " and perhaps, the "A SAT Weapon Test Ban and Space-Based Weapon Deployment Ban, " all other regimes assume some level of ASAT development. These regimes demonstrate that although anti-ASAT arms control arguments and pro-ASAT weapon arguments are related, there are many distinguishing features. ASAT arms control proponents believe that an ASAT treaty is in the national interest; those who support ASAT weapon development believe that this also is in the national interest. However, ASAT arms control proponents do not necessarily oppose all types of ASAT development and ASAT weapon prop~nents do not necessarily oppose all types of ASAT arms control.

Table 7-1.—Effect of Regimes on ASAT Development and Arms Control

	Restrict with arms control	Develop ASAT weapons
Existing constraints ...	No	Yes
Comprehensive ASAT and space-based weapon ban	Yes	No
Test ban and space-based weapon ban	Yes	Yes/No[a]
One each/no new types .,	Yes	Yes[b]
Rules of the road	Yes	Yes[c]
Space sanctuary	Yes	Yes[c]
Ballistic missile defense .	No	Yes

[a]In this regime ASAT weapons could be developed, tested, and dePloyed on Eaflh but not In space The United States could pursue ASAT development wlthln the bounds of the treaty, or (t could forego ASAT development entirely
[b]All ASAT weapons other than "current types" could not be tested or deployed In space
[c]Development and deployment opt !onal but strongly supported by advocates of this regime

Although the individual regimes vary considerably, all of them should be assessed with two important considerations in mind:

1. First, if we wish to continue to use space for military purposes, a commitment to satellite survivability is essential whether or not any arms limitation agreements are in force. The existence of space systems with some inherent A SAT capability makes it impossible to ban the ability to attack satellites. Therefore, even under the most restrictive ASAT arms control regime, programs for satellite survivability and countermeasures must be pursued. In the absence of arms control limitations on

ASATS, ensuring satellite survivability will be a more demanding task.

2. Second, the United States should exercise caution in its reliance on space assets to !perform tasks essential to the national security. No matter what arms control or satellite survivability measures are taken, there will always be some risk that critical satellites can be destroyed or rendered inoperable. The value of continued and future reliance on space systems must be balanced against the probability that such assets may not be available in a conflict situation.

REGIME 1: EXISTING CONSTRAINTS

Legal Regime

The United States could decide that there are no additional arms control limitations relating to space weapons that are in its national security interest. If so, development of antisatellite and space-based weapons by the United States and the U.S.S.R. could continue unrestrained except by the Limited Test Ban Treaty, the Outer Space Treaty, and the ABM Treaty.[1]

Even in the absence of new arms control limitations there are restrictions on what the United States and the Soviet Union can do in space. As discussed in chapter 5, under existing international law and the treaties to which the United States is a party, the following activities are already banned:

- Unprovoked Attack on Another Country's Satellite: Subject to the right of individual or collective self-defense, Article 2 of the U.N. Charter prohibits the use or threat of force. A similar sentiment is to be found in Article III of the 1967 Outer Space Treaty. The SALT and ABM Treaties also prohibit interference by either state with space assets used by the other to monitor those treaties.
- Placement of Nuclear Weapons in Orbit: Article IV of the 1967 Outer Space Treaty (OST) prohibits orbiting nuclear weapons. This would include nuclear "space mines' and, presumably, ASATS that used a nuclear explosion as a power source.
- Detonation of Nuclear Weapons in Space: The 1963 Limited Test Ban Treaty (LTBT) prohibits nuclear weapons tests or other nuclear explosions in space. This would prohibit the full testing of ASATS that use nuclear explosions for destruction or as a power source.
- Development, Testing, or Deployment of Weapons Capable of Countering Strategic Ballistic Missiles, or Their Elements in Flight: Space-based weapons sophisticated enough to "counter strategic ballistic missiles or their elements in fLight" are banned under the terms of the 1972 ABM Treaty. This establishes a somewhat vague upper limit on the capabilities of advanced ASAT weapons.

To summarize, the existing international legal regime prohibits the use of ASAT capability except in national or collective self-defense, the testing or deployment of space-based weapons with strategic BMD capability, and the testing in space or deployment in orbit of nuclear space mines or ASATS that

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[1]The unratified Threshold Test Ban Treaty, and the unratified SALT 11 Treaty, if adhered to, would supply additional restrictions. The Threshold Test Ban Treaty, which was signed in 1974, prohibits testing *on Earth* of nuclear weapons with a yield greater than 150 kilotons. Should a nuclear ASAT weapon require a nuclear explosive of greater yield than this, it could not be fully tested without violating the Threshold Test Ban Treaty. Under Article IX of the Salt II Treaty, the parties agreed not to develop, test, or deploy "systems for placing into Earth orbit nuclear weapons. " This might be interpreted to include nuclear A SAT weapons.

would require a nuclear detonation as a power source. The existing regime places few restrictions on the current ASAT research and development programs of either the United States or the Soviet Union.

Offensive Posture

In the absence of further restrictions, the following weapons could be developed, tested, and *deployed* as deliberate ASAT weapons by either the United States or the Soviet Union, *if deployed in compliance with the ABM Treaty* (i.e., so as not to be capable of countering strategic ballistic missiles or their elements in flight)[4]:

- Coorbital Interceptors: Ground-launched, nonnuclear coorbital interceptors—e.g., the current Soviet ASAT–are allowable under the existing regime. Ground-based nuclear systems could be developed and deployed but not tested in space. There are no restrictions on nonnuclear coorbital interceptors predeployed as space mines.
- Direct-Ascent Interceptors: Ground-launched or air-launched direct-ascent interceptors–e.g., the U.S. ASAT being developed–are allowable. Direct-ascent interceptors carrying nuclear weapons could be developed and deployed but not tested in space.
- Ground-Based or Airborne Lasers: There are no restrictions on nuclear or nonnuclear ground based lasers, or on airborne lasers that would not require a nuclear explosion in the atmosphere.

[4]The constraint that ASAT weapons not be deployed so as to be capable of countering strategic ballistic missiles or their elements in flight is restrictive, but several deployment schemes can be conceived which would be both lawful and useful. For example, a neutral particle beam weapon of relatively low power might be deployed in geosynchronous orbit for ASAT or DSAT purposes. It might be capable of damaging an enemy satellite or ASAT several hundred kilometers away within several seconds, but incapable of darnaging a distant ballistic missile during its flight time of a few minutes. Deployment of such weapons might also be allowed in low orbit, if the U.S.-Soviet Standing Consultative Commission-which was established by the ABM Treaty to consider allegations of treaty violations—should agree that such weapons, if never tested as BMD systems, could not reasonably be expected to have a significant BMD capability.

- Space-Based Lasers: Nonnuclear, space-based lasers are allowable.
- Space-Based Neutral Particle Beam Weapons: There are no restrictions on space-based neutral particle beam weapons.
- Maneuverable Spacecraft: Although not necessarily “deliberate” ASAT systems, maneuverable spacecraft could be given substantial A SAT capabilities under the existing regime.

In addition to these deliberate ASAT systems, other weapon systems such as ICBMS or ABMs that have some ASAT capability could be developed and deployed, but could not be completely tested as ASAT weapons. Such systems could be tested in space as long as they were not detonated. The SALT agreements and the ABM Treaty do place other restrictions on ICBMS and ABMs.

Defensive Posture

The United States and the Soviet Union could develop, test, deploy, and use defensive measures such as hiding, deception, evasion, hardening, and proliferation without legal restraint in the existing regime. In addition to such passive countermeasures, nondestructive active countermeasures such as electronic countermeasures (ECM) and electro-optical countermeasures (E-OCM) could also be used. ECM and E-OCM are likely to be available and inexpensive and are unlikely to by restricted by arms control agreements; however, these countermeasures could be defeated at a reasonable cost.

Many destructive active countermeasures would also be allowed under the present regime. Satellites could be given a self-defense capability (shoot-back) or provided with an escort defense (DSAT). The current ASAT interceptors being developed by the United States and the Soviet Union (respectively, the U.S. Air Force Miniature Vehicle and Soviet coorbital interceptor) are not capable of attacking each other. However, many advanced ASAT weapons that could be built in the current regime would have *some* effectiveness against *some* types of ASATS. For example, a space-based neutral particle beam weapon, in addition to its ASAT role, could also be used as a DSAT to provide 'enclave defense' '—i.e., to defend a number of distant satellites from other weapons such as coorbital or direct-ascent interceptors or continuous-wave lasers. However, neutral particle beam weapons deployed as DSATS could not shoot back effectively at larger neutral particle beam ASATS, nor could they shoot back effectively at expendable single-pulse weapons such as pre-deployed nuclear "space mines" or some nuclear or nonnuclear directed-energy weapons.

Moreover, if shoot-back is to be effective, space objects with known or suspected A SAT capabilities would have to be fired upon while still some distance from U.S. satellites believed to be in danger. As discussed above, attacking an approaching spacecraft is prohibited by international law except in self-defense and one could not be certain that the approaching spacecraft had a hostile intent until it was too late. Hence, active defense against suspected "space mines" might be considered to be unlawful in the existing regime, although deployment of means for such defense may not be.

Neither passive nor active countermeasures could guarantee the survival of satellites attacked by some advanced directed-energy weapons. Although, as discussed in chapter 4, the cost of destroying small, inexpensive satellites and decoys with advanced directed-energy weapons might exceed the cost of building such satellites and decoys. Security for large and expensive satellites might ultimately have to rely on an attempt to deter A SAT attacks by credibly threatening retaliation against enemy space-based or terrestrial assets. A credible retaliatory capability would require a means of discovering that U.S. satellites had been attacked and identifying the attacker. This would probably require attack sensors mounted on satellites and a space-based surveillance system to track and distinguish ASATS from meteorites or space debris. The latter could also be used to verify compliance with future A SAT arms control agreements, if any, or for targeting future ASAT **(or DSAT)** weapons, if any.

Net Assessment

Treaties and agreements presently in force create no significant barrier to the development, testing, and deployment of very capable, nonnuclear ASAT weapons.[5] The current regime also allows a wide range of active and passive countermeasures, including the development of satellites capable of defending themselves by striking at attacking ASAT weapons.

The primary advantage of the current regime is that it allows the almost unrestrained application of U.S. technology to the related problems of protecting U.S. satellites and placing threatening Soviet satellites at risk. Under this regime, the United States would be free to use its comparative advantage in advancecl technology to keep pace with expected developments in Soviet ASATS and other military satellites. Advanced U.S. ASATS might discourage the development of more capable Soviet military satellites designed to place U.S. terrestrial assets at risk. In addition, the United States would be free to respond to Soviet ASAT weapons with increasingly sophisticated defensive weapons and countermeasures, thereby reducing the probability tl-iat the Soviets could successfully use their intentional or inherent A SAT capabilities. Effective A SAT capability could also give the United States a powerful countermeasure against potential Soviet space-based BMD systems.

In addition, research and development on new balfistic missile defense technologies can also proceed without the constraints that might be imposed by certain ASAT arms control regimes. Testing of advanced ASATS could provide valuable information that would contribute to the development of very capable BMD systems. Such testing in the "ASAT

[5]ASAT weapons capable of operating in an "ABM mode' are, or course, limited by the ABM treaty. See discussion, supra, p. 127.

mode" could allow some research to go forward that, if designated as BMD research, might be considered to be inhibited by the ABM Treaty.

The primary disadvantage of the current regime is that it might lead to an expensive and potentially destabilizing arms race in space. Rather than protecting satellites, a competition in space weapons might severely reduce their military utility. Under conditions of unrestrained competition, security might be purchased only at the price of a substantial and sustained commitment to the development of increasingly sophisticated offensive and defensive space weapons. In such an environment, ensuring the survivability of satellites would require more than simple hardening or evasion. Costly measures might have to be taken such as the deployment of precision decoys, pre-deployed spares, or the ability to quickly reconstitute ones space assets. Satellites capable of defending themselves or a companion satellite might ~so have to be developed and deployed.

Should space mines or directed-energy weapons be deployed, they might be capable of the almost instantaneous destruction of a large number of critical satellites and ASATS. This could force nations into a situation in which they must "use or lose" their own pre-deployed space weapons. This might supply the incentive to escalate an otherwise manageable crisis. If missile early warning and communication satellites were highly vulnerable, crisis stability might be lessened. The malfunction of such satellites could be misinterpreted as a sign of imminent attack, since potential nuclear aggressors would find such satellites to be attractive targets.

Another potentially destabilizing factor is that some satellites (particularly communication satellites) play a dual role—they are intended to be force multipliers in a conventional war, yet they are to play a key role in managing a conflict so as to avoid unwarranted escalation. In the event of a conventional war, the possessor of a capable ASAT system would have a strong incentive to attack satellites that were providing support to conventional enemy forces. Destruction of these satellites, however, might contribute to escalation from conventional to nuclear war.

An unrestrained competition in ASAT weapons would also increase the risk posed to space-based ballistic missile defense systems. Such systems are likely to have many critical assets based in low-Earth orbit. So situated, extensive precautions would have to be taken to protect them from even modest ASAT weapons.

It is possible that an ASAT weapon competition could also inhibit the use of space for commercial and scientific purposes. Manned space stations would be quite vulnerable to ASAT attack. Should considerable ASAT testing take place, the resulting debris could prove harmful to scientific and commercial satellites.

REGIME 2: A COMPREHENSIVE ANTI-SATELLITE AND SPACE-BASED WEAPON BAN

Legal Regime

This regime could be established by adhering to treaties and agreements presently in force and, in addition, agreeing to forego the possession of deliberate anti-satellite weapons, the testing—on Earth or in space—of any deliberate ASAT weapon, the testing in an "ASAT mode" of systems with inherent ASAT capabilities, and the deployment–on Earth or in space—of any ASAT weapon.[6] In addition, the U.S.S.R. would be required to destroy all its

[6]Such an agreement might resemble the draft treaty proposed to the United Nations by the U.S.S.R. in August of 1983, except the testing or use of manned spacecraft for military purposes would not, in general, be banned as proposed in Article 2 of the 1983 Soviet draft treaty. (U.N. Document A/38/194, Aug. 23, 1983). The fifth provision of Article 2 of this proposed

coorbital interceptors and the United States would be required to destroy the direct-ascent interceptor it is currently developing.

Offensive Posture

In this regime, the United States could not maintain any deliberate ASAT weapons, whether dedicated or multi-role, nor would the U.S.S.R. be allowed to do so. Space systems with inherent ASAT capabilities such as ICBMS, ABMs, and maneuverable spacecraft would still be allowed, but they could not be tested in an "A SAT mode. "

Defensive Posture

Under a comprehensive ASAT ban the United States would retain the right to deploy and use passive countermeasures such as hiding, deception, evasion, hardening, and proliferation. The United States would not be allowed to develop, possess, test, or deploy weapons for satellite self-defense, defensive satellites (DSATS), or other systems intended to have anti-satellite capabilities, even for defensive purposes.

If the U.S.S.R. complied fully with the letter of such a comprehensive ASAT ban, the risk posed to U.S. satellites would be limited to the risk posed by possible Soviet use of ICBMS, SLBMS, ABM interceptors, and possible future highly maneuverable spacecraft. If U.S. satellites were hardened against the effects of nuclear explosions to a modest degree, only low-altitude U.S. satellites would be at significant risk of damage by such inherent ASAT capabilities, and then primarily at the nuclear level of conflict. Assuming Soviet compliance, U.S. warning and communications satellites in high-altitude orbits would enjoy a high degree of security in this regime.

Net Assessment

Although this regime would contain the most far-reaching arms control provisions and therefore might be most effective at preventing the development of new and more threatening ASAT weapons, it would have the disadvantage of being the most difficult to verify. Unlike an ASAT Test/Space-based Weapon Deployment Ban (regime *3)*, a comprehensive ban would prohibit possession of ASAT weapons *on Earth*. Because it is difficult to obtain information about Soviet military affairs, the United States would have to assume that the Soviet Union could possess some number of their current ASAT weapon.

The current Soviet coorbital interceptor is a relatively small spacecraft launched on much larger, general-purpose boosters. Maintaining such boosters and their launchpads would be allowed, and it would have to be assumed that the U.S.S.R. would continue such activities. Construction of additional boosters and launchpads would also be allowed by an ASAT ban of the type considered here. Hence the U.S.S.R. could maintain and even expand its ASAT force with some confidence that the United States could not gain *unambiguous evidence of a violation* of an A SAT possession ban. However, even if the U.S.S.R. maintained some coorbital interceptors, it could not test them without risking almost certain detection, and in time the confidence of Soviets in a long-untested and never perfected A SAT weapon might erode.

There would always be the possibility that the Soviets might develop a new type of A SAT weapon with the intention of using it, without prior testing, *in extremis (e.g.,* if anticipating an imminent attack). For example, the U.S.S.R. might equip an existing booster or satellite vehicle with a nuclear explosive—either an isotropic nuclear weapon or possibly a nuclear directed-energy weapon—and maintain it in readiness for launch or actually launch it into space. The military utility of

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treaty would obligate parties "not to test or use manned spacecraft for military, including anti-satellite, purposes. " If this provision were stricken or changed to read "not to test or use manned spacecraft for anti- satellite purposes, the resulting draft treaty, if acceded to by the United States and the U. S. S. R., would establish a regime of the type considered in this section. The fifth provision of Article 2 of the proposed Soviet draft treaty would obligate parties *'Not to test or create new anti-satellite systems and to destroy any anti-satellite systems the~ may already have.

such untested systems would be questionable, particularly if the United States aggressively pursued available satellites survivability measures.

Since the United States might agree to a comprehensive ASAT ban only after considerable political friction over question of compliance and verification, it would be important to consider how such a ban might make a greater contribution to U.S. national security than a ban on ASAT testing and space-based weapon deployment (regime 3). The purpose of both bans would be to prevent the use of ASATS, or, at minimum, to reduce the probability that an ASAT attack would be effective. An ASAT test ban would primarily affect weapons reliability, while an ASAT possession ban, if observed, would affect both availability and reliability. It is conceivable that the risk posed by possible illegal Soviet use of ASAT weapons might be somewhat lower in a regime in which the Soviets could not lawfully possess ASAT weapons. Presumably, the inability to overtly possess ASAT weapons would diminish one's ability to use them effectively. Furthermore, an absolute ban on possession might make it less likely that the current generation of ASAT weapons could be upgraded and held in readiness in significant numbers.

However, if the United States could only be confident that the Soviets were complying with a treaty to the extent we could verify compliance, then the United States would not have confidence that this regime offered any greater protection to our satellites than does regime 3 (test ban and space-based weapons ban).

REGIME 3: AN ASAT WEAPON TEST BAN AND SPACE-BASED WEAPON DEPLOYMENT BAN

Legal Regime

This regime would ban what can be monitored with greater confidence—testing in an "ASAT mode"[7] and ASAT deployment in space. Everything that is prohibited under the current regime would continue to be prohibited. In addition, further testing—in space—of the current Soviet coorbital interceptor and the U.S. direct-ascent interceptor would be prohibited, as would the placement of any weapons in space. Unlike regime 2, this regime would not attempt to ban testing, possession, or deployment of ASAT weapons *on Earth.*

Offensive Posture

Although they could not be tested *overtly* in an "ASAT mode, " a number of weapons which have some limited A SAT capability already exist or could be developed. ICBMS, ABMs, and maneuverable spacecraft already exist and have inherent ASAT capabilities which pose some threat to satellites. It might be possible to increase the ASAT potential of these systems without violating a ban on the testing of ASAT weapons. In addition, upon entry into force of a ban on ASAT testing, the United States and the U.S.S.R. would possess deliberate ASAT weapons which would have undergone some developmental testing, although possibly not enough to perfect their designs. Such weapons could be maintained in partial readiness. However, without operational testing for reliability evaluation and training purposes, confidence in the effective ness of such weapons would probably degrade in time.

Advanced ASAT weapons such as neutral particle beam weapons or x-ray lasers could be developed and maintained in partial readiness, but could not be completely tested. Confidence that such weapons would perform ade quately if used might be so low that one would not rely on them in an aggressive first strike nor find it cost-effective to develop them for that purpose. On the other hand, one might

[7]Testing in an "A SAT mode" would include tests of ground-, air-, sea-, or space-based systems against targets in space or against points in space. Testing on the ground of ASAT systems or components would not be prohibited.

use them, if attacked, to degrade enemy capabilities supported by satellites, and might find it cost-effective to develop them for that purpose. That is, the discrepancy between offense conservatism and defense conservatism might decrease the risk which untested weapons could pose if possessed by an aggressive nation.

Defensive Posture

In this regime, testing and deployment in space of advanced ASAT weapons would be prohibited but might be attempted by the U.S.S.R. covertly or after a breakout.[8] Hence the choice of passive countermeasures in this regime would be influenced by the same considerations which favor deception and modest nuclear hardening in the existing regime. Such measures would be more effective, however, in a test-ban regime because it could be assumed that the ASAT threat would be reduced to some degree by the arms control provision. Passive countermeasures would also be more important in this regime, because destructive active security measures—e.g., shoot-back with reliable, tested DSAT weapons—would not be an option. Deep-space surveillance would be even more desirable in this regime than in the existing regime, because of the need to monitor compliance as well as for its role in providing attack assessment information. Hence, in a test-ban regime, attack sensors, space-based LWIR sensors, satellite decoys, and modest nuclear hardening would be at least as desirable, as in the existing regime, if not more so.

Nondestructive active countermeasures such as ECM and E-OCM would be desirable, if not inherent, in a test-ban regime, just as in the existing regime. Destructive active countermeasures, on the other hand, would be severely constrained: new ASAT weapons useful as DSATS could be developed but could not be tested nor deployed in space. An untested NPB or XRL built and readied for quick launch and use as a DSAT could not be responsive enough to use for defensive shoot-back against expedient ASAT weapons such as ICBMS but might have value if maintained for retaliatory shoot-back.

‘Although deployment of an NPB in space—a prerequisite for testing-would probably be observable, maintaining an untested NPB weapon on Earth in readiness for quick launch might not be, and would be allowed. Maintaining an untested XRL weapon on Earth in readiness for quick launch might also be difficult to detect and would also be allowed under the terms of an ASAT test and SBW deployment ban. Illegal deployment of an untested XRL in space would be difficult and costly to observe. However, an enemy could have little confidence in the reliability and performance of untested NPB or XRL weapons, so such weapons would not be as threatening as in the existing regime in which NPB weapons could be legally tested in space.

Net Assessment

A negotiated ban on the testing of weapons in space or against space objects would limit the nature and extent of U.S. and Soviet arms competition in space. Advanced ASAT directed-energy weapons which could threaten high-altitude satellites with prompt destruction could not be lawfully tested and attempts to extensively test such weapons covertly would probably be detectable. Although such a ban could not eliminate all threats to satellites, it would substantially reduce the cost and complexity of ensuring a reasonable level of satellite survivability. The United States would still benefit from hardening its satellites to some extent and deploying spares and decoys, but the more elaborate, expensive, and possibly ineffective precaution of developing and deploying DSATS would be prohibited and, indeed, less attractive. In the absence of reliable, effective ASATS, satellites would be of greater utility since the United States might have higher confidence that they would be available when needed.

Relative to the existing regime, the primary advantage of a regime banning testing of ASAT capabilities and deployment of space-based weapons would be that highly valued U.S. satellites in higher orbits–e.g., the future MILSTAR system–could be protected with some confidence from advanced A SAT weapons, especially if protected as well by passive countermeasures. The fact that advanced ASATS could not be overtly tested would reduce the probability that they would be developed and deployed. If they were developed and used without prior or complete testing, the improbability of their success compounded with the improbability of their attacking an operational satellite rather than a decoy (if such are deployed) would afford such satellites considerable protection and would, at least, disproportionately increase an enemy's cost for an effective ASAT capability. In addition, a ban on testing advanced ASAT weapons and deploying them in space would plausibly inhibit future competition in developing space-based weapons and would discourage development and covert testing and deployment of ASAT weapons of types which would pose the strongest incentives for preemptive ASAT attack. These benefits might be deemed advantageous by both the United States and the U.S.S.R.

As in the existing regime, the United States could retain a capability to attempt to negate low-altitude Soviet satellites (e.g., RORSAT) with its MV ASAT in the event of war and to respond in kind to a Soviet ASAT attack. However, confidence in the operational capability of this system might degrade over time without continued operational testing.

From the point of view of those interested in preserving the present agreement beween the United States and the Soviet Union limiting ballistic missile defenses, another advantage of an ASAT test ban would be its prevention of tests of ASAT technologies with potential BMD applications.

On the other hand, from the point of view of those favoring intensive BMD research, a primary disadvantage of this regime, relative to the existing regime, is that the testing of some types of advanced BMD weapons might be prohibited. Such limitations could be slightly more restrictive than those of the ABM Treaty, and would be very restrictive compared to a regime in which the ABM Treaty was no longer in force [regime 7]. Finally, it must be recognized that a ban on testing ASAT capabilities and deploying space-based weapons would not offer absolute protection for satellites; there would remain some possibility that an untested or partially tested ASAT, if suddenly deployed and used, might actually work well enough to overcome passive countermeasures.

REGIME 4: A "ONE EACH/NO NEW TYPES" REGIME

Legal Regime

A "one each/no new types" regime might be established by adhering to agreements currently in force and further agreeing to ban the deployment in orbit of any weapon and the testing in space, "in an ASAT mode" of any system except the currently operational type of Soviet coorbital interceptor and the U.S. MV direct-ascent interceptor.[9] Research on advanced systems and testing of these systems on Earth would not be prohibited.

Offensive Posture

Offensive postures in a "no new types" regime would be as in an ASAT test ban and space-based weapon deployment ban regime (regime 3), except ASAT weapons of the single allowed type would almost surely be maintained for offensive ASAT missions in wartime.[10] It is possible that each side would be satisfied with the capabilities such fully tested weapons could provide and would be less tempted than it would be in a test ban regime to covertly develop advanced ASAT weapons.

[9] Although the U.S. Department of Defense has stated its belief that the Soviets have two ground-based lasers which could be used against satellites [U.S. Department of Defense, *Soviet Military Power,* 1984, p. 35],testing of such lasers as ASAT weapons would be prohibited. If these lasers had already been tested as ASATS by the time a "no new types agreement" could enter into force then this regime might have to be appropriately modified.

[10] It is possible, of course, that one or both nations would decide–as the United States did after ratifying the ABM Treaty–that its allowed system was not worth maintaining.

Defensive Posture

Passive countermeasures appropriate in a test-ban regime would also be appropriate in this regime, and for the same reasons. In addition, the unambiguous, if limited, threat posed by the one allowed ASAT weapon would provide an additional incentive to deploy passive countermeasures tailored to that weapon. For example, evasion might effectively counter coorbital interceptors such as those tested by the U. S. S. R., and maneuver-although not literally "evasion"- could complicate targeting of the U.S. MV. These countermeasures would probably be developed and employed even though they would not be effective against more capable weapons which might be developed but not tested nor deployed in space.

ECM and E-OCM would be allowed in this regime as in a test-ban/space-based weapon ban regime. Current U.S. and Soviet ASAT weapons would be insufficiently responsive to be effective for defensive shoot-back; however, they could be used in retaliation.

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The primary advantage of a "no new types" regime, relative to the existing regime, would be that critical U.S. satellites in higher orbits could be protected with some confidence from advanced ASAT weapons. If developed and used without prior testing, it is possible that such advanced A SAT weapons would not work properly. If they did work, it would not be clear that they could overcome the survivability measures that could be given satellites in this regime. More generally, a ban on testing advanced ASAT weapons would inhibit to some extent future arms competition in space.

Assuming the United States had successfully developed its MV ASAT, a "no new types" regime might be particularly desirable. Such an agreement could prohibit the testing of Soviet ground-based lasers or MV-type ASAT weapons and limit them to their current, unsophisticated A SAT weapon. Of course, this would make such an agreement less acceptable to the Soviet Union. Should the Soviets test advanced ASAT weapons before such an agreement can enter into force, such an agreement would be less advantageous to the United States. However, since such an agreement might avert the risks posed by even more advanced-particularly directed-energy ASATs–a "no new types" agreement might still be considered valuable and negotiable by both the United States and the Soveit Union.

As in the existing regime, the United States could retain a capability to negate low-altitude Soviet satellites (e.g., RORSAT) in the event of war and to respond in kind to a Soviet ASAT attack. A primary disadvantage of a "no new types" regime, relative to the existing regime, would be that allowed U.S. ASAT capabilities would be inadequate to negate threatening Soviet satellites if such satellites were moved to higher orbits—a feasible but difficult and costly Soviet countermeasure. As in the test ban and space-based weapon ban regime, the testing of some types of advanced BMD weapons which would be allowed in the existing regime would be limited in this regime. Such limitations could be slightly more restrictive than those of the ABM Treaty and would be very restrictive compared to a regime in which the ABM Treaty was no longer in force.

Finally, it must be recognized that the reliability of protection afforded high-altitude satellites by a ban on testing "new types" would be uncertain; there would remain some probability that an untested advanced ASAT, if suddenly deployed and used, might actually work.

REGIME 5: RULES OF THE ROAD

Legal Regime

A legal regime providing for "keep-out zones" around satellites could be established by a "rules of the road" agreement similar to the "Rules of the Road at Sea" Treaty. " As discussed in chapter 6, such an agreement would not prohibit development, testing, or deployment in space of advanced ASAT weapons but would, instead, attempt to enhance security by establishing rules regarding space activities such as close approach of foreign satellites, advance notice of launch activities, high-velocity fly-bys, minimum separation distance between satellites, low-altitude overflight, and "keep-out zones. "[12]

"Keep-out zones' would probably offer the closest thing to security in a "rules of the road" regime. The following "rules of the road" are illustrative of those which might be agreed should it be decided that "keep-out zones' are in the U.S. national security interest:

- Keep 100 kilometers and three degrees out-of-plane from foreign satellites below 5,000 km.
- Keep 500 km from foreign satellites above 5,000 km except those within 500 km of geosynchronous altitude.
- One pre-announced close approach at a time is allowed.
- In the event of a violation of the rules above, the nation of registry of the satellite which most recently initiated a maneuver "burn" is at fault and guilty of trespass.
- Satellites trespassing upon keep-out zones may be forcibly prevented from continued trespass.

The rationale for these rules is as follows:

- ASAT weapons such as nuclear interceptors would have to be kept at a range of several hundred kilometers from moderately hardened satellites in order to protect such satellites; advanced ASAT directed-energy weapons might have to be kept much farther away. '3
- Satellites in geostationary orbit are already so closely spaced that a keep-out zone sufficiently large to protect satellites from nuclear attack could not be established around such satellites without displacing satellites already there and reducing the number of geostationary orbital slots available to other nations in the future.
- There are now very few satellites in supersynchronous orbits," but critical strategic warning and communications functions could be performed by satellites in such orbits. Should space systems be developed to operate in this region, there would be adequate room to accommodate large keep-out zones.
- There are presently few satellite *orbits* in deep space[15] but below geosynchronous orbital altitude. The most notable exceptions are the orbits of various Soviet satellites in highly elliptical, semi-synchronous "Molniya-type" orbits, U.S. Air Force Satellite Data System (SDS) satellites in similar highly elliptical orbits, and U.S. (NAVSTAR) and Soviet (GLONASS) navigation satellites in semi-synchronous circular orbits. Although there are, or soon will be, many such satellites de-

[11]16 UST 794, TIAS 5813.

[12]In addition to agreeing to such "rules of the road, " the United States and the Soviet Union might have to modify their commitment to the 1967 Outer Space Treaty (18 U.S.T. 2410; T.I.A.S. 6347). Since Article II of the Outer Space Treaty states that "outer space . . . is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means, " this could be interpreted as prohibiting establishment of such keep-out zones. A contrary argument maintains that a precedent for "keep-out zones" can be found in the international acceptance of the principle that a satellite should not be placed in geostationary orbit if it will interfere with a satellite already in that orbit,

[13]*In re*: NDEW, see, e.g., L.A. Wojcik, "Separation Requirements for Protection of High-Altitude Satellites from Coorbital Anti-Satellite Weapons, " (Pittsburgh, Pa.: Carnegie-Mellon University, Department of Engineering and Public Policy, dissertation, March 1985); *in re*: NPB weapons, see ch. 4 of this report.

"I. e., higher than geosynchronous orbital altitude.

"I. e., higher than 3,000 nautical miles, or about 5,600 kilometers.

ployed, several satellites will (or could) occupy the same orbit. For example, 24 NAVSTAR satellites will occupy only three orbits, with eight satellites following one another around each of the three orbits. Hence there would be enough room in this region of space to accommodate keep-out zones of several hundred kilometers radius around the satellites presently deployed there.

- There are too many satellites in 1ow-Earth orbit—particularly below the inner Van Allen radiation belt which extends from about 1,800 km (1,000 nmi) to about 5,600 km (3,000 nmi)–to accommodate keep-out zones of several hundred kilometers radius around the satellites presently deployed there. Indeed, many satellites have perigees within several hundred kilometers of the Earth's surface. Requiring keep-out zones of several hundred kilometers radius around low-altitude satellites would therefore be impractical.
- However, it would be feasible to establish smaller keep-out zones around satellites in low orbit and, in addition, to prohibit satellites from entering an orbital plane inclined less than, say, three degrees from the orbital plane of a foreign satellite at such altitudes. Specifying a minimum angular separation between orbital planes would prevent continuous trailing; for example, two satellites in 1,000 km circular orbits with orbital planes separated by three degrees would approach each other closely every 53 minutes, if properly "phased," but would separate by as much as about 400 km at intermediate times and would be separated by at least 200 km about half the time. If, in addition, such satellites were phased so as to not approach one another more closely than 100 km at any time, their separation would vary between 100 km and more than 400 km, at minimum. Under such rules, although satellites would occasionally approach one another so closely as to be mutually vulnerable to, for example, covert on-board nuclear weapons, such approaches would not all occur simultaneously. Therefore, adequately hardened, low-altitude satellites could not be instantly and simultaneously destroyed by relatively primitive ASAT weapons.
- There would be some value in allowing one pre-announced close approach at a time as an exception to the rules above. Such an exception would, for example, permit an inspection satellite carrying a gamma-ray spectrometer to trail a foreign satellite while trying to determine whether the foreign satellite carried fissionable material, possibly in violation of Article IV of the 1967 Outer Space Treaty. A disadvantage of such an exception would be that a trailing "inspection" satellite could carry a weapon and destroy the trailed satellite at close range. However, deployment of one on-orbit spare for any truly essential satellite would eliminate this risk.

Although, given adequate space surveillance, it could be verified that two foreign satellites approached one another more closely than would be allowed by these rules, there could be a problem in determining which nation or other party would be guilty of a violation. It is difficult to predict, to within an accuracy of 100 km, where a satellite will be in several months as the result of an orbital transfer or stationkeeping maneuver. This is particularly true if the satellite is at very low altitude where it would be subject to atmospheric drag or at very high altitude where it would be subject to the lunar gravitational field. Hence, inadvertent close approach might be possible. legal allocation of responsibilities in such a regime might follow precedents established in maritime and, especially, aeronautical law, which specifies minimum separation distances between aircraft and gives right-of-way to relatively unmaneuverable aircraft such as aerostats (balloons) and gliders. One possibility would be to give right-of-way to satellites already in orbit and, by implication, to assign fault to whichever spacecraft most recently initiated or continued a maneuver "burn."

The rules suggested above are intended to be illustrative rather than precise. Careful framing of an agreement would be required in order to prohibit unintended abuses such as establishment of a *de facto* barrier to deep space by deploying many small satellites in low orbit in order to fill an altitude band with keep-out zones. Rationing keep-out zones—e.g., 10 per nation—could solve this problem, but careful study may be required to foresee other possible abuses. In addition to its technical problems, this regime is likely to have a significant political dimensions inasmuch as it will affect the rights of all present and future spacefaring nations.

Offensive Posture

A "keep-out zone" agreement would not constrain offensive postures, and these could be as in the existing regime. The protection afforded by defended keep-out zones would diminish the effectiveness of some types of weapons such as coorbital interceptors and thereby diminish incentives to include them in a space order of battle. However, the effectiveness of advanced ASAT weapons—e.g., directed-energy weapons–would not be significantly reduced by keep-out zones of the size considered here.

Defensive Posture

A "keep-out zone" agreement would not constrain defensive postures, and these could be as in the existing regime. Decoys might be an attractive defensive measure in this regime, because "keep-out zones" would inhibit or preclude certain types of close inspection which might otherwise be able to distinguish decoys from valuable satellites (see discussion in chapter 4). The deployment of DSATS or self-defense weapons would also be attractive, because such weapons could be used to enforce *agreed* keep-out zones. In the existing regime, attempts to enforce a declared keep-out zone by firing upon a "violating" suspected (but not proven) A SAT would probably be considered unlawful unless lethal capability and hostile intent of such spacecraft could be established.

Net Assessment

An agreement establishing minimum satellite separation rules could establish important legal rights to actively defend satellites, and would be an improvement over the existing regime if an active defense posture were desired. Enforcing agreed keep-out zones using DSATS would provide protection against relatively primitive ASAT weapons such as the current Soviet coorbital interceptor. However, keep-out zones large enough to protect satellites from advanced directed-energy weapons could be accommodated only beyond geosynchronous altitude.

A "keep-out zone" regime would have the advantage of not limiting research, development, and deployment of ASAT, DSAT, and BMD technologies. On the other hand, since a defended "keep-out zone" would provide significant protection against current ASAT weapons, it would encourage the development of more advanced systems. Such systems would likely increase in sophistication until the more advanced directed-energy technologies reduced the effectiveness of "keep-out zones."

REGIME 6: SPACE SANCTUARIES

Legal Regime

A legal regime prohibiting the deployment of weapons in deep space (i.e., at altitudes greater than 3,000 nmi (5600 km)) or the testing of any weapons against instrumented targets or other objects in deep space could be established by a "Deep-Space Sanctuary." Such an agreement would be similar in some respects to the Antarctic Treaty,[16] the Outer Space Treaty,[17] the Treaty for the Prohibition

[16] The text of the Antarctic Treaty is reprinted in U.S. Arms Control and Disarmament Agency, *Arms Control and Disarmament Agreements* (Washington, D. C.: U.S. Government Printing Office, 1982), pp. 22-26.

[17] ibid., pp. 51-55.

of Nuclear Weapons in Latin America,1[8] the so-called Seabed Arms Control Treaty,l[8] and other treaties and agreements which establish demilitarized or deweaponized zones. Such an agreement would not prohibit development, testing, or deployment in space of ASAT weapons but would attempt to enhance security by banning the testing and deployment of weapons in deep space where critical strategic satellites are presently based. At present, such systems are invulnerable to currently operational tested ASAT weapons.

In addition to such an agreement, other rele vant agreements currently in force (Limited Test Ban Treay, Outer Space Treaty, ABM Treaty) could remain in force in a "deep-space sanctuary' regime. Amendment of the Outer Space Treaty would not bean issue, since, unlike the "keep-out zone" regime, the "space sanctuary" regime could not be considered as a national appropriation of space.

Offensive Posture

Offensive postures appropriate in a "keep-out zones" regime [regime 5] would also be appropriate in a deep-space sanctuary regime, and for the same reasons. However, nuclear or kinetic-energy weapons—which would require more time to reach a satellite in deep space than to reach a satellite inside a small keep-out zone—would be less attractive as ASAT weapons than in a "keep-out zones' re gime. Advanced directed-energy weapons, when feasible, would be the most capable ASAT weapons allowed in this regime, as in a "keep-out zones" regime.

Defensive Posture

Passive countermeasures appropriate in a "keep-out zone" regime would also be appropriate in this regime, and for the same reasons. However, as in a "keep-out *zone*" *regime,* passive countermeasures could not economically protect large and expensive satellites as high as in geosynchronous orbit from advanced directed-energy weapons, which would be allowed in low orbit and which could be adequately tested against instrumented target satellites in low orbit. As in the existing regime, small, inexpensive satellites might be protected from such advanced weapons because they might cost more to attack than to build.

Active countermeasures appropriate in the existing regime would also be appropriate in this regime, and for the same reasons. As in the existing regime, attacking suspicious approaching ASAT weapons would be unlawful at low altitudes where such objects would have rights of innocent passage. Deployment in deep space of "shoot-back" capabilities or DSATS would probably be prohibited since it might be impossible to differentiate these weapons from offensive weapons.

Net Assessment

The primary advantage of this regime would be that it could protect satellites in high orbits from the current generation of ASAT weapons. In addition, a deep-space sanctuary regime would constrain ASAT development less than would a comprehensive test ban regime or a nonew-types regime. However, should the United States and the Soviet Union choose to pursue advanced ASAT weapons, a space sanctuary might offer only limited protection.

The greatest risks in a space sanctuary regime would be posed by advanced directed-energy weapons which could be tested and deployed at low altitudes. Such testing and deployment would probably be adequate to guarantee effectiveness against targets at higher altitudes. Satellites at very high, supersynchronous altitudes might still derive some pre tection from this regime, but violation of the sanctuary by highly maneuverable kinetic-energy weapons or by satellites covertly carrying powerful nuclear or directed-energy weapons would remain a risk.

‘[3]Ibid., pp. 64-75; the texts of Protocols I and 11 thereto are reprinted in ibid., pp. 76 and 77, respectively.

‘[8]Formally titled "Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof, " the text of which is reprinted in ibid., pp. 103-105.

REGIME 7: A SPACE-BASED BMD REGIME

Legal Regime

If the United States or the Soviet Union withdrew from the ABM Treaty, this would, in addition to allowing ballistic missile defense, eliminate constraints on ASAT capabilities now imposed by that Treaty. The resulting regime would allow both advanced ASAT and space-based BMD weapons. Withdrawal from the Limited Test Ban Treaty and the Outer Space Treaty would also be necessary if the United States or the Soviet Union desired to test and deploy space weapons that used nuclear explosives as a power source.

Offensive Posture

In a space-based BMD regime, ASAT options would be less constrained than in the existing regime and advanced ASAT weapons would be more essential for defeating space-based enemy BMD system. In such a regime, advanced space-based weapons could be deployed at low altitudes and used as ASAT or DSAT weapons as well as for BMD. Some spacebased weapons which would be useful—but not preferred-for satellite negation might be deployed in this regime because of their use fulness as BMD weapons. For example, kinetic-energy weapons and continuous-wave lasers which could destroy fast-burn boosters deep within the atmosphere might be preferred as BMD weapons over neutral particle beam or X-ray laser directed-energy weapons. The latter, although more useful in an ASAT role, could not readily penetrate the atmosphere and therefore may have more limited value as BMD weapons.

Defensive Posture

In a space-based BMD regime, defensive measures would be less constrained and more essential than in the existing regime. Advanced space-based weapons could be deployed at low altitudes and then used as ASAT or DSAT weapons. In a DSAT role, these weapons could offer some protection to low-altitude satellites. However, such satellites would probably remain vulnerable to attack by larger weapons or by expendable single-shot weapons (e.g., single-pulse lasers) which could attack from great range unless held at bay by large "keep-out zones. " As discussed in chapter 4, it is possible that future technological advances might allow decoys to be developed that were cost-effective when compared to future offensive weapons and discrimination capabilities.

In evaluating offensive and defensive postures in a space-based BMD regime, it is necessary to assume that future technology will confer an advantage to ASAT countermeasures vis-a-vis ASAT capabilities. Although such an assumption may be unjustified at present, if the United States is to deploy advanced space-based BMD weapons then it must also have developed highly effective countermeasures to ASAT weapons. It would be irrational for the United States to seek to establish a "spac~based BMD" regime unless it judged that adequate numbers of the space-based BMD components would survive or unless it judged that non-space-based BMD components could provide an adequate defense without spacebased components. Scenarios illustrating each of these conditions are imaginable; for example:

1. The United States may judge that BMD systems with space-based components *could not be destroyed* by the U. S. S. R.: For example, the United States might deploy, in addition to ground-based BMD components, spacebased electromagnetic launchers for kinetic-energy weapons and defend them by hardening, deception, and shoot-back. Deceptive measures employed might include massive decoys made from asteroidal material such as nickel.[20] While

[20] It is speculated that the cost of transporting such material to low Earth orbit and refining and fabricating finished products with it there may eventually be several orders of magnitude lower than the cost of refining and forming such materials on Earth and transporting the products to space. Should this forecast prove accurate, deception may have a favorable cost-exchange ratio even against ASAT systems which can discriminate decoys on the basis of mass density.

the Soviets might be able to destroy some BMD components, the system as a whole would survive.

2. The United States may judge that space-based BMD components *would not be destroyed* by the U. S. S. R.: Even if future technology does not favor A SAT countermeasures to the extent assumed in (l), A SAT countermeasure technology could be so effective that the Soviet leadership would be unwilling to pay the costs of defeating the countermeasures.
3. The United States may desire an extensive BMD system *without space-based components:* For example, U.S. aspiration might be limited to defense of hardened facilities which house strategic retaliatory forces or command and control systems; this might be accomplished using ground-based radars and interceptors but would require deployment of more of these over larger areas than is allowed by the ABM Treaty. Alternatively, the United States might desire an extensive BMD system capable of defending industry and population using only ground-based weapons.

Net Assessment

Depending on one's viewpoint, the principal advantage, or disadvantage, of a space-based BMD regime would be that it would allow the United States and the Soviet Union to deploy highly capable weapons in space. Since even a limited BMD system would probably make a very good A SAT system decision to proceed with BMD deployment necessarily includes a decision not to proceed with certain types of ASAT arms control."

On March 23, 1983, the President called for a vigorous research program to determine the feasibility of highly effective, advanced-technology BMD systems, suggesting that the de ployment of such systems, if feasible, would be desirable. Before the United States deployed space-based BMD systems it would have to determine, first, that the contribution that such systems made to U.S. security was great enough to compensate for the threat which similar opposing systems would pose to U.S. satellites, and second, that space-based BMD components could be protected at competitive cost against advanced ASAT weapons.

The threat to satellites would be greater in a space-based BMD regime than in any other regime because the BMD weapons would likely have extensive ASAT capabilities. The expense of equipping all military satellites with countermeasures against such capabilities would be considerable, particularly if, as some fear, deployment of space-based BMD systems will lead to a major arms race in both offensive and defensive weapons. However, if, as some argue, space-based missile defenses can make us more secure and encourage the Soviets to make real reductions in offensive missiles, this would reduce the threat of U.S./Soviet conflict and to contribute to a mutual desire to protect space assets. In a world where conflict was less likely, satellite vulnerability would be less important.

A SAT countermeasures must prove to be effective for spacebased BMD platforms if a de cision to deploy them is to make sense. It is possible that large improvements in the effectiveness or economy of passive countermeasures such as combinations of hardening, deception, and proliferation might provide the needed protection. If such improvements occur, they might also be used effectively for satellites in the other regimes discussed above. Alternatively, the superior fire-power or massive shielding of BMD weapons might give them a degree of protection unattainable by smaller, less capable satellites.

"lt is p~ssiblc that in a space-based BMD regime one might also wish to negotiate ' 'rules of the road' such as "keep-out zones, or perhaps ex'en a deep-space sanctuary.