Verification Issues

CAVEATS

Verification issues are inherently difficult to discuss in an open meeting. However, a panelist pointed out that verification is much more than a detailed catalog of technical intelligence capabilities. Another panelist agreed, noting that the intelligence agencies say that their job is not verification, but monitoring. They make that distinction very clearly, he explained: "verification" is a political, legal, diplomatic, and military process, of which "monitoring" is only a part.

Workshop panelists started the session devoted to verification by making two observations. First, verification is concerned with determining whether or not specified treaty provisions are being complied with and is therefore inherently dependent on the wording of those provisions. Second, any discussion of verification ought to include consideration of the overall military or security purposes which the treaty is to serve. The level and confidence with which compliance with a provision need be verified must depend on the significance and implications of violating that provision.

GOALS

Therefore, any discussion of verification technology and procedure must implicitly or explicitly be preceded by discussion of philosophy—what is it that the treaty is to accomplish? Five not necessarily mutually exclusive goals of a space arms control or space behavior agreement were identified at the workshop:

1. to reduce the vulnerability of existing space assets to dedicated or residual ASAT threats by constraining those threats;
2. to prevent future development of a high-confidence, high-quality ASAT by the opposing party;
3. to relax tensions between the superpowers by establishing a regime of acceptable behavior in space;
4. to obtain political or diplomatic goodwill; and
5. to avert or constrain an arms race in space.

Some aspects of a treaty maybe much more relevant for achieving the principal purposes of the agreement than others, and therefore it may be more important to verify some portions of an agreement than others.

LEVELS OF VERIFIABILITY

Some provisions in a treaty may serve to ban activities which are not very threatening in themselves but are prohibited in order to ensure that other, more threatening activities are not undertaken. In these cases, the activities which are of less concern might not need to be detected with as high a level of confidence as long as there were higher confidence that the more threatening activities were not taking place. As an example, consider a ban against testing ASAT interceptors at geosynchronous orbit, which would be a more threatening act than testing them in low Earth orbit. It might be easier to ban these high altitude tests if tests in low earth orbit were also prohibited. Even if some low-altitude tests were conducted covertly by masking them as legitimate rendezvous operations, the

low-altitude ban might prevent overt, explicit low-altitude ASAT tests which might be more easily adapted to higher orbits than a covert capability would be.

Limitations which might not be highly verifiable, taken alone, might nevertheless be useful in an agreement as long as one understands the limited contributions such bans might make to security. Subversion of even a leaky ban would require a totally covert program, which would certainly be more difficult than an overt one and which mayor may not be possible. Furthermore, technical encroachment of a treaty proscription by a single component is not the same as development of a militarily significant system. "Soyuz can ram satellites, " admitted a participant, "but you have to have one hell of a lot of Soyuzes floating around to make a terribly militarily effective ASAT system. "

The problem of levels of verification has arisen in previous arms control issues. "In the late 1970's, there was some agreement among a large fraction of the community," said a panelist, "that although cruise missile verification could not be absolute, verification could be good enough considering that they did not pose a first strike threat. " Another panelist noted that we do not necessarily have to respond to weaknesses in our verification capabilities by either contorting arms provisions to avoid the weaknesses or by avoiding arms control altogether. There are defensive means other than arms control, such as hardening and survivability measures or changes in operational procedures, which can offset the military advantage that might accrue to a party attempting to cheat on an agreement.

FACTORS IN VERIFICATION OF ASAT ARMS CONTROL

COMPLICATIONS

Discussion of ASAT arms control brought forth several factors which tend to complicate the verification of compliance with such an agreement, and several other factors which ease that task. One of the complications is the enormous volume of space where illicit activities might be conducted. Verification of compliance with a SALT or START arms control agreement involves inspection of number of areas within the Soviet Union or its immediate airspace. This area, although vast, is relatively well determined and is amenable to close inspection by space-based photographic reconnaissance satellites. The region where space activities might be conducted starts at altitudes of about 100 km and can range well past geosynchronous orbit at 36,000 km. Also increasing the difficulty of verifying compliance with an ASAT treaty *is* the large number and growing variety of Soviet space launches. Soviet launches have increased at a rate of about 2 percent per year, averaged over the last 15 years. Although this launch rate may very well decrease in the future as the Soviets develop longer lived satellites, each additional type of satellite requires a body of experience in order to classify its function and permit discrimination between unusual activity and routine behavior.

Third, the functional characteristics distinguishing ASAT weapons or space mines from other satellites may not be readily observable. All national technical means have imperfect discrimination, and the physical differences between permitted and prohibited satellites may be small. As panelists had previously pointed out, much Soviet space activity is not likely to be completely understood by the United States no matter what the "true" Soviet intent might be.

A fourth complication is the inevitable presence of some residual ASAT capability in systems which may be undesirable or infeasible to ban. ICBMs, SLBMs, ABM interceptors, maneuvering spacecraft, and possibly air-

based or ground-based lasers may fall into this category. These systems may pose problems in determining whether they are being operated in an ASAT mode; normal operation (of rendezvous between spacecraft, for example) may be difficult to distinguish from certain types of ASAT activities. This question of residual ASAT capability is one of the most crucial factors in the debate concerning the desirability of an ASAT accord, and just how much ASAT activity could go undetected is a critical question. As the number of systems possibly having some ASAT capability proliferates, the monitoring task of determining how these systems are being used will become even more difficult.

A fifth, somewhat ironic, point made during this discussion was that at present, the principal motivation for the United States to develop the sort of space monitoring capability which would be useful in verifying an ASAT accord is to provide targeting information for the U.S. ASAT weapon. Panelists did note, however, that it is likely that any monitoring capability needed to verify a treaty would be desirable in any case. Intelligence collection requirements would persist even in, or especially in, the absence of a treaty. However, the lack of an ASAT weapon system might reduce the bureaucratic enthusiasm or political backing for an extensive space monitoring system.

SIMPLIFICATIONS

Mitigating these complications are several offsetting factors which assist our capability or monitoring space arms control. First, although space is large, it is transparent and accessible to monitoring, and weaknesses in round-based monitoring systems can be mitigated by putting those systems into space. Soviet satellites will be observable by U.S. national technical means. Confusion as to the true nature of a Soviet spacecraft maybe mitigated by an agreement which will serve to reduce ambiguity of space operations. Furthermore, all ASAT-related activities start on the ground. Relevant ground sites, including launch facilities, can be observed by an extensive array of U.S. monitoring facilities; all launches of significant size from Soviet territory can now be detected. After all, although the Soviets have never publicly announced their existing ASAT tests, these tests have been detected and analyzed by the United States.

Second, if the Soviet Union attempts to conduct covert ASAT testing or development, it will need to monitor its own activity if it intends to obtain any data concerning how well its system performs. The Soviet requirement to recover data from or observe its activity in some way may also provide the United States with an opportunity to detect or intercept the transmission. The Soviet need to hide covert testing from the United States may narrow down the regions where the United States need concentrate its own verification effort.

Finally, the claim has been made that unattainably stringent levels of verification are needed for an ASAT treaty because U.S. targets are few and valuable and therefore vulnerable to even a small amount of cheating. This reasoning was thought by many participants to be not so much an argument against an ASAT treaty as it was a compelling reason for the United States to increase the survivability of its space systems. Rather than precluding arms control, the situation of having few but valuable satellites calls for having alternatives to them. “If the United States is truly and genuinely that dependent upon a few satellites, I’d just like to know what the hell DOD plans on doing about it, because in the absence of any ASAT arms control, the problems are only worse. ”

VERIFICATION PARTICULARS

The verification discussion was explicitly not intended to be an exhaustive analysis. Security considerations, in particular, prevented many highly relevant points from being studied in detail. However, like the other workshop sessions, the session on verification did serve to foster discussion on a range of topics.

One participant pointed out that ASAT treaties would ban, first of all, the act of destroying satellites, and that this aspect of any ASAT treaty is readily verifiable. Less clear was how detectable the capability to destroy a satellite or its ability to function would be.

Satellite failure can easily be detected. Although there was concern that the Soviets might be able to develop a system which could cause one or two U.S. satellites to fail in a manner mimicking an equipment malfunction, panelists noted that satellites presently have a lot of on-board "state-of-health" monitoring. These sensors can be augmented to determine whether a failure is due to an internal flaw or whether it has been externally induced. Satellites can have sensors to measure incident laser light, rises in temperature, or sudden accelerations, for example. A satellite's location or behavior might also indicate a cause for its failure, either hostile or benign. Therefore, the Soviets would not have high confidence that covert interference would remain undetected.

Central to the ASAT arms control debate is the level of residual or covert ASAT capability which could remain, or be developed covertly, after a treaty had been ratified. A panelist noted that capabilities associated with known ASAT launch sites and research and development facilities would be detectable. The detectability of other possible residual or covert activity was more controversial. One possible "worst-case" evaluation of ASAT capability which might be covertly developed or maintained under a test ban was attempted at the workshop. Again, no detailed assessment of the likelihood of these developments, or of the particular means the United States could employ to search for them, was undertaken. There was, however, a general feeling that nothing arose in that evaluation which would clearly permit covert development of a high-confidence, high-quality ASAT weapon under such a test ban, although some panelists did express strong reservations about the detectability of nuclear space mines and ground or air-based lasers. ASAT capability is categorized below by technology.

DIRECT INTERCEPTION

1) Fully capable, dedicated, tested systems.—Neither the United States nor the U.S.S.R. now has such a system. Developing one would require an extensive testing program. If such a proposed system were to be similar to the existing Soviet ASAT, its launches would be visible; orbiting vehicles would be noticed, especially maneuvering ones. If such a direct intercept system were to be similar to the U.S. miniature homing vehicle, its ascent could be seen, its telemetry could be detected, and its target could be seen. Suspicious rendezvous operations in space could be inquired about Tests against points in space would eliminate any observation of the target, but there would be concomitant loss of confidence in the results of the test.

2) Existing Soviet ASAT.–Tests of the ex isting Soviet ASAT can be monitored. We possibly would not be assured that all ASAT interceptors had been destroyed pursuant to a ban, but we could with high reliability know if one had been tested. There will certainly not be high confidence that an ASAT intercept would work reliably mated to a booster it has never been tested with. Even with no major design change, the confidence in and signifi cance of any untested system is bound to degrade with time.

3) Residual "baling-wire" direct intercep ASAT.—One can never rule out the existence of some covert, improvised ASAT capability of this sort, but one can deny high confidence in such a system by preventing tests.

4) Nuclear-armed ICBM or ABM missiles used as ASATs.—Testing nuclear warheads in space is risky, in terms of collateral damage to friendly systems; prohibited, under the limited test ban treaty; and easily detectable. (Testing warheads underground could be done with high confidence.) Nuclear ASAT capability cannot reasonably be prohibited since ICBMs and possibly ABMs will exist with or without an ASAT treaty. Workshop panelists felt that such systems did not present a significant ASAT threat except during nuclear war, in which case damage to satellites would be likely whether or not it had been intended. "The Soviets are bad, but they're not lunatics, " said one panelist, "and I can just see no credibility whatsoever in the notion that they'd fling a nuclear weapon up into the heavens and crack it off. It would cost them a lot. "

5) Non-nuclear ICBM or ABM used as ASATs.–With appropriate radar support, it is possible that the Soviet Galosh ABM could perform ASAT attacks with a non-nuclear charge. Galosh deployment and testing are permitted under the ABM treaty, but the location of the launchers and the consequent range of orbits at risk are limited by the ABM treaty and protocol. Testing of an ICBM or ABM in an ASAT profile would be prohibited under an ASAT test ban, would be differentiable from ABM tests, and would likely be detected.

"SPACE MINES"

In general, any satellite very close to another country's satellite is a priori suspicious. Any mine or weapon which would be effective from further away is a complex system which requires maneuvering or pointing and would therefore require testing. These tests would be detectable. Concerning close approach, however, panelists noted that under the regime presently existing on the high seas, opposing forces do have the right to make close approaches. Banning close approaches in space would require codification of principles not incorporated in present law. Such an agreement would be highly verifiable, and could be made even more so by putting potential target satellites in orbits "out in the middle of nowhere" where there would be no innocent reason for other satellites to be anywhere nearby at all.

1) Non-nuclear space mines.—These would have to get very close (on the order of 1 km) to their targets. There would be no innocent reason to have a satellite that close to another country's satellite, and such approaches could be easily detected.

2) Nuclear space mines.—The Outer Space Treaty of 1967 prohibits orbiting of "nuclear weapons, or any other kinds of weapons of mass destruction. " Nuclear space mines are therefore presently prohibited. There are also significant inhibitions (collateral damage, breaking the nuclear threshold) against their use for ASAT (see "Nuclear-armed ICBM or ABM missiles" section above). At present, nuclear space mines can easily be built, tested underground, and deployed. However, actual emplacement of mines within a nuclear kill radius (100 to 200 km) of their targets, or of mines able to be maneuvered within that range, would likely be identified from tracking data. Inspector satellites that could detect nuclear weapons in space satellites were briefly discussed. However, they may not be technically feasible, and negotiating an agreement regulating their use might pose problems (see "Cooperative Verification Measures" section below).

3) Projectile-emitting. -Satellites carrying interceptors which could travel 100 kilometers or so to their targets could similarly be identified from tracking data; furthermore, projectile-emitting satellites would likely require extensive testing of their target acquisition and homing systems, and these tests would likely be detected.

DIRECTED ENERGY WEAPONS

1) Space-based directed energy.–Space-based directed energy weapons might best be considered space mines with kill radii of hundreds to thousands of kilometers since they are ef-

fectively instantaneously acting. Space-based, non-nuclear-pumped lasers would be quite large and may emit hydrogen fluoride or other gases. Their operation and testing would be observable. Nuclear-pumped directed energy weapons, like non-directed nuclear weapons, could not be tested covertly in space, and placing them into orbit is contrary to existing treaties. On-board nuclear weapons might be searched for (see discussion of inspection in "Cooperative Verification Measures" below).

2) Air-based, ground-based, or pop-up directed energy.—All such systems would require testing. Possible targets could in principle be monitored to see if they are being illuminated by strong lasers, are giving off gases, are being unexpectedly accelerated, or are emitting unusual signals. Air and ground-based systems may be detectable by national technical means; furthermore, they are increasingly less effective as the target altitude increases, since intensity drops off as the square of the distance between the weapon and the target. It is far easier to blind an optical sensor than to damage a satellite, requiring probably one millionth of the energy. Lasers capable of blinding sensors are easily available, so the capability of blinding sensors cannot be banned. However, the act of blinding a satellite would be readily detected: after all, "imaging satelites are only so particularly vulnerable when they are looking at you. "

SPOOFING, JAMMING, OR OTHERWISE INTERFERING WITH THE OPERATION OF SYSTEMS USING SATELLITES

These categories would likely not be covered under an ASAT testing ban, since ensuring the absence of such capability would not be verifiable. Furthermore, the United States is not likely to negotiate away the capability to interfere with hostile satellites in these ways: "We would like to do that, we're very good at doing that, and we intend to do that in case of conflict. "

COOPERATIVE VERIFICATION MEASURES

Some of the verification techniques discussed at the workshop would require, or would at least greatly benefit from, cooperative verification procedures between the United States and the U.S.S.R. Just one example would be verifying the absence of orbiting nuclear weapons, although such measures might be useful in many other cases as well.

If the capability for detecting nuclear weapons in orbit were felt to be required (note that the 1967 Outer Space Treaty forbidding them was ratified, and remains in force, in the absence of such explicit procedures), some sort of co-operative program would need to be established. One method mentioned at the workshop might involve a form of "on-orbit" inspection. In that example, all satellites would be required to withstand some level of neutron irradiation. On demand, suspect satellites would be subject to such irradiation from an orbiting inspector satellite. Emission of delayed neutrons from the target would reveal the presence of fissionable material. Alternatively, non-intrusive examination for fissionable material might be done on the launch pad.

There are several difficulties with inspection in orbit. In the case mentioned above, for example, it might be possible to conceal a nuclear warhead by shielding it appropriately. A more general problem with any "on-orbit" inspection is that the inspector satellite, requiring the capability to acquire, track, and rendezvous with a target satellite, would have and would regularly test all the attributes of an ASAT interceptor except for detonation of a warhead. Another problem with actively probing inspections in particular, noted a panelist, is that "if it's carrying an accelerator, one

might want to think about it" —such an inspector might indeed have A SAT potential in its own right. Perhaps limits on the size, approach velocity, or capability of inspector satellites could be established.