Overview

This workshop focused on anti-satellite weapons as an arena for arms control. Early in the first session, however, a panelist pointed out that such a focus in many ways creates an artificial distinction. Space holds a special "emotional allure." Much of the public debate concerning the militarization of space may result as much from that allure as from an informed judgement of the contribution of space activities to the military balance of power.

"Nuclear weapons and nuclear war remain the most important focus for arms control," a panelist pointed out. "ASAT arms control could reinforce nuclear arms control, but it could also divert attention from that central, overriding threat." At the same time, however, he and the remainder of the panel recognized that the appeal of space for military support operations is indeed high, and that the "allure of space" cannot be neglected in any discussion of ASAT arms control.

ORGANIZING DISCUSSION

Three ways of organizing discussion about ASATs were presented in the opening session. The first is to enumerate the various mechanisms of destroying satellites. There are essentially three distinct types: 1) direct interceptors, such as the current U.S. and Soviet ASAT weapons which home in on and then destroy target satellites; 2) "space mines," satellites which are stationed in orbit and later detonated to destroy nearby satellites; and 3) directed-energy weapons, which destroy satellites by delivering particle or radiation beams from a distance.

Other techniques such as concealment, spoofing, jamming, capturing control, and attacking ground stations, can disrupt the operation of a satellite. The difference between interfering with a satellite and permanently disabling it is significant, especially with respect to what is possible or desirable to regulate in a treaty. This distinction was made several times during the workshop.

A second method of organizing ASAT issues is to focus on the functions of potential target satellites and on the implications of subjecting these satellites to attack. So far, there are five primary roles for military support satellites-communications, surveillance and warning, navigation, meteorology, and geodetic survey. Different measures may be required to preserve each of these different functions in the presence of an ASAT threat.

A third organizational scheme is to enumerate anti-satellite attack scenarios and consider their effects on military capabilities and their prospects for escalation. Journal articles and press reports have discussed "just about every possible circumstance" involving anti-satellite activity, from tampering in peacetime to global nuclear war. Studying various possible scenarios has the advantage that, while ASAT technology can and will change, the scenarios for A SAT conflict may be more constant.

DISCUSSION FOCUSES

According to one panelist, the intersections or confluences of these three approaches—ASAT technologies, tempting or particularly threatening targets, and plausible circumstances-show the relevance of ASAT weapons and tactics to arms control. He singled out in the first workshop session several points about which further discussion could be fo-

cused. These issues, along with some items identified later in the workshop, are briefly described below and include:

RESIDUAL ASAT CAPABILITY

Many systems can destroy satellites besides those built or designed for that purpose. For example, ICBMs can be reprogramed to attack satellites rather than terrestrial targets, giving both the U.S. and U.S.S.R. a de facto nuclear ASAT capability. The nuclear-armed Galosh anti-ballistic missile (ABM) interceptors, deployed by the Soviet Union around Moscow under the terms of the 1972 ABM Treaty, can easily destroy satellites passing overhead at altitudes lower than about 1,000 km. However, several panelists pointed out that the use of nuclear warheads against satellites is not plausible in situations short of nuclear war.

There is also nonnuclear residual capability. Rendezvous and docking procedures used in manned spaceflight could be applied to ASAT interception. With sufficient radar support, it is conceivable that Galosh interceptors having conventional warheads might be effective against satellites.

Since the above systems would remain even if all dedicated ASAT systems were banned, panelists agreed that residual ASAT capability will exist under any arms control regime. The more that space utilization and space technology develop, the greater the residual ASAT threat will become. Therefore, panelists strongly emphasized that no arms control agreement can replace the need to make the functions that we carry out in space survivable (see app. A). Functional survivability includes protection against non-ASAT threats, such as attacks on ground stations, and it does not require survival of all space assets. Space systems can be duplicated, and non-space-based alternatives for many support functions now done in space can be developed. Panelists noted that survivability would be easier to ensure if dedicated ASAT systems, especially highly threatening future ones, were controlled.

Determining the level and effectiveness of residual ASAT capability is important to weighing the desirability of any treaty. An ineffective ASAT which had no more capability than the residual capability of non-ASAT systems would not significantly increase the threat these non-ASAT systems potentially pose to satellites. There is, then, some minimum level of capability that an ASAT weapon would have to exceed before its existence would be significant. It would make little sense for an ASAT treaty to require a level of verification holding ASAT capability far below this minimum. However, exactly where this minimum level is located is a highly debatable point. Panelists who felt that the residual capability of non-ASAT systems was quite significant questioned the value of negotiating any limit to dedicated ASATs at all. The level of residual ASAT capability was discussed further in the verification session of the workshop.

COMPARISON OF U.S. AND U.S.S.R. ASAT WEAPONS

Although this topic is unavoidable in any discussion of ASATs, several panelists warned against overemphasizing the two countries' respective capabilities in isolation, without simultaneously considering their respective target sets and possible scenarios.

Both U.S. and U.S.S.R. weapons are designed to intercept target satellites using a three-step procedure. First, ground-based sensors identify the target satellite and determine its orbit. Next, the interceptor is launched and guided towards the intercept point, and finally, the interceptor's homing sensors are activated and it closes in on the target satellite. However, while the U.S. air-launched ASAT climbs directly towards its target satellite in ten or twenty minutes, the Soviet ground-launched ASAT must roughly match orbits with its target, a process which has taken up to several hours in tests.

The range of the booster and the homing process determine which target orbits an ASAT weapon can threaten. The U.S. Miniature Homing Vehicle (MHV) ASAT weapon now undergoing testing destroys its target by direct impact and can home in on its target from a wide range of directions. It needs only to get to the same place at the same time as its target, and does not need to match orbits with that target. The present generation of Soviet ASATs, on the other hand, is co-orbital-it needs to be in the same place at the same time traveling roughly in the same direction at the same speed as its target. So far, all Soviet ASAT tests have been conducted against targets in orbits with inclination angles near 65 degrees.

Workshop panelists felt it "beyond doubt" that the U.S. air-launched approach is "clearly superior" to the Soviet ground-launched technique. Besides the limitation of having to share its target's orbit, the Soviet ASAT is restricted by the small number of launch sites that can handle its modified SS-9 booster. As many as twelve hours might be required, while the Earth turns under the target orbit, to bring the target within range of a launch site. The Soviets are further limited by the recycle time of each launch pad, and they cannot launch many ASATs in rapid succession. U.S. air-launched ASAT interceptors can be launched much more rapidly, and from a much wider geographic area, than the Soviet ground-launched ASAT. The advantages of the U.S. ASAT's airplane-launched approach, and its direct homing interception, more than compensate for its altitude limit, which has not been released by the Air Force but was estimated by a panelist to be considerably lower than that of the Soviet ASAT. Although present U.S. plans call for ASAT-equipped F-15 squadrons having the associated logistical support to be based only at two sites within the continental United States, the planes and the associated support structure could be based in other areas to give even wider geographic coverage and more immediate response.

Another important asymmetry between near-term U.S. and U.S.S.R. ASAT capabilities is the target sets which each weapon will face. Many critical functions which the United States performs in space are carried out by satellites in geosynchronous orbit, far out of range of the Soviet ASAT. Similar functions for the U.S.S.R. are in many cases carried out by satellites in highly elliptical "Molniya" orbits, which could be vulnerable to U.S. attack at their lower altitudes. Present plans for deploying ASAT-equipped squadrons within the continental United States would not permit such attacks, but suitably equipped planes might be able to attack these Soviet satellites if they, and the appropriate logistical support, were based in the Southern Hemisphere. Even assuming appropriate bases could be obtained, in-flight refueling would be required.

Countering the potential advantages of the United States system is that it is still undergo ing preliminary testing, whereas the Soviet ASAT has been tested, in a restricted manner, about twenty times over the last 16 years. The U.S. Department of Defense considers the Soviet ASAT to be operational. A panelist warned against comparing something that is "technologically possible that one side doesn't have" against an opposing system which "perhaps looks a little bit like a turkey" but in fact does have some capability. At any rate, no one doubted that the U.S. system could be made operational within a few years at most.

MILITARY ROLE IN SPACE

Much of the concern about ASATs and ASAT arms control deals with the role of satellites in military activities and the corresponding threat to military capability posed by ASAT weapons. Space systems are used extensively for military support, but satellites do not now fill a crucial, indispensable, and irreplaceable role. Many functions now carried out in space can be performed by other means. A paradox arises in that, to the extent that ASAT arms control masks the intrinsic vulnerability of satellites, alternatives to space systems may not seem necessary and satellites will be increasingly relied upon. If space utilization grows, so will the incentive to build

ASAT weapons. The solution is for arms control, if pursued, to supplement satellite survivability and redundancy programs and not to replace them. This point was repeated throughout the workshop: ASAT arms control cannot be a substitute for protecting and duplicating satellite functions.

ASAT ATTACK SCENARIOS AND POTENTIAL FOR ESCALATION

Does ASAT attack have a unique potential for triggering wider conflict? Does it imply that future conflict might be restricted to space? These points stimulated considerable discussion, but the panel doubted both.

Since military satellites are used principally for support activities, they don't functionally differ from terrestrial support systems. "Is the sinking of a U.S. intelligence ship not as likely and as inflammatory in a crisis as interception of a U.S. spy satellite?" questioned one panelist. Another panelist pointed out that "war in space cannot at all be separated from war on Earth. " In any conflict, each side has certain objectives, and they are on the ground. "You don't shoot satellites just for the fun of it. "

Other participants pointed out, though, that an ASAT attack might be less provocative than a terrestrial attack since people would not be directly threatened. "Maybe you destroy the 'allure of space', " said a panelist, "but you don't kill anybody." One panel member stressed that one cannot dismiss isolated ASAT scenarios to consider ASAT attack only in the context of a wider conflict. "I am skeptical about that because the United States has worked as hard as it possibly can to make itself extraordinarily vulnerable" to a low-level ASAT attack. "We have nothing in the pipeline to replace anything that's in space."

One panelist stated that the most worrisome ASAT scenarios involve low-level conflicts. In desperate cases, even a party not having a dedicated ASAT weapon might be tempted to attack an opposing satellite with whatever means could be arranged on the spur of the moment. In a low-level crisis which had not yet escalated to such a stage, however, existence or lack of a dedicated ASAT able to intercept with high confidence a threatening satellite might make the difference between attacking and not attacking. Carrying out such an attack "would be a tremendous temptation if it were easy to do so and could be done quickly and precisely and with very low collateral damage," even with the attendant risk of escalation.

Another panelist disagreed, maintaining that having fewer or poorer weapons does not necessarily lower the probability of their use. If a power feels that conditions warrant an attack on a satellite, it will be as likely to carry out that attack if it has one weapon as if it has 100. A decision of that magnitude will be a response to many internal and external pressures. "It isn't going to happen by itself, " and if it is deemed to be necessary it may as likely happen with an improvised system as with a dedicated one.

An ASAT attack scenario which has been widely discussed involves attacks on the satellite-borne sensors that provide the U.S. early warning of a Soviet first strike. One participant minimized the importance or plausibility of such an attack scenario. A Soviet attack on warning sensors to prevent a preemptive or "launch-under-attack" U.S. strike might instead trigger that strike. So, if it were not to reveal an imminent Soviet nuclear attack, any Soviet ASAT attack would have to be nearly simultaneous with the launch of the ICBMs that it was intended to mask. Since any direct-intercept ASAT would take several hours to climb to the U.S. early warning sensors at geosynchronous altitude (no existing ASAT is presently capable of getting that far), only yet-to-be-developed directed-energy weapons or pre-emplaced space mines would present a significant threat in this scenario.

At any rate, the United States does not rely solely on early-warning satellites for notification of impending attack. Ground-based radars provide a backup, and for submarine-

launched missiles they give negligibly less warning time than space-based sensors. Ground-based radars can also be supplemented by ship-borne, air-borne, and rocket-borne sensors.

CONNECTIONS BETWEEN ASAT AND BALLISTIC MISSILE DEFENSE

There are quite significant strategic and technological links between anti-satellite weapons and ballistic missile defense (BMD) systems. ASAT issues are central to BMD, and while consideration of BMD is less crucial to analysis of ASAT per se, the two subjects have significant overlap.

One connection is that any effective BMD (except for local, low-altitude site-defense systems) is an even more effective anti-satellite weapon. Even a poor BMD can have significant ASAT capability since satellites are much easier to destroy than missile reentry vehicles (RVs). A system used for ASAT would face at most a few dozen targets, and therefore could take much more time to attack a satellite than a system used for BMD could allocate to each of the up to 1,000 ICBMs or thousands of warheads in a massive attack. Satellites are intrinsically more vulnerable to damage than are RVs, and in a great many ASAT scenarios, attacks on satellites would take place in a much less hostile environment than the nuclear war in which a BMD would have to operate. Furthermore, an orbiting satellite's trajectory is completely predictable, except for limited maneuvers, making a satellite in effect a fixed target.

A second link between ASAT and BMD is that BMD systems (again with the possible exception of local site-defense systems) have space-based elements which would be vulnerable to ASAT attack. Even if a BMD system did not use weapons based in space, it would likely have space-based sensors and communications links; any BMD system intended to attack ICBMs during their boost phase necessarily would require space-based sensors to detect missile launch. If BMD weapons systems were put in orbit, they would be ideal targets for each other. They would be large, expensive, and hard to miss. All indications at present are that space-based weapons would be much cheaper to destroy than to replace "probably by a factor of 10. Right now it looks like a factor of 1,000. " On the other hand, they might be capable of self-defense once they became operational.

As ASAT technology is perfected, it will become increasingly unrealistic to deploy "anything that's space-based and expensive." Conversely, if BMD technology is significantly developed, it will severely constrain the possibilities for ASAT arms control, but it might also elevate strongly the incentive for ASAT arms control.

PROSPECTS FOR VERIFICATION

The issue of verifying compliance with an ASAT accord occupied much of the later workshop sessions. Panelists agreed that a total ban on anything having any ASAT capability would be both infeasible and unrealistic considering that residual ASAT capability (ICBMs, manned spacecraft, etc.) will invariably remain even if all dedicated ASAT systems are banned. There was also considerable agreement, though, that the extensive testing program necessary to develop and acquire confidence in an advanced ASAT weapon would almost certainly be detectable, and that a ban on such testing would require less extensive verification measures than a ban on possession. These issues are discussed further elsewhere in this report (p. 39 ff.).

"RULES OF THE ROAD"

Another important point developed in later sessions was the concept of "Rules of the Road" or "Utilization of Space" agreements. Whether or not some agreement limiting ASAT weapons or testing is desired or implemented, panelists saw a use for an agreement between the United States and U.S.S.R. which would allow each party to continue its use of

space without unnecessarily threatening the other. The United States and U.S.S.R. are each likely to conduct space activities which will appear provocative to the other, and some arrangements for reducing uncertainty might be helpful. The form of such an agreement was not discussed in detail; some additional discussion is reviewed in later sections of this report.

PRESENT TECHNOLOGY

The panel agreed that present ASAT technology (both Soviet and U. S.) is limited in significant ways, and that developing systems free of these limitations would require testing programs which would almost certainly be observable. Both existing systems (the Soviet system and the U.S. system undergoing tests) are only capable of reaching low earth orbit (on the order of 1,000 km)–neither can reach important satellites located at geosynchronous orbit (36,000 km). Both systems have inherent time delays, in waiting for targets to come within range of the launch site and in reaching their targets once launched. (The U.S. system, however, is significantly less constrained in these respects.) Both systems leave intact the adversary's ability to launch ASATs. There was general agreement that present ASAT weapons are much less threatening, and much less destabilizing, than what could be deployed in a new generation of ASATs, including ones which could attack many targets promptly and which could reach geosynchronous orbit.

As an example, one panelist posed the case of both the United States and U.S.S.R. having constellations of space-based beam weapons. As mentioned previously, such systems would likely be targeted at each other. Whichever side attacked first would not only retain its own ASAT (or BMD) capability but would eliminate its opponents. This extreme incentive to attack first would be highly destabilizing.

Another participant took issue with this scenario, stating that the systems would likely operate so that such an attack by one side would result inmost of both constellations being destroyed. For instance, one party detecting an attack could detonate space mines trailing its opponent's systems. All panelists agreed, however, that the present systems are not as threatening as future ones could be.