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The Soviet Space Program

National Intelligence Estimate
Volume II—The Estimate

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THE SOVIET SPACE PROGRAM

VOLUME II—THE ESTIMATE

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THIS ESTIMATE IS ISSUED BY THE DIRECTOR OF CENTRAL INTELLIGENCE.

THE NATIONAL FOREIGN INTELLIGENCE BOARD CONCURS, EXCEPT AS NOTED IN THE TEXT.

The following intelligence organizations participated in the preparation of the Estimate:

The Central Intelligence Agency, the Defense Intelligence Agency, the National Security Agency, and the intelligence organization of the Department of State.

Also Participating:

The Assistant Chief of Staff for Intelligence, Department of the Army

The Director of Naval Intelligence, Department of the Navy

The Assistant Chief of Staff, Intelligence, Department of the Air Force

The Director of Intelligence, Headquarters, Marine Corps

CONTENTS

SCOPE NOTE

This Estimate describes current Soviet space capabilities, identifies elements of the space program in various stages of development, and estimates how these will affect future Soviet capabilities in space through the 1980s and into the 1990s in the absence of space-related arms control agreements. Volume I presents the Key Judgments and a summary of how expected Soviet space developments will affect political, military, and economic competition as well as Soviet prestige. Volume II provides a more detailed discussion of the missions and capabilities of the Soviet space program.

For purposes of this Estimate, we have judged the likelihood of various Soviet space developments as ranging from very low to very high. These judgments, stated in terms of probability of occurrence, would be:

Very low = less than 10 percent

Low = 10 to 40 percent

Moderate = 40 to 60 percent

High = 60 to 90 percent

Very high = more than 90 percent.

CHAPTER I

SOVIET VIEWS OF SPACE

1. Despite their large and comprehensive space program, we believe that Soviet leaders perceive that overall US leadership in space could continue. Thus, the Soviet space program is viewed by the leadership as an important part of the overall competition with the United States. The space program is viewed by the Soviet leadership as an instrument of policy, the essential goals of which remain the same both in peace and war. Soviet foreign policy goals include the expansion of Soviet influence, the eclipsing of the United States as a superpower, and, as First Deputy Premier Andrei Gromyko recently pointed out, the control of the direction of international relations. Domestic policy goals include the maintenance and improvement of centralized political control over the state as well as the economic and scientific growth of the Soviet Union. The space program contributes directly to each of these goals. It is, therefore, viewed by the Soviets as contributing significantly to the correlation of forces, which include, but are not limited to, military, diplomatic, economic, scientific, and prestige factors. The use of space for these objectives is important, but it is also difficult and costly. Accordingly, the Soviets have adopted a design philosophy that reduces the risks and costs of operating in the space environment.

Military Factors

2. The military factor is viewed as the most important element in the correlation of forces and the Soviet space program is predominantly military in nature. More than 70 percent of Soviet space missions are for military purposes only, with another 20 percent serving a dual military-civil function. Soviet interest in the military aspects of space is as old as space flight itself. Throughout the late 1950s and early 1960s Soviet writings discussed an interest in and requirements for space defense. The organization responsible for antiballistic missile (ABM)/space defense (PRO/PKO) was established in the mid-1960s. It was subordinate to the then existing Soviet air defense forces (PVO Strany) with one of its responsibilities defined as the destruction of enemy military space systems. This ABM/space defense organization became subordinate to Soviet air defense forces (Voyska PVO) when the reorganization of Soviet air and air defense forces took place in 1980.

3. There is very little direct knowledge of Soviet military policy for the use of space. Such a policy almost certainly exists, however, and we believe its general outlines can be extrapolated from Soviet military writings and teachings as well as current trends in the Soviet space program.

4. Soviet military thinkers do not consider space to be a demilitarized zone with an international status analogous to that of Antarctica. From the Soviet military perspective, space is viewed as an extension of theaters of operations rather than as a separate arena of conflict. They have claimed that war cannot be waged exclusively in space, and any major conflict on Earth cannot be conducted without involving space systems. One of their most authoritative writers, Marshal Sokolovskiy, has noted that "the concept of a theater of military operations may include the entire territory of a belligerent or coalition, whole continents, large bodies of water, and extensive regions of the atmosphere, including space." Soviet military precepts, such as the importance of surprise, the necessity of confusing the enemy, and the use of overwhelming force to secure military objectives, are also likely to apply to Soviet military operations in space during a war.

5. The Soviets view space systems as an integral part of their overall offensive and defensive force. Classified Soviet military teachings require that in conflict the combat readiness of military assets in space be comparable with that of those forces it is called on to support. Soviet writers also acknowledge the need for a "correct relationship between active equipment in orbit and standby equipment on the

ground." This includes the maintenance of sufficient reserve equipment, both in orbit and on the ground, presumably to augment or replace space-related equipment. Thus, with regard to readiness, support, and reserves, the Soviets view their assets in space the same as the rest of their armed forces.

6. Short of direct US-Soviet conflict, it seems unlikely the Soviet leadership would risk physical destruction of US satellites, whereas they could perceive nondestructive interference as a somewhat less risky option. We do not believe that any antisatellite (ASAT) activities would be undertaken merely for warning or demonstration purposes. We believe there is a high likelihood that, during a NATO-Warsaw Pact conventional conflict, the Soviets would attempt to interfere with selected US space systems that provide important support, using both nondestructive and destructive means. In such a conflict Soviet leaders may perceive an operational advantage if both sides experience significant satellite losses because of greater US dependence on space systems, particularly photoreconnaissance assets that have a direct bearing on the tactical situation. In addition, Soviet satellites can be more quickly replaced if space-launch facilities remain intact. The decision to launch ASAT interceptors against satellites during the early part of a conventional NATO-Warsaw Pact conflict would be affected by Soviet uncertainties with regard to US responses, including the likelihood of attacks against existing Soviet space-launch sites. If a general war were under way in which the massive use of nuclear weapons appeared imminent, the likelihood of attempted interference with all US space systems is very high, using all available means.

7. Soviet writings are useful guides to Soviet procedures, intentions, and requirements. But they are not adequate in themselves to understand the Soviet space threat, which depends on capabilities as well as intentions. For example, current Soviet ASAT capabilities are limited and fall short of meeting the apparent requirement to be able to deny enemy use of space in time of war. The Soviets are devoting substantial resources to the development of high-energy lasers with potential ASAT advantages over the current interceptor. These advantages include faster response times and a multishot capability, thus contributing to the requirement for speed and surprise.

Diplomatic Factors

8. The Soviet's view of space in the framework of international diplomacy is in large measure determined by their adversary relationship with the United States. Soviet perceptions of an overall US lead in space heighten the competition. The Soviets have gone to great lengths to characterize their space program as "peaceful and scientific," in contrast to that of the United States, which they have termed aggressive and militaristic. The key elements of Moscow's "peace offensive" in space are two arms control proposals: a multilateral treaty to ban all weapons from space and a call for the resumption of bilateral ASAT talks with the United States. The ban on space weapons would include limitations on the US shuttle and new US ASAT developments such as the programed air-launched miniature vehicle (ALMV). Ultimately, the objective of Soviet diplomatic initiatives and propaganda, related to space, is to slow down or halt US space programs. Even if the Soviets are unsuccessful in this objective, they derive political benefits from arguing that they are peacemakers whose efforts are blocked by US intransigence. Soviet diplomatic initiatives also serve to isolate the United States in international political forums.

9. Soviet officials acknowledge the right of free passage through space. However, they claim certain space activities are illegal and reserve the right to take appropriate actions. Illegal activities, in their assertions, include space-based intelligence gathering that is for other than treaty verification as well as direct-broadcast satellites that could interfere with their control of the flow of information to their populace. In their presentation to the UN General Assembly in 1972 of a proposed convention dealing with direct-broadcast satellites they expressed the view that a state has the right to use any means to counteract such activities not only within its own territory but also in outer space.

10. Soviet leaders have consistently shown a preoccupation with potential US space threats. They argue that the United States is preparing for space war. They cite as evidence substantial increases in US spending for military space programs, the establishment of a new US Air Force Space Command, a Presidential Directive on national space policy that they claim directs the Pentagon to prepare for the

conduct of military operations in space, the substantial US investment in laser weapons research, the development of the ALMV, and the military potential of the US space shuttle. Their concern over US intentions and technological capabilities, an awareness of the limitations of their own space systems, and a desire to limit their costs have been the basis for persistent Soviet efforts to negotiate mutual restraints on space activities, particularly when equal restraints tend to give them a disproportionate advantage. For example, in bilateral discussions on ASAT limits in the late 1970s, the Soviets expressed interest in a ban on new ASAT developments, but were reluctant to discuss existing systems. They were willing to forgo new developments of their own in exchange for curtailment of the US ALMV. This would have left them with the only operational ASAT.

Economic Factors

11. The Soviet leadership views the space program as already providing substantial benefits to the Soviet economy with the potential to provide other benefits. The most important economic benefit is the acquisition of agricultural and geological information for the Soviet Union. Obtaining economic intelligence on harvest prospects and resource developments in other countries may provide the USSR with some advance knowledge of international market trends. [redacted]

12. The space program is also viewed as aiding in the development and control of vast regions in the Soviet Union. For example, communications satellites have permitted remote areas to be interconnected without the expense of laying cables through difficult terrain. Telephone and television service has been expanded to cover most of the country. These developments have thus facilitated centralized control by the political leadership in Moscow.

13. The Soviet Union has marketed telecommunications and space launch services to other countries on a limited scale, and we expect them to become a competitor in these fields. The provision of such services on a larger scale could provide a source of hard currency and would also provide a measure of influence and leverage over purchasing states.

14. Another possible economic benefit could be realized from manufacturing and materials processing in the gravity-free environment of space. Experiments by the Soviets with the manufacture of materials for semiconductors, superconductors, and special alloys on their Salyut space stations already are well advanced. Where feasible, a variety of items may be manufactured in space and returned to Earth on a regular basis once the Soviet space shuttle and space base become operational. The Soviets have publicly declared that they will have one module of their space station dedicated to manufacturing research.

15. The Soviets have expressed interest over the longer term in space-based solar power stations. Apart from the potential advantages of providing energy to aid in the development of the Soviet Union's more remote and isolated areas, the long-term attractions of such stations may include the leverage and influence that might accrue to the Soviet Union from the sales of such energy or equipment to other countries.

Scientific Factors

16. In line with a long tradition of research in basic sciences, Soviet scientists have conducted some pure research in space. We expect they will continue to support the study of basic geophysical, solar, and astronomical sciences. However, scientific research over the past few years has increasingly concentrated on applied tasks that directly support the military services and the national economy. We expect this policy will continue at least through the period of this Estimate.

Prestige Factors

17. One of the greatest perceived benefits to the Soviet Union from its space program is the contribution to its status as a superpower. The Soviets have compiled and publicized an impressive array of space records, including the first satellite, the first man to orbit the Earth, the first automatic resupply spacecraft, the first spacecraft refueling, the first woman in space, and the largest total man-days in space. They

have also gained substantial international recognition from such projects as unmanned expeditions to Venus; the hosting of cosmonauts from Third World countries (as well as France) on their Salyut space stations; and their COSPAS satellite, which, in a joint program with the United States, France, and Canada, has located emergency signals from ships and aircraft in distress.

18. The Soviet space program is viewed by the leadership as an important part of the overall competition with the United States. If the Soviet Union were to establish itself as the unquestioned leader in the exploration and uses of space, it would significantly enhance its status and influence as a superpower, which currently is almost wholly dependent on its military capabilities. The Soviets desire such a position of leadership and are working toward this goal. One of the motivations of the expensive Soviet manned space program, which includes the nationally declared goal of a large and permanently manned space station, is to regain recognition as a leader in space that they lost with the successful US Moon landings and shuttle flights.

19. The Soviets have expressed interest in other projects that would substantially enhance their prestige if successfully put into effect. These include a manned mission to Mars or the possible establishment of a lunar base by the late 1990s.

20. Domestically, the leadership perceives the space program as a source of national pride for the Soviet people and a source of legitimacy for its own political regime. Soviet achievements in space are heavily publicized and are always identified with the Communist Party, which is depicted as the guiding force behind all such achievements. Cosmonauts, who invariably are members of the party, are idealized and turned into heroes not as individuals but as representatives of the party and the Soviet people. Yuri Gagarin, the first man to orbit the Earth, is perhaps the best example of this kind of apotheosis.

Design Philosophy

21. Soviet procurement and design philosophy is not directly related to any policy goals but is essential to an understanding of the Soviet space program as a whole. Technically, space is a difficult environment in which operations are costly and hazardous. To minimize risks, the Soviets have adopted a relatively cautious design and engineering philosophy in the procurement of their space systems. Wherever possible, they innovate through modification rather than force the state of the art with high-risk, novel designs. They also tend to use systems that offer substantial flexibility and cost savings. This is most evident in the manned space station project but is also apparent in others. Early photoreconnaissance satellites, for example, were modified manned vehicles.

22. To diminish the chances of malfunction, Soviet satellite types, with two exceptions, are designed for one mission only and are built as simply and as ruggedly as possible. Another method possibly adopted by the Soviets that would ensure against the consequences of malfunction or loss is to maintain some inactive satellites in on-orbit storage.

23. The Soviets also tend to augment space systems without retiring old ones so that they are, in effect, steadily increasing their backup capabilities. For instance, the advent of high-altitude communications satellites (comsats) has not led to the abandonment of older communications systems; even expensive landlines continue to be maintained and improved.

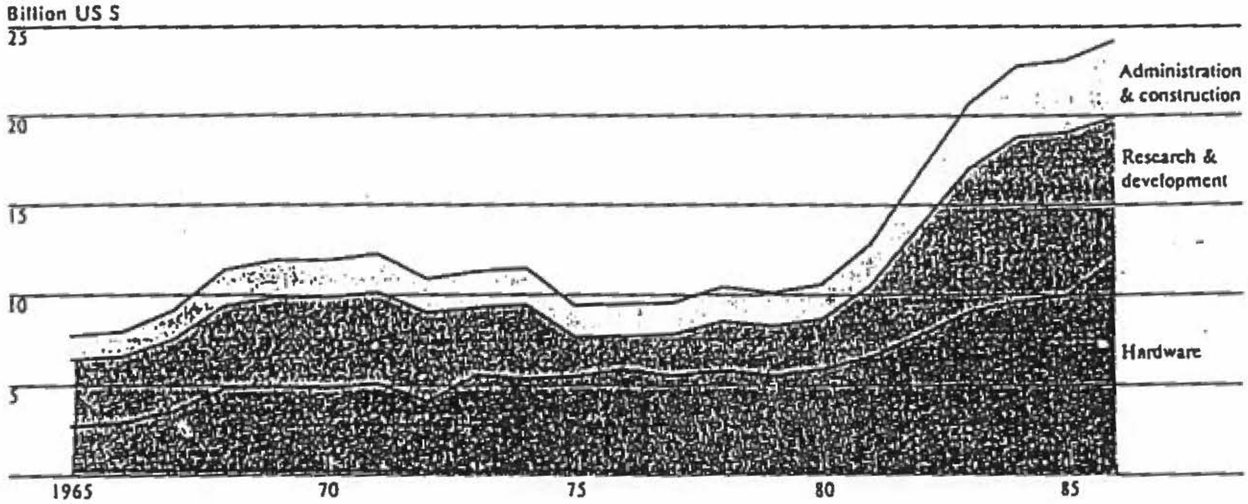
24. The cost of space vehicles is high, but the Soviets have realized substantial savings by applying concepts and technology developed elsewhere. They have, for example, used the US Dyna Soar program and shuttle orbiter as models for their own space plane and shuttle. Partly by choice and partly by necessity, the Soviets have realized some savings from economies of scale in the production of their space equipment. Their high launch rates and relatively short vehicle lifetimes have elicited regular production lines of both launch vehicles and spacecraft. As a byproduct, space launches are much more routine in the Soviet Union than they are in the United States.

CHAPTER II

THE SOVIET EFFORT IN SPACE

1. By all measures, the Soviet level of effort devoted to space in the 1980s is increasing significantly over the activities noted in the 1970s. (See figure II-1.) The continued allocation of substantial resources indicates that the space program enjoys considerable support among the Soviet leaders. There is no indication that the space program will receive any less emphasis under Andropov's leadership. The dollar cost equivalent of the Soviet space program in 1983 is estimated at about $20 billion, as compared with about $13 billion for US Government space expenditures plus several billion dollars in additional US commercial investments in space. The European Space Agency (ESA), France, and Japan have developed modest space programs, but they are not competitive on a scale with the USSR; each program amounts to less than $1 billion annually. The Soviet investment is reflected in part in the wide range of new systems that we have identified in development, which stands in contrast to the 1970s, when most of the new spacecraft were updated modifications of previous systems. Seventeen new Soviet space systems that have been

Figure II-1
Dollar Costs of the Soviet Space Program[a]



[a] These dollar estimates represent what it would cost to replicate Soviet development and procurement of space systems in the United States and then launch and operate the systems as the Soviets would. We have more confidence in our estimates of hardware cost than our estimates for research, development, administration, and other support costs. Data are in constant 1981 US dollars. Because our cost estimates cover only those existing or planned programs for which we have evidence, they may underestimate overall program costs.

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identified in various stages of development are likely to undergo testing in the next 10 years. (See figure II-2.) Estimated total Soviet space costs have doubled from $10 billion in 1978 to the projected $20 billion in 1983 for an average annual increase of 15 percent. After 1983, growth in space expenditures is expected to be less rapid, perhaps averaging about 6 percent a year through 1986.

2. Steady growth also is reflected in the design bureaus, production facilities, launch complexes, control sites, space support ships, cosmonaut training facilities, and other elements of the space support infrastructure. (See table II-1.) Altogether, the growth rate for the Soviet space program will exceed the growth rate of Soviet military spending in the 1980s. We believe that the military space components will account for an increasing share of Soviet military-related expenditures. (See figure II-3.)

3. Within the Soviet space program, manned space missions and communications systems account for most of the growth in expenditures. By 1986 manned space activities, which are heavily military oriented, will account for about one-fourth of Soviet space expenditures. In part, this reflects the publicly stated Soviet objective of establishing a continuously manned space station. Soviet space officials also acknowledge that

Figure II-2
Major New Soviet Space Systems in Development

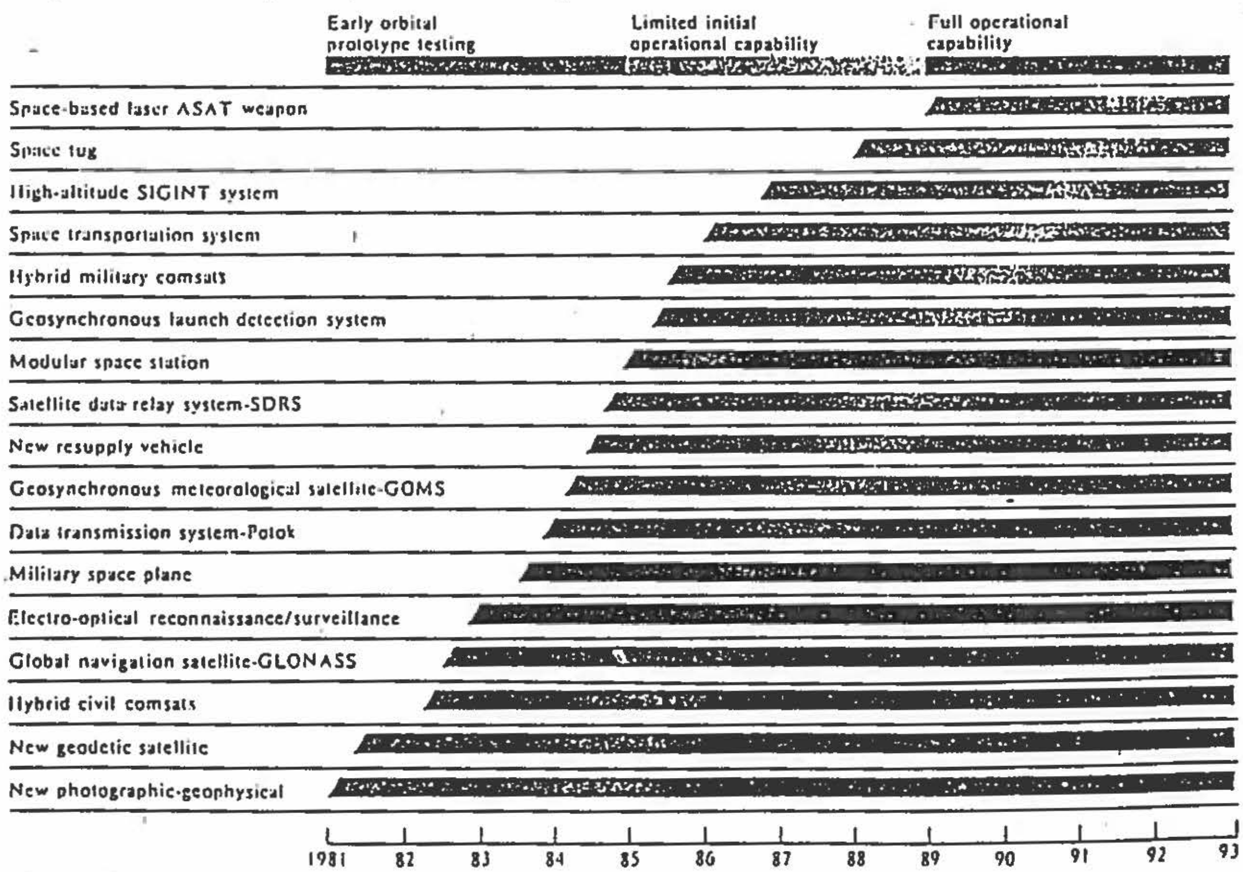

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Table II-1
Growth of Infrastructure of Soviet Space Program

	1975	1980	1985
Design bureaus, plants, and institutes *(million square meters of floorspace)*	1,730	2,080	2,390
Space control sites	23	25	27
Space control ships	10	11 [a]	14
Launch site pads	16	17	23
Tyuratam	6	8	12
Plesetsk	6	7	9
Kapustin Yar	4	2	2

[a] Three older ships were retired and four new ships added in the 1976-77 period.

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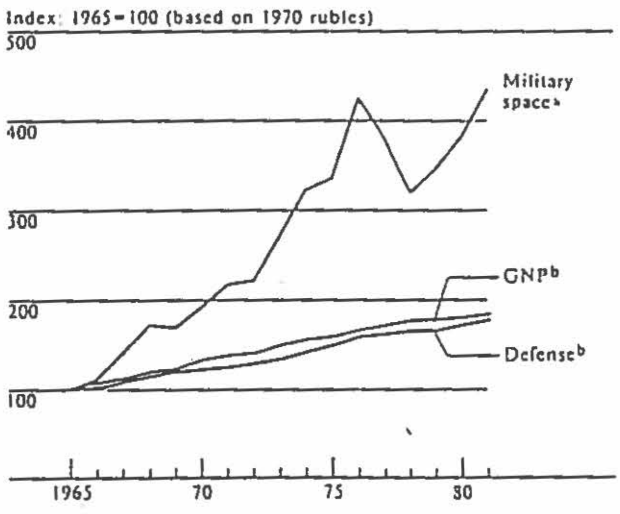
Figure II-3
Relative Rates of Growth: Soviet GNP, Military Spending, and Military Space Hardware



[a] This category only includes ruble costs for space that we identify exclusively as military hardware. If civilian space procurement was included, the relative growth rate for space hardware would be lower than shown here.

[b] Soviet GNP was approximately 300 million rubles (1970 prices) in 1965. About 13 to 14 percent of that was devoted to defense; in turn, 1 to 2 percent of defense was allocated to military space hardware in 1965. By 1981 the share going to military space hardware had risen to 3 to 4 percent of defense spending.

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manned space vehicles are more expensive and involve higher risks than unmanned spacecraft, but they are willing to pay the premium to have cosmonauts in space directly involved in the development of new space systems.

4. Soviet communications satellites are increasing in numbers and sophistication. New comsat and data relay systems are being introduced and by 1986 will account for about 20 percent of Soviet space expenditures.

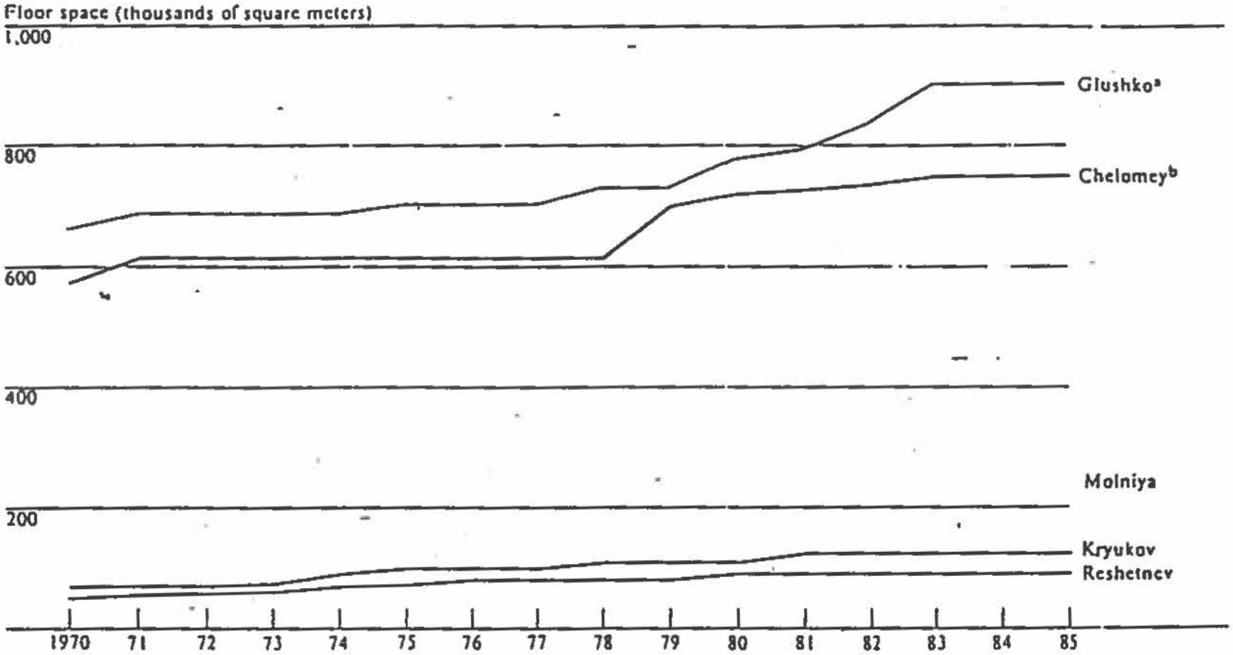
Design Bureaus

5. The Soviet space program benefits from a society that is geared toward marshaling its economic resources toward the achievement of a limited number of high-priority objectives. The personal attention of the Soviet leadership to the space effort imparts stability to the organization, funding, and staffing of developmental activities. Soviet space systems are developed within the context of a leadership commitment that is supported by a long-range planning process and a management style that places a premium on both schedule adherence and incremental follow-on improvements. As a result, the space design bureaus are continually working on new and modernized systems in different stages of development. At any one time, about 50 missiles and space systems are under development. These projects are assigned to a design bureau as soon as the basic and applied research and feasibility tests are completed. Competition is seldom involved, and most of the developmental missile and space systems eventually are produced. This process, instituted about 1960, tends to simplify early stages of development, but it probably inhibits the introduction of new technologies and may raise overall costs.

6. The development and production of Soviet space systems is carried out at six main design bureaus, several of which have undergone significant expansion since the early 1970s. (See figure II-4.) On the basis of the capacities and identified developmental programs that we can associate with each design bureau, Chelomey,[1] the second largest of the design bureaus, appears

[1] For the purposes of this Estimate, design bureaus are referred to by the name of their director, except for the scientific production organization Molniya whose director is not known.

Figure II-4
Growth of Major Soviet Space Design and Production Facilities[c]



[a] The total floorspace includes Plant I in Kuybyshev.
[b] Total floorspace includes design bureau and production facilities in Reutovo and Fili.
[c] Utkin not included since its main involvement is with missile production.

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to have excess capacity and probably has some projects that we have not as yet identified. (See table II-2.)

Space Launch Vehicles

7. The Soviet space program, like the US space program, initially relied on modified ballistic missiles to launch satellites. (See figure II-5.) Six of the eight current space launch vehicles (SLVs) are derivatives of IRBM (intermediate-range ballistic missile) or ICBM (intercontinental ballistic missile) boosters. However, the increased production of the Proton (SL-12/13), the development of a new medium-lift SLV and the introduction of a heavy-lift SLV will very likely result in decreased production of the SS-6–based SLVs (SL-3, -4, and -6) and possibly other smaller SLVs. (See figure II-6.) The medium-lift SL-X-16 will probably be a two-stage vehicle having a lift capability between that of of the SL-4 and SL-12/13. Therefore, it should be suitable for launching the space plane; new, heavier photoreconnaissance and radar reconnaissance satellites; and possibly space station modules. If a third-stage booster is added, it also could launch communications, meteorological, and navigation satellites into geosynchronous or semisynchronous orbits. The first stage of the medium-lift vehicle will use conventional liquid propellants, while the upper stage or stages will use liquid oxygen and liquid hydrogen. The SL-X-16 should be ready for flight-testing in 1983 and should reach operational status by 1984.

8. A heavy-lift launch vehicle (HLLV) is a critical component in several Soviet space systems. We expect the HLLV to be tested in 1986, but any serious delays in this program would adversely affect several other space systems. The HLLV is in the Saturn V class, and has been under development since about 1974. The

Table II-2
Soviet Design Bureaus for Major Space Systems [a]

Current Space Systems	Future Space Systems
Chelomey Design Bureau	
ASAT orbital interceptor	Improved radar-reconnaissance and targeting satellite
Target vehicle	New resupply vehicle
ELINT ocean reconnaissance satellite	Large space station
Radar ocean reconnaissance satellite	Improved Proton launch vehicle
Salyut military space station	
SL-13 Proton launch vehicle	
Glushko Design Bureau	
Photoreconnaissance satellite	NRT electro-optical reconnaissance and surveillance
Photogeophysical satellite	Heavy-lift launch vehicle
Earth resources photographic satellite	Space tug
Salyut space station	Space-based laser ASAT
Biological satellite	SL-X-16 launch vehicle [b]
SL-3, SL-4, and SL-6 launch vehicles	
SL-12 fourth-stage booster	
Kryukov Design Bureau	
Lunar, planetary missions	SLBM launch detection satellite
Prognoz/Intershock	Lunar polar orbiter
Launch detection satellite	Lunar far side sample return module
Astron space telescope	Mars soil sample return module
	Jupiter probe

Current Space Systems	Future Space Systems
Reshetnev Design Bureau	
MPCS communications satellite	High-altitude SIGINT satellite
SPCS communications satellite	Potok data relay satellite
Molniya communications satellite	Satellite data relay system
Gorizont communications satellite	Hybrid military comsat
Ekran communications satellite	Hybrid civil comsat
ELINT reconnaissance satellite	GLONASS (navigation) satellite
Raduga communications satellite	
Radar support, calibration satellite	
Naval support satellite	
Geodetic satellite	
Utkin Design Bureau	
Scientific satellite	Geosynchronous meteorological satellite (GOMS) [b]
SL-8 launch vehicle	
SL-11, SL-14 launch vehicle	
Meteorological satellite	
Intercosmos communications satellite	
Molniya Design Bureau	
None	Space shuttle orbiter
	Space plane [b]

[a] In addition to those programs listed, projects to modify current systems also may be under way.
[b] Association with this design bureau is tenuous.

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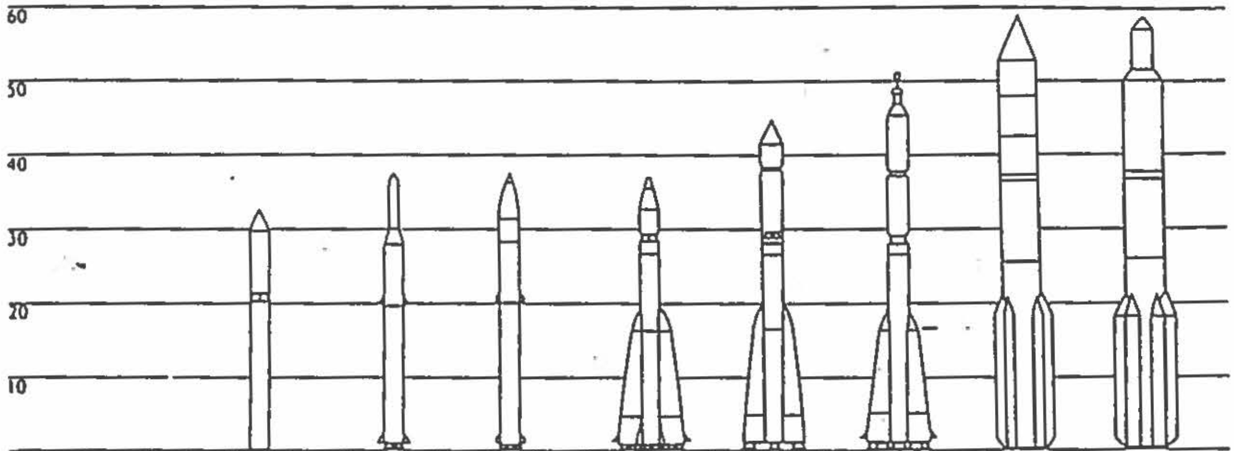
configuration of the launch and support facilities and the projected payloads for such a vehicle indicate there will be two or three variants of the new heavy-lift vehicle. One version closely resembles that used for the US space transportation system (STS), except that the main engines are attached to the main propellant tank, not the shuttle. This version provides a flexible heavy-lift launch capability that can be used for a variety of purposes in addition to launching a shuttle orbiter. It also will allow separate testing of the launch vehicle and the orbiter. Even though attached to the main launch vehicle, the engines probably will be recovered, reconditioned, and reused. The main engines are similar to those on the US shuttle and probably have been the pacing item in developing the Soviet STS. [redacted] the Soviets have been testing these liquid hydrogen engines [redacted] Both the SLV and orbiter are projected to have capabilities close to that of the US STS.

9. Additional upper stages and strap-on boosters, probably under development, may be used to develop

Figure II-5
Soviet Space Launch Vehicles, Payloads, and Launch Sites



		SL-8[a]	SL-11[b]	SL-14[b]	SL-3[c]	SL-6[c]	SL-4[c]	SL-12	SL-13
Payload weight (kg) to 185-km orbit		1,600	4,000	5,000	5,900	7,000	7,000	18,000	19,000
Payloads		Naval support Geodetic ELINT (2nd gen.) Radar support ASAT target Scientific	ASAT intercept Radar recon. ELINT ocean recon.	ELINT (3rd gen.) Scientific Meteorological	ELINT (3rd gen.) Meteorological	Molniya Prognoz Launch detection	Soyuz Progress Photorecon.	Ekran Gorizont Raduga Venera Mars Luna Astron	Salyut Cosmos 929-type
Launches in 1982		24	8	4	5	11	45	9	1
Launch sites									
Kapustin Yar	7C[e]	●							
Plesetsk	1[e]				●	●	●		
	2				●	●	●		
	3				●	●	●		
	9[e]	●							
	10	●							
	27[e]			●					
Tyuratam	A-1				●	●	●		
	B-1				●	●	●		
	G-1A/B		●						
	G-3/4							●	●
	U-1/2							●	●

[a] Derived from SS-5 IRBM
[b] Derived from SS-9 ICBM
[c] Derived from SS-6 ICBM

[e] These sites have two launch pads

● Site being refurbished, modified, or newly under construction.

● Active launch site

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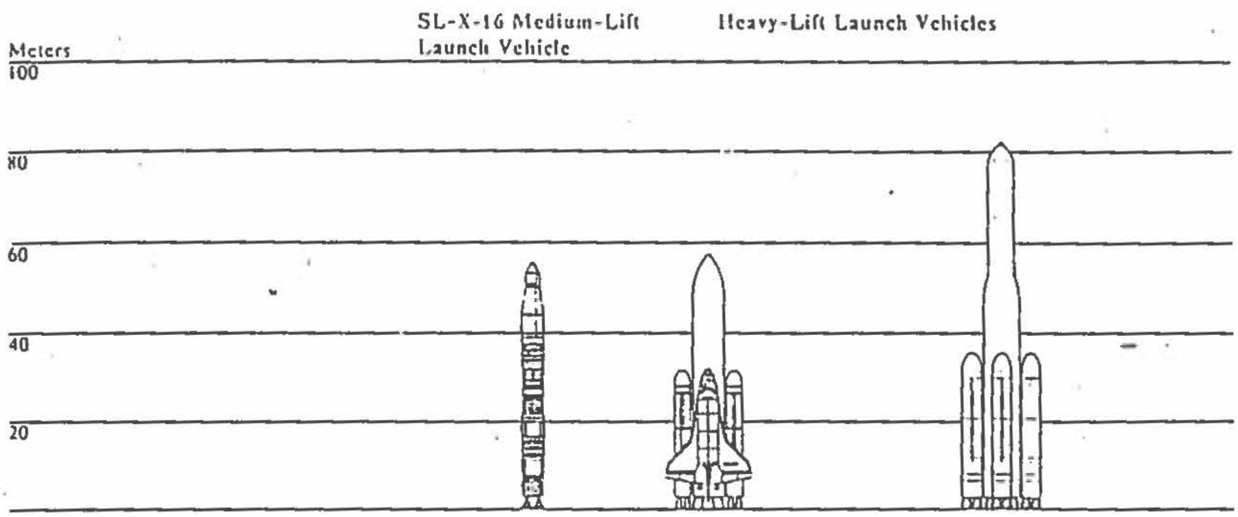
Figure II-6
New Soviet Space Launch Vehicles



			With 3 strap-ons	With 4 strap-ons
Lift-off weight (kg)	390,000	1,700,000	2,100,000	2,550,000
Lift-off thrust (lbs)	1,000,000	5,600,000	7,800,000	10,000,000
Payload to 185 kilometers (kg)	15,000	75,400 *	119,000	148,000

Note: These configurations and characteristics are estimates.
* Shuttle payload 27,300 kg.

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a variety of heavy-lift capabilities with a maximum lift-off thrust at least 20 percent greater than the Saturn V. An upper stage with liquid hydrogen and liquid oxygen propellants would enable this version to place approximately 17,000 kilograms (kg) into geosynchronous orbit. This type of vehicle could be used to launch payloads, such as large components of a space base and a space tug to transfer satellites between low and high orbits, and to launch exploratory missions to the Moon or to Mars or the other planets. We expect the first flight tests of the heavy-lift launch vehicle to take place as early as 1986. If these tests prove successful, the entire Soviet STS could be tested in 1986 or 1987 [ ] the Soviets are probably constructing four shuttle orbiters.

10. The Proton launch vehicle, in both the SL-12 four-stage and SL-13 three-stage versions, will account for an increasing percentage of Soviet space launches. Proton production capacity has tripled, and the number of Proton launchpads has doubled (from two to four) since the late 1970s. The Proton probably will be used to launch most of the new communications satellites and perhaps the modular space station. The use of a single Proton to launch three experimental navigation satellites in 1982 demonstrated a new and highly efficient use of the SL-12. Accordingly, we expect the Proton launch rate to approach 16 launches per year within the next few years. The Soviets have indicated their willingness to launch foreign spacecraft on the Proton. The prices charged may be considerably lower than those of the US STS. For example, a price of $24 million was recently quoted for launching an Inmarsat (International Maritime Satellite Organization) satellite.

Space Launch Facilities

11. Soviet space launch facilities are being steadily expanded. The three major launch centers—Tyuratam, Plesetsk, and Kapustin Yar—currently have a total of 19 launch positions and conduct about 100 space launches per year. By 1985, 23 space launch positions will be available. These launch centers are operated by the Soviet Strategic Rocket Forces (SRF).

12. Extensive construction has been under way at Tyuratam since the mid-1970s. A new launch complex with two pads for the SL-12/13 was completed by 1980. In 1978 the Soviets broke ground for a second new launch complex with two pads that will be used to launch the new SL-X-16 medium-lift launch vehicle. (See figure II-7.) The Soviets also broke ground in 1978 for a third new complex for launching the heavy-lift launch vehicle. (See figure II-8.) This new single-pad complex will probably be used for space shuttle operations. In addition to this new pad, two more pads which were used in the 1969-72 period in an unsuccessful project to develop a heavy-lift launch vehicle for manned lunar flights, are being modified. In addition, a runway comparable to the shuttle recovery runway at the Kennedy Space Center is nearing completion. It will be used initially for the delivery of the HLLV and orbiter components to Tyuratam and later will serve to recover Soviet shuttle orbiter missions. Another shuttle orbiter recovery runway is under construction in the Far East, near Vladivostok. Large new buildings are also being constructed at Tyuratam for assembly and checkout of Proton boosters, for servicing of the Soviet shuttle orbiter, and for payload handling.

13. After space systems are tested at Tyuratam, many are shifted to Plesetsk for routine operations. About 70 percent of Soviet space launches take place at Plesetsk. To date, only the smaller series of boosters (SL-3, SL-4, SL-6, SL-8, and SL-14) have been used at Plesetsk. Larger payloads and geosynchronous comsats must be launched from Tyuratam. One older pad has been modified, bringing the total number of active launchpads at Plesetsk to nine by late 1983. We believe it is unlikely that Plesetsk will be used to launch the new series of SLVs within the next 10 years.

14. Kapustin Yar, with two space launchpads, will continue to play a limited role, providing only about 1 to 3 percent of the space launches. Currently, only the SL-8 is launched from Kapustin Yar. Should the USSR become more actively involved in providing space launch services to foreign customers, Kapustin Yar would be a logical location for launching small payloads. However, larger payloads and geosynchronous satellites cannot currently be launched from Kapustin Yar.

Space Mission Control Network

15. Sophistication has been the main characteristic of the growth in the Soviet space mission control network, although expansion also has been significant.

16. The SRF controls the majority of the satellite operations, but other organizations have constructed ground stations and conduct special satellite operations.

17. The SRF space mission control network has been under development for 25 years. It began with only four tracking sites in the late 1950s and currently consists of 18 tracking sites, several control centers, and a fleet of oceangoing ships to augment the land-based sites.

Space Operations

20. During the 1970s and early 1980s, the annual number of Soviet launches steadily increased from 79 in 1970 to a record 107 in 1982. This trend corre-

sponds to a similar trend in the number of operational Soviet spacecraft in orbit. The majority of this increase is related directly to the completion and maintenance of multisatellite networks. During the past year most Soviet networks were maintained at or near full operational capability (see table II-3), and some included satellites in a standby or redundant capacity.

21. We expect the Soviets will maintain their high launch rate until the late 1980s or early 1990s when their space shuttle system is expected to go into full service. By that time we expect to see a marked decrease in the number of SL-3, SL-4, and SL-6 missions. Payloads associated with these vehicles will be phased out and replacement missions will be launched on the Soviet shuttle. When the shuttle reaches full operation in the early-to-middle 1990s, the Soviet launch rate should be below 80 launches a year. The number of operational Soviet spacecraft in orbit at any time should continue to grow from the 110 currently to perhaps 140 by 1990. As Soviet satellite lifetimes increase, we expect the Sovicts will make considerably more use of on-orbit spares and redundant satellites.

Table II-3
Soviet Satellite System Networks

System	IOC	Ideal System Size	Average Size, 1970	Average Size, 1976	Average Size, 1982
Communications					
Molniya 1	1965	4	5-6	8-9	8-10
Molniya 2	1971	4		5	0
Molniya 3	1974	8		4-5	4-5
SPCS	1970	3	1	3-4	3-6
MPCS	1971	16-24	8	6-16	16-24
Statsionar	1975	14		1-2	3-6
Meteorological					
Meteor 1	1969	3-6	3-6	6-8	0
Meteor 2	1975	2-4		1	2-4
Navigation					
Navsat 1	1967	3	2-3	2-4	0
Navsat 2	1974	6		5-7	6-7
Navsat 3	1976	4		0-1	4-5
Reconnaissance					
ELINT 2	1968	6	3-4	4-5	1
ELINT 3	1970	6	0-1	2-3	5-6
EORSAT	1975	4		1-2	1-2
RORSAT	1971	7		0-2	0-2
Surveillance					
LDS	1976	9		0-1	6-7
Total			21-29	48-75	59-85

~~This table is Secret.~~

Space Systems of the 1980s

22. If Soviet investment in space continues as expected, 17 new military and civil space systems which have been identified in various stages of development are likely to undergo testing in the next 10 years. Most of these are expected to be deployed by the early 1990s. (See table II-4.) This nearly doubles the rate at which new systems were introduced in the 1970s. In addition to these new space systems, six lunar and planetary projects have been identified and probably will be pursued. The 1980s will be more like the 1960s, when several new systems were introduced. In contrast, the 1970s were characterized by the introduction of improvements and the establishment of fully operational networks of satellites.

23. By US standards, the Soviet space program is relatively unsophisticated and expensive—costing the equivalent of 1 percent of the Soviet gross national product during the past 10 years and more than 1.5 percent today. However, we believe that the space program adequately satisfies most current Soviet requirements. The introduction of new Soviet space systems in the next 10 years will make more timely and more accurate information available to Soviet political leaders and military commanders. Also, improved communications will be available to Soviet leaders, and a space-based laser will probably be tested. Ambitious manned space activities will enhance Soviet prestige. Table II-5 describes what capabilities currently are derived from the Soviet space program and how they will change if all of the anticipated systems in development (table II-4) progress according to our estimates. Major new capabilities in the next 10 years will result from the successful introduction of a reusable space transportation system, a space tug, and especially the the heavy-lift launch vehicle which is a critical component of other space systems, including the shuttle and the large space station. Moreover, any delay in developing the

Table II-4
Major New Soviet Space Systems Likely To Be Tested in the 1980s

Systems	Estimated Date of Prototype Testing	Degree of Confidence [a]
Military and Civil		
Antisatellite		
Space-based laser ASAT (megawatt class, low orbit)	1988-93	Moderate
Intelligence collection		
Electro-optical reconnaissance/surveillance	1983-85	High
High-altitude SIGINT	1986-89	Low
Photogeophysical, second generation	1981-83	High
Communications		
Potok data transmission	1983-85	High
Satellite data relay system	1984-86	High
Hybrid military comsats (Statsionar, Gals, Luch-P, Volna)	1985-87	High
Hybrid civil comsats (Luch, Volna, Statsionar)	1982-84	High
Military support		
Geosynchronous meteorological satellite (GOMS)	1983-85	High
Global navigation system (GLONASS)	1983-85	High
Geosynchronous launch detection satellite	1984-86	Moderate
Geodetic, second generation	1981-83	High
Manned systems		
Modular space station	1984-86	High
Military space plane	1983-85	Moderate
Space transportation system	1986-88	High
Space tug	1988-91	Moderate
New resupply vehicle	1983-86	High
Lunar and Planetary [b]		
Lunar polar orbiter	1990-92	High
Lunar far side soil sample	1991-93	High
Mars soil sample return	1986-90	High
Jupiter probe	1989-92	Moderate
Venus radar mapping	1983	High
Venus–Halley's Comet flyby (VEGA)	1984	High

[a] Our information on specific systems varies considerably. This estimate of confidence indicates the relative levels of our understanding of the various developments, not the likelihood of testing, as in table II-6.
[b] For the developments, date is that of mission, not a prototype test.

~~This table is Secret~~

heavy-lift launch vehicle also will seriously affect Soviet plans for placing large payloads in geosynchronous orbit. These systems, and the changes in Soviet capabilities resulting from them, are discussed in chapters 3, 4, 5, and 6.

Possible Developments in the 1990s

24. There are several other possibilities in the Soviet space program that could occur in the next 10 to 20 years, but the evidence is insufficient to make firm judgments. In some cases, on the basis of limited information on the general nature of Soviet research, we are inferring possible significant future developments. In other cases we are assuming logical Soviet choices based on the expected availability of key technologies. These developments are discussed in chapters 3, 4, 5, and 6. (See table II-6.) We do not expect these systems to be operational before the 1990s because the typical Soviet space system takes 12 to 15 years to develop. Because of the high cost of these projects, formidable technological challenges, and limitations on research, design, and production facilities, we do not expect all of them to be pursued to the system testing phase. We do, however, consider them important targets for US intelligence collection and analysis.

Table II-5
Main Capabilities of Soviet Space Systems

Existing Capabilities and Expected Improvements

Navigation. Location data (within 180 meters) are provided to Soviet naval and commercial shipping. A new system, GLONASS, will aid ships and other mobile users in determining their positions, possibly within 30 meters.

Mapping, Charting, and Geodesy. Data are generated for accurately locating points on the Earth's surface and for producing accurate models of the Earth's gravitational field for intercontinental ballistic missile (ICBM) targeting and other uses. New generations of geodetic and geophysical satellites will provide more accurate data for targeting by ballistic and cruise missiles.

Calibration. Testing and development are facilitated by calibration satellites.

Weather. Data are provided for global weather forecasting and may be used to improve effectiveness of space-based imagery collection. The new geosynchronous system (GOMS) will provide better coverage and more timely data.

Command and Control. Secure and redundant communications and data relay are made available to major Soviet military units as well as military advisory groups. New systems will provide higher capacity, more secure, global communications.

Civil Communications. Newer geosynchronous satellites will make domestic telephone and television services available to about 90 percent of the Soviet population.

Military Intelligence. The deployment and exercises of most major NATO and Chinese ground, naval, and air units are monitored by space systems providing current order-of-battle information, warning of possible attack, and monitoring of treaty compliance and crisis situations. Improved SIGINT and new electro-optical satellites will provide improved coverage and more timely indications and warning information as well as tactical data. A new satellite data relay system will pass reconnaissance data from low-altitude satellites directly to Moscow in near-real time.

Naval Targeting. Satellites locate US naval battle groups and other naval formations and transmit the derived target information on a real-time basis to selected Soviet naval combatants. These satellites have gaps in coverage.

Warning. A nine-satellite system provides on a continuous basis 30 minutes' early warning of US ICBM launch. It supplements ground-based ballistic missile early warning radar systems. A new network of geosynchronous satellites is expected to begin initial testing in 1984 and reach full operational capability by 1990.

Resupply Vehicle. Existing "Progress" vehicles deliver about 2,300 kilograms of cargo. Newer resupply vehicles have greater capacity and will be able to recover materials produced in space, return cosmonauts in emergencies, and return equipment.

Earth Resources. Data on domestic and foreign natural resources and crop surveys are collected using a recoverable film system. A developmental electro-optical system with capabilities similar to US Landsat will provide more timely information and attain longer mission duration.

ASAT. Orbital interceptors can attack satellites in low Earth orbit one at a time, and up to eight within a 24-hour period. The operational system has destroyed a target in nine of the 15 tests to date. Future ASAT improvements are expected to include a space-based laser, which we believe will be tested by the early 1990s. We do not expect a high-altitude conventional orbital interceptor to be developed.

Lunar and Planetary Exploration. Unmanned exploration of the lunar far side and a Mars soil sample return mission are likely within the next decade. Venus probes will continue to be frequent in the near term.

Space Station. Soviet space stations have been manned about 40 percent of the time. Cosmonauts have conducted military experiments, reconnaissance, materials processing, and other research. By about 1986, modular space stations, with crews of six to 12 persons, will provide permanently manned platforms for similar activities and weapons component testing.

New Capabilities

Space Transportation System. This system, similar to the US space shuttle, will be able to transport bulk cargo to and from space stations. It also will enable delivery, recovery, refueling, and repair of satellites. It also may be a test bed for laser weapons. A space tug, if perfected, would assist the space station and shuttle and transfer satellites between high and low orbits for servicing.

A Military Space Plane. A spacecraft is being developed for a mission we cannot yet determine, but is likely to include reconnaissance and satellite inspection roles.

Heavy-Lift Launch Vehicle (HLLV). Current Soviet space launch vehicles are limited to placing about 20,000 kg in low orbit. The new Saturn V–class HLLV booster will be capable of lifting at least 100,000 kg into low orbit.

~~This table is Secret~~

Table II-6
Possible New Soviet Space-Related Developments in the 1990s

System	Likelihood of Testing by the Year 2000 [a]
Radar imaging	Moderate-high
Large aircraft detection	Moderate
Submarine detection	Uncertain
Submarine laser communications	Moderate
Advanced communications satellite	High
Space power station	Very low [b]
Geosynchronous space station	Low-moderate [b]
Large space station	High [b]
Manned lunar base	Low [c]
Manned orbital Mars mission	Moderate [c]
Geosynchronous laser ASAT	Moderate-high [d]
Space-based laser BMD	Low-moderate
Space-based jammer	Low
Ground-based radiofrequency ASAT weapon	Moderate
Space-based radiofrequency ASAT weapon	Very low
High-altitude conventional orbital interceptor	Very low
Offensive space-to-space missiles	Low
Defensive space-to-space missiles on manned platforms	Moderate
Space mines	Very low
Space-based particle beam ASAT weapon	Low
Space-based ground-impact weapon	Low

[a] We have considerable uncertainty in many of these judgments. Among the criteria considered in making these judgments were: (1) the availability of necessary technologies elsewhere that could be acquired by the USSR; (2) demonstration of similar technologies by the USSR; (3) concepts observed in Soviet research publications; (4) a project identified or associated with a design bureau; (5) component testing reported; and (6) perceived requirements. These estimates do not prejudge the effectiveness of the systems should they complete the developmental process and be deployed.
[b] Likelihood of full-scale system.
[c] Likelihood of mission.

~~This table is Secret~~

CHAPTER III

SOVIET SPACE SYSTEMS

1. Clear distinctions between Soviet military and civil space systems are not always possible because some systems perform both military and nonmilitary functions. In figure III-1 all of the currently operational Soviet space systems are categorized according to their mission and function. Those space systems that perform a purely military function now account for about 70 percent of the annual launches. The number of missions fulfilling a dual military-civil function has grown steadily since the early 1970s and now accounts for more than 20 percent of annual launches. The number of missions of a scientific nature continues to

Figure III-1
Soviet Spacecraft Categories

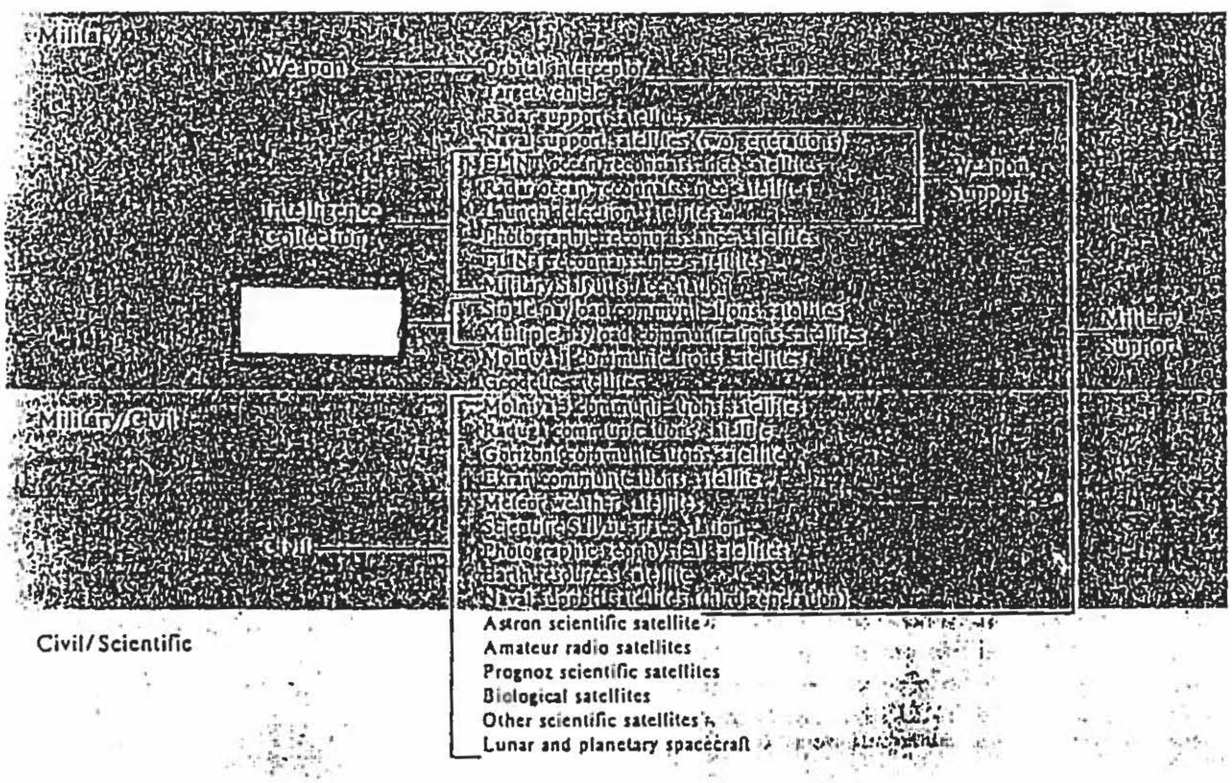

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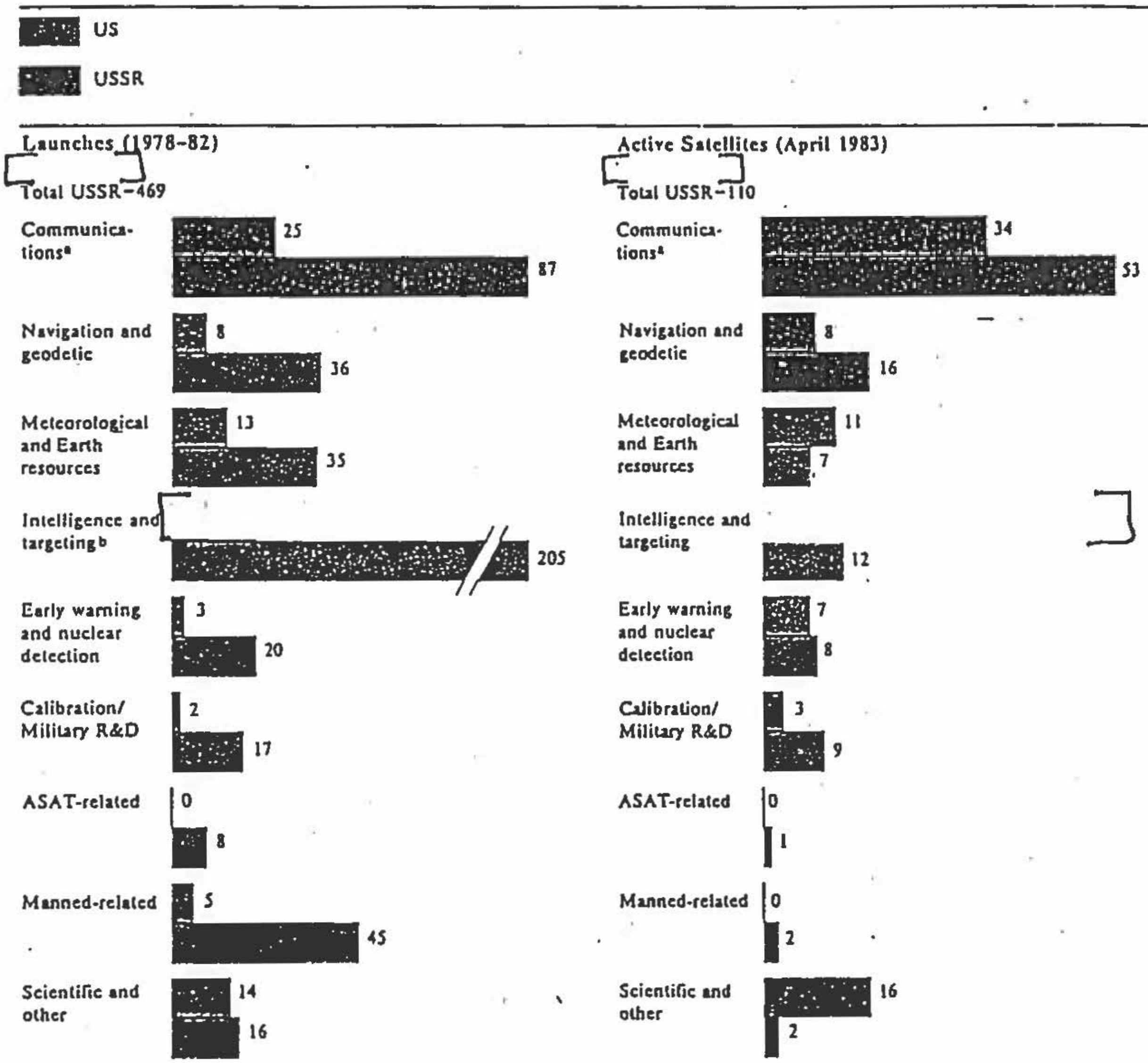
Figure III-2
Comparison of US and Soviet Space Operations



[a] These figures do not include international telecommunications satellites (e.g., INTELSAT).

[b] The short lifetime of Soviet satellites and the use of short-duration photoreconnaissance missions result in a high launch rate.

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dwindle with less than 10 percent of the annual launches falling in this category. In 1982 there were none.

2. The USSR currently maintains about 110 active satellites in orbit, providing communications, intelligence, warning, targeting, weather, mapping, navigation, and other types of support to a variety of users. This is approximately the same number of active satellites that the United States maintains in orbit, but the mix is quite different. Figure III-2 illustrates these differences, which are subdivided into nine major categories and presented both in terms of satellites launched and satellites in orbit.

3. There are several reasons for the large difference between the annual launch rates of the United States and the USSR. First, Soviet satellites are relatively short lived, with most failing within two years, while US satellites routinely obtain lifetimes of seven years or more. Second, the Soviets have not made extensive use of geosynchronous orbit. (See table III-1.) Instead, the Soviets have relied on systems or networks of low-altitude satellites (as illustrated in table II-3 in chapter II). This, coupled with the short lifetime, results in most of the annual launches being for replenishment of these networks. Finally, almost one-third of all Soviet launches are photographic reconnaissance missions, which are of short duration (13 to 49 days).

[redacted]

4. Although we believe that our knowledge of the technical characteristics, performance, and uses of most current Soviet systems is adequate, the time required for us to define and assess new systems has increased [redacted]

Reliability, Productivity, and Obstacles

5. During the past decade most Soviet satellites have been reasonably successful in achieving designed operational criteria. The less successful systems have been the more complex launch detection, ASAT, electronics intelligence (ELINT), ocean reconnaissance, and high-altitude communications satellites. These satellites have very demanding operational requirements. The failures are due to a wide range of technical problems, but generally reflect difficulty in translating system designs into reliable devices.

[redacted]

8. Although the goal of improving the design life from two to three years does not seem impressive by US standards (US satellites average seven to 10 years in operation), it would be a significant improvement for the Soviets. The satellite systems that would benefit most by improving design life are those at geosynchronous orbit, because launch vehicle and satellite costs for such systems are high. Currently, Soviet geosynchronous satellites seldom achieve more than 18 months of useful life. Doubling this lifetime to 36 months would reduce replenishment costs by half. We expect the Soviets will achieve this goal by the late 1980s.

Imagery Collection

9. Photographic reconnaissance satellites are by far the most frequently launched satellites in the Soviet space program, accounting for about one-third of all Soviet spacecraft launched each year. This high launch rate is the result of using technically limited space systems to fulfill an apparent operational requirement for a nearly continuous photographic capability. Early Soviet photographic reconnaissance systems used space vehicles originally designed as manned spacecraft that were too heavy to be placed into Sun-synchronous orbits. Also, most of these satellites were battery powered. As a result, missions are of short duration (about 14 days) and are limited to orbits in which lighting conditions remain favorable for only limited periods of time. Further, poor film technology has restricted the total capability of Soviet photoreconnaissance satellites. However, more recent Soviet photoreconnaissance satellites have been developed with solar panels and have demonstrated mission durations of 49 days. Acquisition of advanced photoreconnaissance film technology could permit the Soviets to extend their film-based reconnaissance missions. Also, orbital maneuvers now allow for maintenance of favorable lighting conditions. There are no Soviet systems with long mission durations and timely delivery of data comparable with the US KH-11, which is in orbit continually and transmits imagery on a near-real-time basis. An operational system of this type could be ready by 1987.

10. To gain more timely data, on occasion several photoreconnaissance satellites have been launched within short periods of time. For example, during the 1973 Middle East war, the Soviets launched seven photoreconnaissance satellites in 24 days and deorbited most of them about six days after launch. Multiple launches within short periods are possible with a limited number of launchpads because systems have been developed with short on-pad times. Spacecraft are fueled and mated to the booster in a horizontal position, and subsystems are checked out in buildings located near the launch sites. The mated booster and spacecraft are then taken to the launch site and erected; the booster is fueled and the vehicle is launched in as short a time as four hours after leaving the checkout building. In one case (1962) only one day was required to prepare the launchpad for a second launch. This is the minimum time yet observed.

11. Table III-2 lists the Soviet photoreconnaissance satellite systems and their major capabilities. The mainstays of the Soviet space program are the second-generation, high-resolution system and the medium-resolution system. The second-generation, high-resolution system is the first to make operational use of film capsules and solar panels to increase mission duration. The best resolution of this system is estimated to be 0.3 meter. The medium-resolution system has replaced the low-resolution system last launched in 1979. However, the limited number of high-orbit (400 kilometers), medium-resolution missions does not provide coverage comparable with that obtained with the low-resolution system. Thus, coverage provided by the medium-resolution system probably is being supplemented with data from Earth resources photographic satellites and Salyut space stations.

12. The second-generation, high-resolution photoreconnaissance satellite is the mainstay of Soviet spotting missions. The medium-resolution photoreconnaissance system, when operated at low altitudes (about 230 kilometers), also has a spotting capability. Use of these two systems allows improved resolution photography by the second-generation, high-resolution system and coverage of larger areas, at reduced resolution, by the medium-resolution system. This improved coverage, however, is achieved at the expense of eliminating stereo coverage, which was provided only by the first-generation, high-resolution system. We expect to see a mix of the current Soviet photoreconnaissance satellite systems for the next several years. Evolutionary improvements in photographic quality also are expected to continue. Film return capsules may be introduced on additional systems to further increase mission lifetimes. However, we expect that the capability to quickly orbit short-duration missions will be maintained.

13.

We believe that the critical technologies—large arrays of electro-optic sensors and wide band, high data rate transmission links—for a real-time imagery system already have been developed. We believe the purpose of the first Soviet real-time system will be for indications and warning and crisis monitoring. Our assessment of Soviet technology leads us to conclude that such a medium-resolution system would have a 2- to 4-meter ground sample distance.[1] This resolution is adequate to monitor targets, such as airfields, staging areas, and ports.

14. In late 1982, a possible precursor to a near-real-time electro-optical imaging system was put into orbit. Cosmos 1426 remained in orbit for 67 days and was deorbited and probably intentionally destroyed.

[1] Ground sample distance is the ground area sampled by a single detector.

15. The development of a near-real-time, electro-optical imaging system will provide a major improvement in the timeliness of satellite imagery data. We expect that a network of operational data relay satellites (either Potok or Satellite Data Relay System) will be available by 1985 or 1986 to support imaging satellites. We believe that two versions of an electro-optical imaging system will be deployed. A medium-resolution system will most likely be deployed first in 1986-87, with a high-resolution system following within a few years. A full network of two to four imaging satellites could be established by the late 1980s.

Radar Imaging

16. A radar-imaging system could augment the USSR's photoreconnaissance satellite systems by obtaining images in all types of weather and lighting conditions. A space-based synthetic aperture radar (SAR) is the most likely means for providing this capability. The Soviets have conducted research and development (R&D) flights of SARs on aircraft for nonacoustic antisubmarine warfare (ASW) research since 1971.

If a SAR is tested on the current Soviet Venus radar mapping mission, it could significantly further the development of a radar-imaging reconnaissance satellite. A critical technology that will influence development of a radar-imaging system and should be available to the Soviets in the mid-1980s is onboard specialized signal and data processing. On the basis of our view of their perceived needs, we believe there is an even chance the Soviets will decide to develop a space-based radar-imaging system and a moderate-to-high likelihood of prototype testing at some time in the 1990s. Orbital flight tests may be possible by the mid-1990s. A system that used ground-based processing instead could be available several years earlier.

ELINT Reconnaissance

17. The Soviets have two types of satellites that perform ELINT reconnaissance—the second-generation and the third-generation ELINT satellites.

18.

19. The current ELINT satellite systems appear to adequately meet the Soviet requirements for land- and sea-based radar reconnaissance and radar order of battle. The most recent type of Soviet ELINT satellite was introduced in 1970. We expect either an improved ELINT satellite to be introduced in the mid-1980s or a new generation in the late 1980s or early 1990s. The requirements for such a satellite would most likely include continuous coverage, real-time transmission, and tactical land battle support.

20. The technology necessary to develop a high-altitude ELINT collection system is already available to the USSR, but we have no direct evidence that they intend to do so. Activity possibly related to such a development includes work on large spaceborne

antennas (the 10-meter-diameter antenna deployed on Salyut 6, for example, was developed under military sponsorship). Large high-gain antennas are required on high-altitude collection satellites to provide sensitivity for the detection of low-power signals radiated from emitters on the Earth's surface.

21.

[redacted]

Naval Targeting and Surveillance

23. The Soviets have two types of satellites in this category, the ELINT ocean reconnaissance satellite (EORSAT) and the radar ocean reconnaissance satellite (RORSAT), which can detect and locate surface ships [redacted] Flight-testing began in 1967 for the RORSAT and in 1974 for the EORSAT. Both systems probably became operational by at least 1980. The Soviets often keep one satellite of each type in orbit. The maximum number in orbit has been two for each type, and on occasion there have been gaps of several months with no RORSATs or EORSATs in orbit. These two types of satellites are primarily wartime and crisis weapon targeting systems. [redacted] for use against aircraft carriers and naval battle groups. The required coverage for nearly continuous targeting and the demonstrated orbital spacing indicate that prior to hostilities the Soviets will attempt to expand the satellites networks to four EORSATs and seven RORSATs.

24. Both the RORSAT and EORSAT have short average lifetimes—two and four months, respectively. However, this may not be a significant limitation to their wartime targeting mission. The Soviets probably recognize that these satellites are vulnerable and would be short lived once hostilities began. The satellites would be useful just before hostilities and as hostilities begin. We expect the Soviets to attempt to complete a full EORSAT/RORSAT network with launches by SL-11s in a matter of days.

[redacted]

25. The EORSAT is a specialized ELINT satellite [redacted]

26. The accuracy of the EORSAT targeting data is generally sufficient for the associated antiship missiles [redacted] The probability of detection varies [redacted] About 20 Soviet [redacted]

naval combatants currently are configured to receive the EORSAT data. Major limitations of the EORSAT system include:

[redacted]

— Cannot detect ships using EMCON.

— Excessive time required for a single satellite to revisit the same targets—six to 14 hours at northern latitudes and about 28 hours at the equator. A network of at least four EORSATs is required to provide continuous targeting data—that is, no more than two hours old—at high latitudes. Such a network is not expected in peacetime, but may be launched in a crisis.

[redacted]

[redacted]

27. We believe the EORSAT will continue to be used for the next several years. We project changes in the system may be introduced, including improved receiver sensitivity, extended radiofrequency coverage, and improved locating capabilities. Improvements in the EORSAT program will include fitting out more Soviet naval combatants to receive the collected data directly and increasing satellite lifetime.

28. The Soviets probably will maintain up to two EORSATs in orbit during peacetime. Peacetime functions of the EORSATs consist of ocean reconnaissance, detecting and locating naval targets, and transmitting the targeting data in real-time to Soviet submarines and ships for training during antiship missile firings and simulation exercises.

29. The EORSAT system is designed to operate in conjunction with the RORSAT. The RORSAT uses a radar capable of detecting and locating ships of destroyer class and larger. Soviet RORSAT satellites are launched by the SL-11 into circular orbits 260 km above the Earth. After a mission is terminated, a segment of the spacecraft containing a small nuclear reactor for generating electric power is separated and boosted into a higher (900 km) orbit, where it should remain for 500 to 1,000 years, allowing time for decay of the radioactive fuel.

[redacted]

[redacted]

31. The RORSAT system, like the EORSAT system, is primarily a weapon targeting system for use during wartime or a crisis. In a crisis the Soviets could quickly launch additional EORSAT and RORSAT satellites. A network of seven RORSATs and four EORSATs could provide targeting data about every two hours in the 50- to 70-degree latitude region (see figure III-5). Targeting data more than two hours old are usually too inaccurate for targeting solutions. The Soviets have had as many as two RORSATs in orbit during peacetime. (See chapter IV for a discussion of augmentation and replacement options open to the Soviets.)

32. Major advantages and capabilities of the RORSAT system include:

[redacted]

[redacted]

The RORSAT system also has some major limitations, including:

[redacted]

33. The RORSAT has experienced numerous onboard system failures. The failures have been due to various causes. The Soviets suffered a serious setback in January 1978 when Cosmos 954, including its nuclear reactor, made an unintentional reentry, scattering radioactive debris in Canada's Northwest Territory. The resulting adverse world reaction to the use of nuclear power sources in space led to deliberations in the UN Outer Space Subcommittees. A majority of nations supported regulations for the use of nuclear power sources, including a ban on their use in low Earth orbits. Despite these reactions, another RORSAT was launched in April 1980, after a 27-month standdown. The long hiatus was undoubtedly to allow time for necessary technical modifications. Since the Cosmos 954 incident, all RORSATs have had a backup system, which was described in Soviet reports to the United Nations. Fifty minutes after separation, the nuclear reactor core probably is ejected, normally in high storage orbit. If the primary disposal method of separating the reactor core and boosting it to higher orbit fails, the backup design calls for ejecting the core from the casing while still at low orbit. This enhances the likelihood that the radioactive material will burn up during reentry. That is what we believe happened to Cosmos 1402. The main body reentered in January 1983, and the reactor core was probably destroyed during reentry in February 1983.

Figure III-5
Requirements To Achieve Adequate Target Coverage, EORSAT and RORSAT*

	Revisit Times at Various Latitudes *(Hours)*									
	0°	10°	20°	30°	40°	50°	55°	60°	65°	70°
1 EORSAT	28	24	24	20	16	14	12	6	6	28
2 EORSATs	14	12	12	10	8	7	6	3	3	14
4 EORSATs	7	6	6	5	4	3.5	3	1.5	1.5	7
1 RORSAT	56	54	52	46	40	32	28	22	16	8
2 RORSATs	28	27	26	23	20	16	14	11	8	4
4 RORSATs	14	14	13	12	10	8	7	5	4	2
7 RORSATs	8	8	7	7	6	5	4	3	2	1
1 EORSAT and 1 RORSAT	19	17	16	14	11	10	8	5	4	6
2 EORSATs and 2 RORSATs	9	8	8	7	6	5	4	2.3	2.2	3
4 EORSATs and 4 RORSATs	5	4	4	4	2.9	2.4	2.1	1.2	1.1	1.6
4 EORSATs and 7 RORSATs	4	3	3	3	2.4	2.0	1.7	1.0	0.9	0.9

* Adequate coverage is based on revisit times of two hours or less. Location data more than two hours old are usually considered too inaccurate for targeting.

Adequate target coverage

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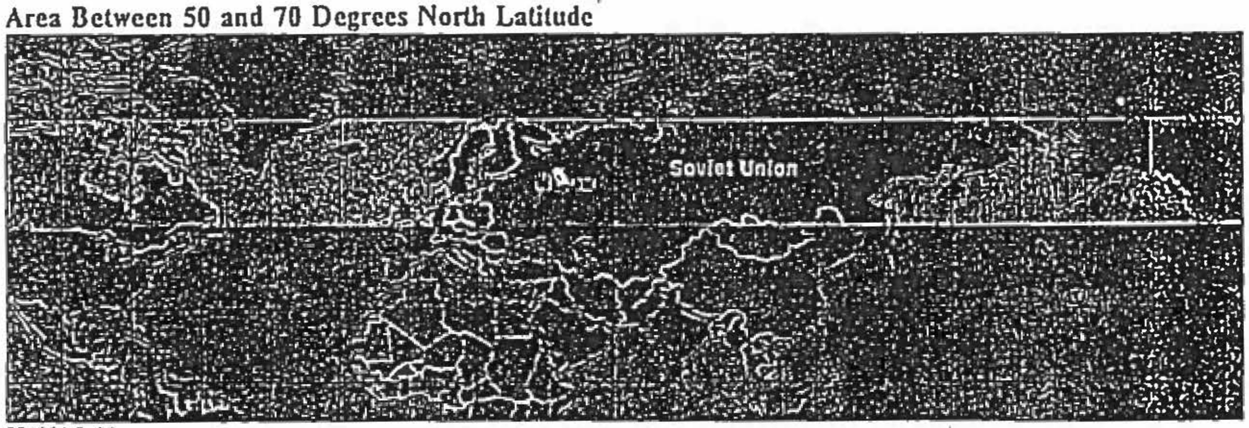
Area Between 50 and 70 Degrees North Latitude



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34. Seven RORSATs were launched between the Cosmos 954 and Cosmos 1402 incidents, indicating the Soviets' desire to continue the RORSAT program despite adverse world reactions. Nuclear reactors are used on the RORSAT because low orbit complicates the effective use of large solar arrays. A probable Soviet goal would be to increase RORSAT lifetime significantly beyond the 50-day average mission duration. We believe the system was designed for a much longer operational life, because the quantity of onboard propellants for orbit maintenance is sufficient for mission durations of about 210 days and the nuclear reactor power supply should last at least a year. We expect the RORSAT will evolve into a new generation of space-based radar systems. Although we have no evidence of such a system, we believe an advanced RORSAT will be deployed by the late 1980s that will be able to operate in adverse weather conditions and may be less susceptible to jamming and electronic countermeasures.

Submarine Detection

35. [redacted] Data collected by the various imaging and advanced nonimaging space systems will add to the knowledge of the feasibility of detecting surface effects produced by ships and submerged submarines.

36. [redacted] Future Soviet high-altitude data relay satellites could service networks of sonabuoys for submarine detection. But, to provide useful, real-time data directly to a user, the satellite would require an onboard signal processor. We are uncertain whether such a capability could be achieved in the next 10 years.

37. We have limited knowledge of the precise nature and degree of success of the Soviet submarine detection program. [redacted] Therefore, we cannot state with confidence that they have not had some success in their research. We cannot judge whether the Soviets will achieve a technological breakthrough in remote sensing of submarine-generated effects during the next 10 years. Even if such a breakthrough were to occur, we do not believe, in view of the operational considerations and the length of time needed for full system deployment, that there is a realistic possibility that the Soviets, during the next 10 years, will have a system that could simultaneously track a substantial fraction of the US nuclear-powered ballistic missile submarine (SSBN) force. We are more uncertain, and hence more concerned, about the capabilities that could potentially be realized and deployed in the mid-to-late 1990s.

38. An alternative view[4] is that the preceding text understates our knowledge of the extent of the Soviet research program to detect submarines from space [redacted] Further, the holder of this view believes the Soviets have not had significant success in these techniques and are unlikely to achieve a technological breakthrough in remote sensing of submarine-generated effects during the next 10 years. The holder of this view believes that the US Navy's understanding of the basic phenomenology of submarine detection is sufficiently advanced to support the conclusion that an effective broad area search and detection capability will not emerge from Soviet R&D activity during the next decade. For many years the US Navy has had an intensive R&D program in submarine detection. One of the objectives of this program has been to examine the detectability of submarines by sensors utilizing the same procedures observed in Soviet R&D activity. None of these sensors has shown an adequate detection performance to be able to have a significant impact on Soviet ASW capabilities for broad area search. The US Navy continues to examine extensively phenomena that might permit the detection of submarines. So far, there are no phenomena known to the US Navy that could be exploited by the Soviet Union to develop an operationally significant detection capability against US SSBNs within the foreseeable future.

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[4] *The holder of this view is the Director of Naval Intelligence, Department of the Navy.*

Warning and Attack Assessment

39. The Soviet launch detection satellite (LDS) system currently provides continuous, real-time coverage of the US ICBM fields. Such coverage is being achieved by eight satellites in appropriate semisynchronous orbital positions. We expect a nine-satellite LDS system will be completed during 1983, providing continuous redundant coverage. Operational satellites can detect both isolated and massive launches of US ICBMs and can provide about 30 minutes' warning before impact. We believe they can also provide limited attack assessment information. These satellites are not intended, nor can they be effectively used, to provide coverage of submarine patrol areas. (See figure III-6.)

40.

44. The Soviets experienced reliability problems early in the LDS program (see figure III-7), but they

finally achieved an initial operational capability of five satellites in March 1981. One satellite failed two months later, however, and the network did not regain operational status until March 1982. Reliability problems now appear to have been largely corrected. [redacted]

46. We believe the Soviets also will develop a new system of satellites to provide coverage of the launch areas of long-range SLBMs. Deployment of such a system can increase Soviet warning time of SLBM attack by up to 15 to 20 minutes, depending on the location of the SSBNs. It could probably also provide coverage of launches of land-based ballistic missiles from Europe and Asia. Soviet development of an SLBM (submarine-launched ballistic missile) detection system may be in advanced stages, and we expect initial flight tests in 1984. Full operational capability is expected by 1990:

- New construction at the current LDS ground station may be related to the development of a geosynchronous launch detection system possibly including the capability for SLBM launch detection. [redacted]

- Soviet filings with the International Frequency Registration Board (IFRB) call for a four-satellite network of geostationary satellites called Prognoz. The stated use for the satellites in the Prognoz network—the study of atmospheric processes, the state of the world's oceans, and natural resources—is sufficiently vague that it could have a military mission. The westernmost satellite in the Prognoz network will be positioned at 24 degrees west, the same position occupied by the only Soviet developmental LDS placed in geosynchronous orbit in 1975 and now inactive. It can cover all of the Atlantic and some of the Indian Ocean. The easternmost satellite (80 degrees east) will allow the coverage of almost all the Eastern Hemisphere ocean areas, including the Indian Ocean and part of the Pacific Ocean, from which western SLBMs, including the Trident C-4, could be launched at European USSR targets. [redacted] Further, according to the filings, these geosynchronous positions are to be filled by the end of 1984, coincident with the completion of the construction at the LDS ground site.

Nuclear Detection

47. We have not identified a Soviet satellite that provides data on nuclear events. However, all Soviet satellites in synchronous and semisynchronous orbits provide extensive coverage of the Earth's surface. Other possible candidates are scientific satellites that are placed into highly elliptic orbits (five times synchronous). According to Soviet open sources, these satellites collect data on solar radiation to improve the forecasting of the effects of solar proton flares. However, scientific papers associated with this satellite program have addressed nuclear detection from space, inferring that solar forecasting satellites may have a secondary mission of nuclear detection.

Aircraft Surveillance

48. We believe the Soviets will perceive a need to detect and locate US aircraft in flight over certain critical routes around the world. This need could potentially be satisfied by advanced space systems using nonimaging IR or real aperture radar sensors. Although the detection of very small vehicles such as cruise missiles will most likely not be possible for some time, overhead detection of large aircraft, such as bombers and cruise missile carriers, will soon be a technological possibility for the Soviets.

49. Soviet experience with space-based real aperture radars extends back to the first RORSAT in 1971. The development of sufficiently large antennas that can be properly deployed in space appears to be a

critical technology for a space-based radar for detecting aircraft. A 10-meter-diameter, 2-GHz antenna was tested in 1979 on Salyut 6. However, further development and testing would be required before an antenna of sufficient size or accurate shape could be obtained for this mission. We believe a 10-meter-diameter, 6- to 9-GHz antenna, or an equivalently larger antenna operating at a lower frequency (30 meters at 2 GHz), could be tested, probably on a manned space station, before 1985 and would be a major step toward acquiring the required technology.

50. An operating system of space-based radars for aircraft detection would require several satellites. It could take one of several forms because factors such as radiated power, search rate, detection range, and area to be covered must be considered. An example of a conceptualized system is three satellites in elliptical 7,000-km polar orbits that could provide continuous coverage of the northern polar area.

51. A space-based infrared system capable of performing this task would probably operate in the far infrared region (8 to 14 microns) and would be based on detecting the temperature difference between the aircraft and the Earth background. This type of detection requires that the sensors be small enough that the aircraft would occupy a significant amount of the area covered by each element. To provide continuous coverage of a significant area on the Earth requires a large number of small sensor elements (on the order of 100 million elements).

52. For both systems the communications link is the key to the operational capability of the surveillance system. The link between ground station and sensor satellites should permit the operator at the ground site to have direct access to satellites at all times. Therefore, satellite-to-satellite data relay is mandatory for any low-orbit system.

53. Two methods of processing the sensor return signals are possible: on board the satellite or at a central ground site in the USSR. Both methods have difficulties associated with them:

- Onboard processing requires the development of a minicomputer larger than that currently used and a space-related processing capability for handling extremely large amounts of data. However, having a signal processor on board the spacecraft would permit the real-time transmission of target data directly to the user. It also allows for a much narrower bandwidth for the data link (on the order of 1 megahertz versus 100 MHz) as compared with the method for central ground-site processing. Having the signal processing performed on the satellite also has the potential of achieving a higher level of ECCM (electronic counter-countermeasure) capability for the downlink. Conceivably, onboard processing of the raw sensor data could enable the target location data to be transmitted from the spacecraft to an Airborne Warning and Control System (AWACS) or interceptor aircraft without going through the ground station.
- For ground-based processing, the raw sensor data would most likely be digitized on board and then transmitted to the ground site in real time via direct data link when the surveillance satellite is within view of the site or via satellite-to-satellite relay data link when the surveillance satellite is out of view. Although the ground-site processing approach requires the least hardware in the spacecraft, it does demand a very wide bandwidth for the downlink. A downlink bandwidth of up to 200 megabits per second is required.
- The high data requirements in real-time signal processing anticipated for space-based sensors incorporating moving target indicator, target discrimination, signature analysis, and computer-driven control functions will require an onboard central processor. The requirement cannot be circumvented by downlink and ground-based processing. Such ground-based support would require extremely high data rates probably not achievable with current digital circuitry. Soviet integrated circuit technology probably lacks the maturity to provide the high data rates for sophisticated processing either on board or for multiplexed downlinks.

54. The required technology level will be difficult for the USSR to achieve and success will depend on

how well many difficult problems are resolved, including weather, detectors, and data processing. We believe there is a low-to-moderate chance that orbital flight tests of a space-based radar system will be conducted in the early-to-middle 1990s and a moderate chance by the year 2000. We believe it less likely that a space-based infrared system will be pursued. If they do elect to develop an infrared system, a prototype could be tested in the mid-1990s.

Communications and Data Relay

55. The USSR is currently increasing its use of communication satellites for its military and government communications. However, unlike the United States, it has retained and enhanced its ground-based high-frequency (HF) communications and has added flexibility and redundancy with its various microwave, troposcatter, and landline communications systems. Nevertheless, comsats will increasingly be used to support intelligence, military, and political activities during the next 10 to 20 years. The projected developments will have the dual advantages of significantly improving the speed, flexibility, and reliability of command and control and other communications, while concurrently improving the security of those communications. [redacted]

56. Current and future Soviet comsat systems are summarized in table III-4. The USSR currently operates six comsat systems. Four of these—Molniya 1, Molniya 3, Statsionar, and Statsionar T[4]—use satellites in high-altitude (semisynchronous and geostationary) orbits. These satellites use wideband transponder systems for real-time reception, amplification, and retransmittal of communications signals. The other two comsat systems—designated as multiple-payload communications satellites and single-payload communications satellites—are in low-altitude orbits. These satellites record Soviet communications for transmittal at a later time (store-dump). With the exception of the television relay satellites, all existing Soviet comsats are used extensively and in some cases exclusively to support the Soviet military and political leadership and the intelligence services. Proliferation of comsat capabilities has favored early delivery to those units with nuclear weapons or with nuclear weapons release responsibilities. [redacted]

[redacted]

[4] The Statsionar system (currently utilizing both Raduga and Gorizont satellites) is to occupy 15 orbital positions. The Statsionar T system consists of the Ekran television satellite at one orbital position. A proposed Statsionar T2 system may supplement or replace the current Statsionar T system.

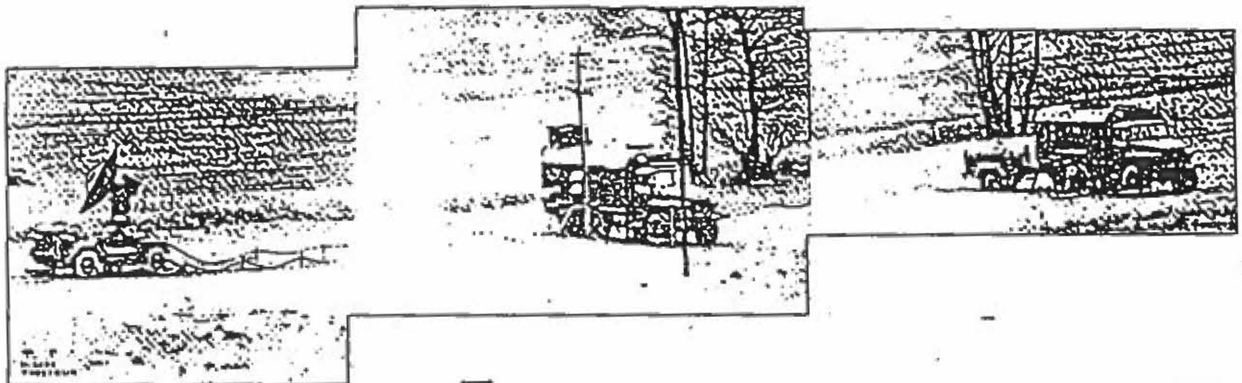
[redacted]

Table III-4
Current and Prospective Soviet Comsat Systems

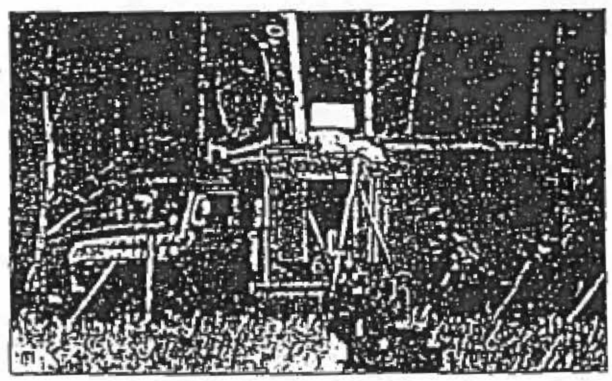
Satellite System	Number of Satellites in System	Orbit
Current		
Molniya 1	8	Semisynchronous
Molniya 3	4	Semisynchronous
Statsionar	15 [a]	Geosynchronous
Statsionar T	1	Geosynchronous
MPCS	16-24	1,500 km circular
SPCS	3	800 km circular
Future		
Gals	(6) [b]	Geosynchronous
Volna	(4) [b]	Geosynchronous
	(4) [b]	Geosynchronous
Luch	(4) [b]	Geosynchronous
Luch-P	(4) [b]	Geosynchronous
Statsionar T2	1 [c]	Geosynchronous
Potok	3	Geosynchronous
Satellite data relay system (SDRS)	3	Geosynchronous

[a] The Soviets have filed for 15 geostationary positions with the IFRB for their Statsionar system. To date, seven of these positions have been occupied by two different types of satellites (four Raduga satellites and 3 Gorizont satellites).

Figure III-8
Soviet Mobile Communications Satellite Terminals



Park Drive terminal deployed in operational mode



New Woodbine terminal photographed in East Germany.

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67. The USSR is actively pursuing a comprehensive program for geostationary communications systems that could include satellites that serve more than one communications network, intersatellite crosslinking, and laser communications links. Four communications systems are being developed: Volna, Gals, Luch, and Luch-P. These systems may be colocated on satellites in the Statsionar system. Figure III-9 compares the orbital positions of satellites in the current and planned geosynchronous communications systems. We believe that one way the Soviets will meet the requirements of these new systems will be through the use of "hybrid" satellites—that is, satellites that carry transponders for more than one communication network. The first hybrid satellite, Gorizont 5 launched in March 1982, carries Statsionar C-band (4 to 8 GHz), Volna L-band (1 to 2 GHz) and Luch K-band (11 to 14 GHz) transponders.

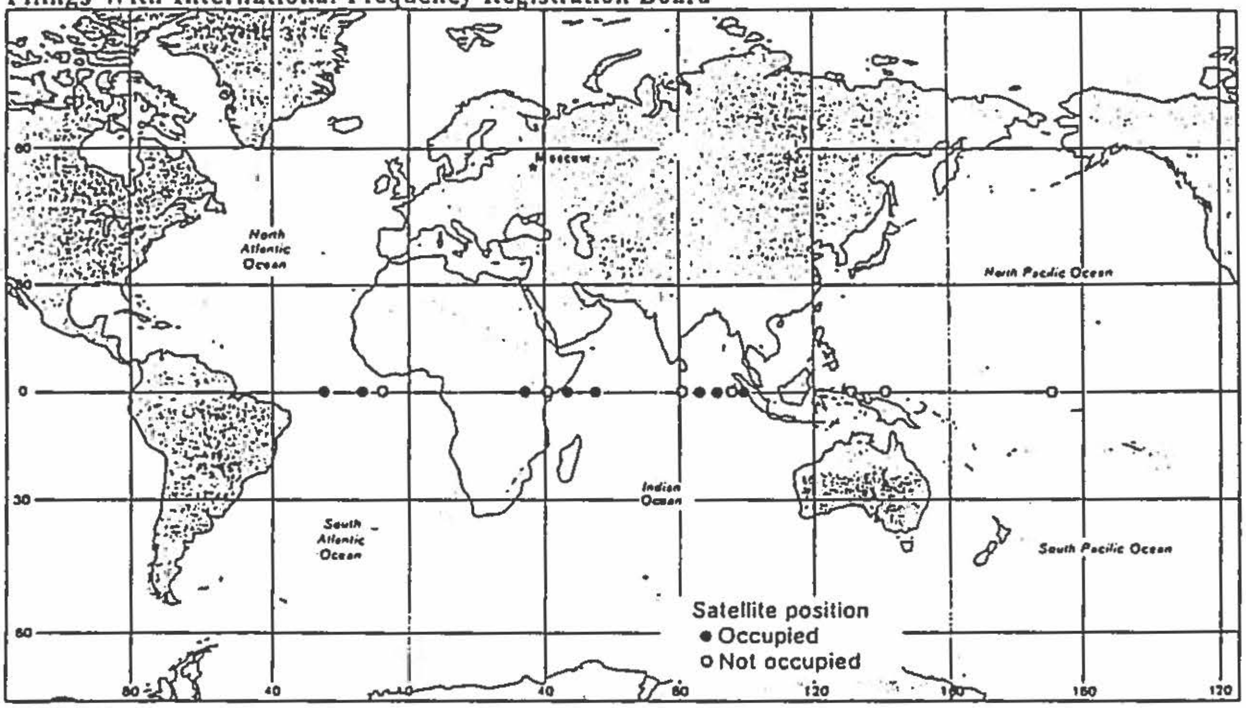
68. We project that a system of four hybrid communications satellites carrying transponders for the Statsionar, Volna, and Luch systems will support civilian users primarily although they will carry both civilian and military communications. Transponders of the even-numbered positions of the Volna system are to be used with air- and sea-mobile terminals while transponders of the Luch system are to be used for telephone, telegraph, TV, and radio transmissions.

69. The proposed geostationary locations and allocated frequencies further suggest that transponders of the Statsionar, Gals, Luch-P, and Volna (odd-numbered positions only) networks may be combined on single hybrid satellites to form a six-satellite multiple-band communications system with near worldwide coverage for government and military command and control communications. The frequencies to be used in the Gals network (8 GHz uplink/7 GHz downlink) are internationally recognized for military communications satellites. Satellites with Gals transponders will have both global and regional beams. In addition, Soviet filings indicate that two satellites will have spot beam capabilities directed at regions in the North Atlantic and North Pacific suggesting naval roles.

70. We expect the entire Statsionar, Gals, Volna, Luch, and Luch-P communications satellite systems to be completed by the late 1980s. Although the Soviets have filed for more than 40 network positions (see figure III-9), we believe they could meet these requirements with as few as 14 satellites carrying hybrid payloads. As the new comsat systems become operational, we expect some of the current satellites in the Molniya 1 and possibly the Molniya 3 systems to be phased out.

71. In addition to the comsat networks, we believe a three-satellite Potok data transmission satellite system and a three-satellite satellite data relay system (SDRS) will be established in geostationary orbits during the mid-to-late 1980s. The Potok system is designed to transmit digital information between central Earth stations and peripheral Earth stations. The purpose of the Potok system remains unclear but may include military missions. SDRS is designed to relay data from low-orbiting satellites, including the manned Salyut type, to Earth terminals near Gus 'Khrustalnyy in the western USSR and near Nikolaevsk-na-Amure in the eastern USSR. Such a system will greatly improve the real-time control of low-orbiting satellites and their timely transmission of data. Potential applications include the real-time transmission of data from low-orbiting intelligence collectors, timely redirection of collection activities, and on-demand orbit adjustments of low orbiters (for example, to counter a US ASAT attack).

Figure III-9
Soviet Geostationary Communications Satellite Network Filings With International Frequency Registration Board



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Geosynchronous position	25°W	14°	8.5°W	35°E	40°	45°	53°	80°	85°	90°	95°	99°	130°	140°	170°W
Network position numbers															
Statsionar	[illegible]	[illegible]	11	2	12	3	5	13	[illegible]	6	14	12	[illegible]	7	10
Gals				5		2			3				3		
Volna*	1	3		[illegible]		3	4		5	[illegible]			[illegible]	5	7
Luch		1		•			2			[illegible]				[illegible]	
Luch-P	1					2			5			[illegible]			[illegible]
Total filings 41	4	3	1	3	1	4	3	1	5	3	1	2	3	3	4

Hybrid military comsat
Hybrid civil comsat
Direct-broadcast TV satellite
International comsat

~~Secret~~

Volnas 9 and 11 have not been filed officially with the IFRB.

72. New Soviet comsat systems will use advanced communications technologies that will result in the capability to relay billions of bits of data per second by the early 1990s. Also, spread spectrum signals will provide better antijam and anti-intercept protection. These advances will provide more reliable communications with higher data capacities to an increasing number of users. By 1990, lasers will be used experimentally for intersatellite relay and possibly with other comsat systems to achieve even greater bandwidth and communications security. In the early-to-middle 1990s we believe an advanced Soviet commu-

nications satellite system will be put into orbit and operate at high frequencies, up to 30 GHz, and will have increased capacities over current systems. These systems could support the expanding manned space programs and real-time sensor satellites.

73. Soviet satellite communications research has included efforts to develop a satellite-to-submarine laser communications link. The research was initiated about 14 years ago and involves experimentation with a blue-green laser that can be used to communicate with submerged submarines. [redacted] A laser communications link would be able to handle extremely broadband, short-duration signals. Such a system could enhance the security and survivability of SSBNs on patrol. There is a moderate likelihood that testing of laser communications components will take place in space in the mid-to-late 1980s, perhaps on board a manned space station. If tests are successful and sufficient resources are committed, a small network of laser satellite-to-submarine communications satellites could be operational as early as the mid-1990s.

Navigation

74. Development of naval support satellite (NAVSAT) systems began in the mid-1960s to provide Soviet naval forces with accurate and timely navigation signals [redacted]

75. The second-generation system, NAVSAT 2, consists of six satellites in near Earth orbits [redacted]

76. In July 1982 a NAVSAT 3 equipped with two special radio transponders for relaying distress signals from ships and aircraft was placed into orbit, as part of the joint US, Soviet, Canadian, and French COSPAS-SARSAT program. This program was first publicized in June 1980 when the Soviets submitted their contribution for the joint project to the IFRB. The Soviet project is administered by the Ministry of the Merchant Fleet and utilizes three ground stations in the Soviet Union to process the signals transponded by the satellites. The location accuracy for emergency transmitters is reportedly within 2 kilometers.

77. In early 1982 the Soviets filed with the IFRB for a Global Navigation Satellite System (GLONASS). These filings indicate that the GLONASS network is designed for worldwide aircraft radio navigation. It will have nine to 12 satellites that will be positioned in three orbital planes with three to four satellites in each plane for positional accuracies possibly within 30 meters. In many respects GLONASS appears similar to the US Global Positioning System (GPS) currently being established. If, as announced, the nine- to 12-satellite system is developed, it will lack a three-dimensional (latitude, longitude, and altitude) position-fix capability. Such a capability exists with the US GPS system and would require an 18- to 24-satellite network with the Soviet design.

78. A GLONASS prototype was launched in October 1982, when a single SL-12 Proton vehicle was used to launch three satellites in the Cosmos series into orbits very similar to those indicated in the filings for

GLONASS. Soviet announcements further indicated that these satellites were intended to develop "equipment of a space navigation system . . . to locate civil aviation planes and merchant marine and fishing ships." We believe that, if tests are satisfactory, an operational network of nine satellites (three satellites in three planes) will be established by 1986.

80. The US TRANSIT navigation satellite system is currently used by Soviet ships and aircraft to supplement their own Doppler navigation satellites. We expect continued Soviet procurement of Western receivers, so that Soviet ships and aircraft can use both GLONASS and GPS for navigation.

Mapping, Charting, and Geodesy

81. Accurate maps, charts, and Earth gravitational models are required for a variety of military missions, including precise targeting information for ballistic missiles. Soviet use of space systems for such purposes began in the 1960s when geodetic and photographic-geophysical (PHOTOGEO) satellites were developed to improve the targeting data for strategic missile forces.

82. Geodetic satellites were used to develop and refine geodetic and gravitational models of the Earth. These satellites were first launched in 1968 and continued to be launched at a rate of about two per year until 1978.

[redacted]

Meteorological

87. Meteor 2 satellites provide meteorological data both for civil weather forecasting and military support. Probable military functions include scheduling and routing aircraft and ships, executing force movements, scheduling tests of optical devices that propagate through the atmosphere, such as lasers, and scheduling other operations and exercises. Another possible use includes support for Soviet photoreconnaissance satellite targeting. The Meteor 2 system is operational, with two to four active satellites typically in orbit. Normally, two satellites are used per day. A two-satellite constellation can cover all of the Earth's surface in 24 hours, whereas one satellite would miss some regions near the Equator. Each satellite carries visible, near-infrared, and far-infrared scanners that can provide day and night real-time and recorded cloud-cover imagery. Each satellite also uses an Automatic Picture Transmission (APT) link, the same as that used by US weather satellites.

88. Eventually, a three-tier meteorological satellite system will be developed consisting of a low-altitude manned space station, medium-altitude satellites (the current Meteor 2 series), and a system of geostationary satellites. The manned space station will probably include sensors for collecting meteorological data which differs from that provided by unmanned satellite sensors. The Geostationary Operational Meteorological Satellite (GOMS) originally was scheduled for launch in 1978 in support of the Global Atmospheric Research Program, but was delayed because of technical problems. We expect a launch in 1983-85. GOMS will be positioned over the Equator at 76 degrees east and will provide visible and far-infrared cloud-cover imagery every half hour. Soviet planners will thus have access to more timely cloud-cover data over the Indian Ocean and most of Europe, Africa, and Asia than are provided by the Meteor 2s, which typically pass within range of a given location every six hours. GOMS also will reportedly relay Meteor 2 cloud-cover imagery, either directly or through other APT-equipped stations. This will allow reception in the Soviet Union of real-time or near-real-time cloud-cover data over a larger portion of the Earth than could be achieved by either the Meteor 2 or GOMS systems independently. This capability would be useful for optimizing the use of Soviet photoreconnaissance satellites.

Calibration

89. Radar support satellites (RADSATs) have been used since the early 1960s [redacted] Both the RADSAT 1s (first generation) and the RADSAT 2s (second generation), which replaced the RADSAT 1s in 1976, have been used to accomplish this calibration function. [redacted]

[redacted]

CHAPTER IV

SPACE SYSTEMS IN WARTIME

1. In addition to the characteristics already described, an evaluation of Soviet space systems must include:

— Augmentation and replacement.

— Space system defenses.

— Space warfare capabilities.

— Likelihood of interference with US space systems.

Augmentation and Replacement

2. The USSR currently maintains about 110 active satellites in orbit. Some indication of the Soviet surge launch capability was demonstrated in 1982 when 28 space launches were conducted in 56 days, bringing the number of active satellites to an alltime high of 129. We expect Moscow to maintain about 110 to 140 satellites active over the next five to 10 years. Of these, at least 90 will be in support of military activities. We believe that some of these satellite systems would be augmented during crises or prior to war in order to optimize the RORSAT, EORSAT, ELINT, METSAT (meteorological satellite), and photoreconnaissance networks. Table IV-1 compares the current Soviet satellite networks with what we would expect to see after the networks were augmented.

Table IV-2 depicts our estimate of 1993 Soviet space networks in peacetime and in crisis.

3. The capability to augment or replace satellites is a function of launch preparation times, pad turnaround times, surge and replenishment launch rates, numbers and types of satellites required, and the survivability of the specialized launch and control facilities. Current launch and control facilities are vulnerable, and we have no evidence of current or developmental land-based mobile launch or control facilities. We believe, however, that a mobile control capability using either ships or ground-based mobile terminals will be developed. A capability to relay commands to manned spacecraft via ships that receive the commands from Moscow already has been demonstrated. We believe the establishment of a mobile command capability could be accomplished within the next few years and would significantly increase the survivability of space system ground segments. A survivable launch capability is more difficult to establish. Although ballistic missile submarines and ICBMs in hardened silos could be modified for satellite launches, we believe such a capability has not yet been developed because we have seen no evidence of testing. As solid-propellant, mobile ICBMs are deployed beginning in the mid-1980s, we believe that an emergency launch capability for small communications satellites could be available, possibly as early as the late 1980s. A similar system with near-real-time photoreconnaissance satellites could be available by the early 1990s if the Soviets are able to develop a lightweight photoreconnaissance satellite. However, the Soviets will continue to depend primarily on their ability to augment existing satellite networks, in a short period of time if necessary, using present fixed space launch facilities prior to the onset of general nuclear war, when they would presumably be destroyed.

4. The estimated launch rate and local storage capabilities for the current series of Soviet space launch vehicles (SLVs) are described in table IV-3. We believe these capabilities are adequate to meet Soviet augmentation requirements of about 40 satellites within a three- to four-week period. The major limiting factors are the availability of propellant and adequate crews for sustained operations.

Table IV-1
1983 Augmentation of Soviet Military Support Satellites in Crisis

System	1983 Peacetime Configuration	Number of Satellites in Crisis [a]
Photoreconnaissance		
Medium resolution	1-2	2-4
High resolution	1	2-4
ELINT reconnaissance		
ELINT 2	1	1-2
ELINT 3	5-6	9-12
EORSAT [b]	0-2	2-4
Radar ocean reconnaissance (RORSAT) [b]	0-2	4-7
Launch detection	9	9-12
Communications		
Molniya 1	8	8-12
Molniya 3	4	4-6
MPCS	18-24	18-24
SPCS	3-5	4-6
Statsionar	4-8	5-10
Navigation		
NAVSAT 2	6	9-12
NAVSAT 3	4	4
Meteorological	2	2-4
Manned	1	0-2
Totals	67-85	83-125

[a] This column reflects additional payloads launched to augment existing systems and to pre-position spares in orbit.
[b] EORSAT, RORSAT, and ASAT all use the same SL-11 launchpads.

~~This table is Secret.~~

Table IV-2
Projected 1993 Augmentation of Soviet Military Support Satellites in Crisis

System	1993 Peacetime Configuration	Number of Satellites in Crisis
Photoreconnaissance		
Electro-optical high resolution	0-1	1-2
Electro-optical medium resolution	2-3	4-6
ELINT reconnaissance		
High-altitude ELINT	4	4-6
EORSAT	0-2	2-4
Radar ocean reconnaissance		
Improved RORSAT	0-2	4-7
Launch detection		
LDS 2	9	9-12
Synchronous LDS	4	4-6
Communications and data relay		
Molniya 1	4	4
Statsionar	15	15-20
MPCS	18-24	18-24
SPCS	3-5	4-6
Potok	3	3-5
SDRS	3	3-5
Navigation		
NAVSAT 2	6	9-12
NAVSAT 3	4	4
GLONASS	9-12	12-15
Meteorological		
Meteor 2	2	2-4
GOMS	1	1-3
Manned		
Cosmos 929-type	0-1	1-2
Large space station	1	1
Space plane	0-1	2-4
Totals	88-107	107-152

~~This table is Secret.~~

5. The demonstrated pad turnaround time for the SS-6–based systems (SL-3, -4, and -6) is 24 hours. Propellants for the SS-6–based systems are loaded from railcars at the site into the launch vehicle on the pad. This may be a constraining factor on the number of surge launches of SS-6–based systems, as it takes about 17 propellant railcars to service a single SL-4 launch. The maximum number of assembled SS-6–based systems that can be housed within the assembly and checkout facilities at Tyuratam and Plesetsk is about 42. We are uncertain what the payload mix may be because payloads launched by the SS-6–based systems include ELINT 3, Molniya 1 and 3, HI-RES (high resolution) 2, MED-RES (medium), LDS, PHOTOGEO 2, Progress, Soyuz T, Meteor, and Meteor 2. Assuming adequate propellants and sufficient ground

Table IV-3
Soviet Quick-Launch Capabilities

Launch System	Number of Launch Pads	Estimated Pad Turnaround Time	Estimated Maximum Storage Capacity [a]	Estimated Maximum Initial Launch Rate [b] *(per day)*
SL-3, -4, -6	6	24 hours	42	6
SL-8	5	12 hours	43	10
SL-11	2	RORSAT/EORSAT: 4 to 5 hours	7	6 to 10
		ASAT: 2 to 3 hours	15	6 [c]
SL-12, -13	4	15 days	36 [d]	1 per day for 4 days
SL-14	2	4 to 5 hours	8	6 to 10 [e]

[a] These figures are the maximum storage capacity without providing room for handling and preparation of the launch vehicles.
[b] This column does not consider constraints on optimal launch times (for example, satellites can only be launched during certain time windows to perform their missions effectively). The major limiting factors are the availability of propellant and adequate crews for sustained operations. The sustained launch rate probably would be half of this maximum launch rate.
[c] Target dependent: maximum of two launch opportunities per day per target.
[d] 1985 capacity.
[e] Judgment uncertain. Little data.

~~This table is Secret~~

crews are available, we estimate that by using both ranges six vehicles could be launched on the first day. Propellant loading time and crew availability will probably drop the sustained rate to about three launches per day.

6. Minimum pad turnaround time for the SL-8 is assessed at 12 hours. Propellants for the SL-8 are loaded into the erected launch system from storage facilities at the launchpad. We believe the maximum surge capacity for the SL-8 at Kapustin Yar and Plesetsk is 10 launches per day. However, the payload mix is again uncertain because the SL-8 launches ELINT 2, NAVSAT, SPCS, and MPCS.

7. The EORSAT and RORSAT share the SL-11 launch facilities with the ASAT orbital interceptor. The minimum required on-pad time for the SL-11–launched EORSAT and RORSAT is not known [redacted] We believe this time could be reduced to four to five hours. The ASAT requires only two to three hours to launch [redacted] Currently, there are storage facilities for 22 SL-11 boosters and payloads. We believe that the majority of these boosters would be used for ASAT missions.

8. Facilities at Tyuratam for the SL-12/13 consist of four launchpads and by 1985 an estimated storage capacity for about 36 boosters. The SL-12/13 launch system has a demonstrated pad turnaround of 15 days. The SL-12/13 payloads include the Raduga, Gorizont, and Ekran geostationary comsats; the GLONASS navigation satellite; the Salyut space station; and the Cosmos 929–type spacecraft.

9. The SL-14 launch facilities at Plesetsk are similar to the SL-11 facilities at Tyuratam, but are not believed to be capable of launching EORSATS, RORSATS, or ASATs. Our SL-14 data base is not large, but with the launch facilities available at Plesetsk, including the in-pad erector, four and a half hours is probably a reasonable turnaround time. Third-generation ELINT satellites and scientific payloads are launched by the SL-14.

10. Satellites probably will be stored in orbit for use during a conflict. We have not identified any Soviet satellites currently being stored in orbit. [redacted] In a crisis situation, when hostilities are likely, the number of satellites in orbit probably would be increased and augmented.

over a long time in an attempt to establish spares without alerting the enemy.

Space System Defenses

12. We believe current and prospective US antisatellite capabilities including the air-launched miniature vehicle (ALMV), electronic warfare (EW) capabilities, and laser weapons will stimulate Soviet measures to increase satellite systems survivability. Various measures could be taken to enhance the survivability of Soviet space assets, including active means (for example, maneuvering to avoid interception) and passive means (for example, hardening to protect against nuclear or laser damage).

Space Warfare Capabilities

28. Current Soviet space warfare capabilities are limited to an ASAT orbital interceptor, ground-based test lasers with probable ASAT capabilities, and the technological capability to conduct electronic warfare against space systems. The ABM/Space Defense Forces—a component of Voyska PVO, the Soviet air defense organization—is responsible for antisatellite and antimissile forces. It controls the network of radars

for ballistic missile detection and satellite tracking, operates a large computer center, and controls all of the existing antisatellite and antimissile weapon systems. Table IV-6 describes the Soviet systems with the potential for destroying or otherwise intentionally interfering with US satellite systems.

29. Soviet capabilities to detect and track satellites include ballistic missile detection and tracking radars and ABM battle-management radars for low Earth orbit (up to 6,000 km), satellite, optical sensors (cameras, telescopes, and lasers) for high-altitude satellites, and SIGINT (ground based) for all altitude regions. Four dual Hen House radars are dedicated to space tracking functions. Soviet telescopes and cameras for satellite observations are located in many countries but have little capability against high-altitude targets. Fifteen new optical tracking facilities are being deployed that may have a capability to detect and track the ever-increasing number of high-altitude satellites. Also, a new generation of laser trackers is being deployed, but these are probably designed to work with cooperative Soviet satellites

Orbital Interceptor

30. The Soviet nonnuclear orbital interceptor has been operational since the early 1970s. Since 1968, 15 tests of the orbital interceptor have been conducted and nine were successful, the last success having occurred in March 1981. The most recent test in June 1982 was the first failure of the operational interceptor since 1977. During the period 1976-81, five tests of a developmental version of an ASAT interceptor were conducted incorporating a probable passive electro-optical sensor; all five were failures. We do not expect significant improvements in the reliability of either the operational or developmental ASAT orbital interceptors.

31. The Soviet ASAT system includes ground-based target tracking radars to establish a projected intercept point, two launchpads at the Tyuratam Missile Test Range, and a ground control facility near Moscow. These ground facilities are not hardened against nuclear strikes, suggesting that the system would most likely be used before a nuclear attack on the Soviet Union.

32. The ASAT orbital interceptor uses an onboard radar sensor during the terminal portion of the engagement [redacted] (See figure IV-2.) Both one- and two-revolution intercepts have been successfully demonstrated. The two-revolution intercept profile requires about 195 minutes to complete the engagement [redacted] The time required for an engagement using the one-revolution profile is about 95 minutes [redacted] The one-revolution profile reduces the amount of time available for the enemy to deduce that an attack is under way and to employ evasive maneuvers or other countermeasures to prevent satellite destruction. Because the Soviet interceptor itself is destroyed when the warhead is exploded to destroy the target, a separate inteceptor must be launched for each target satellite. Also, if the interceptor is unsuccessful in encountering the target, it cannot conduct a second attempt or pursue an alternative target.

33. We do not know the readiness state of ASAT orbital interceptors at Tyuratam. If orbital interceptors are brought up to a high level of readiness, an orbital interceptor probably could be moved from the support areas at Tyuratam to the pad in one hour and launched within another one to two hours. We believe three to five orbital ASAT interceptors could be launched from each of two pads at Tyuratam during the first 24 hours of ASAT operations. The ability to successfully employ these weapons is a function of target accessibility, launchpad refurbishment requirements, and competing requirements for EORSAT/RORSAT launch and other factors. It would also be a function of Tyuratam's survivability. The minimum time between launches from the same pad may be as little as four hours.

34. The orbital interceptor system presents a significant threat to [redacted] US intelligence and military support satellites in near Earth orbits. Although it has demonstrated satellite intercepts at altitudes up to 1,600 kilometers, its maximum altitude capability is considerably higher. (See figure IV-3.) [redacted]

Table IV-6
Current and Future Soviet Systems With Potential Antisatellite Capabilities

Systems
Nonnuclear orbital interceptor
Current system
Developmental system (modification of current system)
High-energy lasers [b]
Ground-based
Space-based
Direct-ascent ABM interceptors with nuclear warhead
ICBMs
Space launch vehicles
Electronic interference
Radiofrequency weapons (including electromagnetic pulse)
Particle beams

[redacted]

[redacted] We believe low-orbiting intelligence and navigation satellites are high-priority targets for the orbital interceptor. Geosynchronous satellites are too high, and satellites in highly elliptical semisynchronous orbits pass through the interceptor's engagement altitudes at velocities that are too high for the interceptor to engage successfully. [redacted]

[redacted]

35. We believe that a new version of an ASAT orbital interceptor will not be developed to attack satellites in semisynchronous or geosynchronous orbit. Even though such a requirement has existed for a long time, we have no evidence of a program to develop a high-altitude ASAT orbital interceptor. The new sensors being tested on the developmental version of the orbital interceptor have a short acquisition range (under 30 kilometers) and would be unlikely to be used to attack geosynchronous targets. Further, it does not appear that a large launch vehicle with a quick reaction capability like the SL-11s under development. Even if one were, the time to reach geosynchronous orbit (six to seven hours) seems excessive for use of a coorbital interceptor. Finally, we believe that emerging technologies, specifically directed energy, offer better prospects for solving the problem of attacking high-altitude targets.

Direct-Ascent ABM-Type Interceptor

36. We believe the probability is low that the USSR will expend Galosh ABM interceptors in an ASAT mission. However, certain tests of the Galosh ABM suggest that this role may have been considered. The first of four tests occurred in 1970 and the most recent occurred in July 1978. All of these tests reached final, free-flight altitudes of about 900 km

Satellites at altitudes up to about 1,000 km could be attacked by a nuclear-armed Galosh. However, the use of a Galosh interceptor with a nuclear warhead would probably result in serious disruptions to Soviet satellites. If the Galosh were fitted with a nonnuclear warhead for the ASAT mission, greater accuracy would be required for a closer approach and the maximum attack altitude would be reduced to about 500 km, unless a homing system were developed.

Space Launch Vehicles and ICBMs

37. Soviet space boosters with nuclear warheads could be modified to perform a direct-ascent ASAT

intercept. However, we have no evidence of a Soviet program to develop such capabilities and believe the likelihood of such developments is low. Two space boosters, the SL-6 and the SL-12 could be modified for direct-ascent, high-altitude ASAT attack, but relatively low launch rates make them unlikely candidates.

38. We believe ICBMs are unlikely to be used in an ASAT role, although ICBMs are available in larger numbers and can reach higher altitudes than ABMs. Also, ICBMs are protected by hardened silos and control facilities. We believe the Soviets are unlikely to risk collateral damage to their own satellites by using ICBMs with nuclear warheads, and they would be wary of the risks and uncertainties about US responses if a conflict were otherwise still at the conventional force level. We do note, however, the Soviets' potential advantage in reconstituting their space systems if their launchpads remain intact.

39. Current ICBMs probably would require some modifications and a short period of testing to be ASAT capable. The SS-18 is the most capable ICBM, but, with its standard payload of about 6,000 kg, could only achieve a maximum altitude of about 9,000 km in a direct-ascent flight profile. If the total payload were reduced to as little as 100 pounds, its maximum altitude could be 18,000 km—still well short of geosynchronous satellites. To achieve geosynchronous altitudes, a third stage similar to the type used on the SL-14 would be required. In this configuration, it could deliver a payload of up to 1,800 kg to geosynchronous orbit. But such modifications would require flight-testing, and we would expect to observe testing of a new upper stage. We have seen no evidence of such a development or testing program and believe the likelihood of such a development is low. Furthermore, an SS-18 modified in this way would not fit into existing silos and there are currently no other launchpads configured to handle the SS-18.

40. Any use of nuclear warheads in space eventually would result in widespread collateral damage to all satellites, including those of the USSR. In addition to the prompt damage to any satellite within range of the detonation, there is long-term persistant damage from high-energy electrons created by the blast. These electrons are trapped in the Earth's magnetic field and are dispersed into shells that encompass the Earth. [redacted]

Electronic Warfare

41. [redacted] we believe the Soviets intend to use active EW to attack both selected satellites directly and the ground-based users of space systems. We consider EW to be the most likely type of initial Soviet ASAT activity. Such a capability potentially poses the most serious threat to US space systems. Against high-altitude satellites, this currently may be the only ASAT capability. We believe that the USSR now has the technological capability using active EW to attempt to interfere with foreign space systems. Compared with other ASAT techniques, an active ASAT EW program would have relatively low cost and low risk of escalating a conflict. Further, such a role is consistent with ambitious EW programs existing throughout the Soviet military forces. However, we have no evidence of Soviet equipment or organizations with an ASAT EW mission.

42. An alternative view is that there is insufficient evidence at this time to support the judgment of Soviet intent to use active EW against satellites. [redacted] Moreover, the holder of this view concludes that, if a

Soviet active EW capability against satellites does exist, brute force jamming would be the most likely EW technique. On the basis of available evidence, it is difficult to judge with any confidence that a Soviet technological capability would include more complex forms of jamming.*

43.

While testing directly against US space systems would give the Soviets some increased confidence in the effectiveness of their ASAT EW capabilities, such testing would provide opportunities to develop more effective US countermeasures. There is a moderate probability that in peacetime the USSR will attempt occasional covert technical probes of some US space systems in an attempt to determine weaknesses.

44. Active EW could involve either denial jamming or deception to prevent satellite systems from carrying out their missions. Intentional interference may involve command and control links, communications links, or mission sensors.

47.

We see no evidence of Soviet efforts to develop a spaceborne jammer and believe there is only a low likelihood of such a capability being tested by the year 2000.

* *The holder of this view is the Director, National Security Agency.*

48. Potential Soviet active EW platforms include many fixed, transportable, and mobile transmitters. The fixed ground sites have the advantage of high-power transmission and accurate pointing and tracking capabilities, whereas mobile platforms, such as tactical EW equipment, space support ships, and aircraft are more widely deployable, but generally radiate less power and have less accurate pointing capabilities.

49. Fixed ground sites and large ships offer the most severe jamming threat because of their large, steerable antennas (generally 12 or 25 meters in diameter, but up to at least 50 meters for some ground-based sites), extensive on-site processing, and cooling capabilities necessary for high-power transmitters. These sites and ships would be capable of accurate tracking of target satellites and, assuming a configuration for jamming, could project high-power levels.

50. About 13 to 15 Soviet ground sites in the Soviet Union and one in Cuba have been associated with a SIGINT collection mission against foreign communications satellites. [ ]

51. There are many other sites in the Soviet Union, including about 60 antennas associated with the Molniya communications satellite network, that could be used for SIGINT collection or active electronic warfare activities. In addition, Soviet missile range instrumentation ships, space event support ships, space operation control ships, and intelligence collection ships operated by the GRU also could be used to conduct active EW against US space systems. Finally, there are some land-based mobile or transportable systems that could be adapted for jamming uplinks. Transportable communication satellite terminals and mobile military terminals have been used in Cuba, Africa, and Asia, as well as in the Warsaw Pact countries.

Radiofrequency Damage

52. Soviet research has been conducted in the use of strong radiofrequency (RF) signals that could produce physical damage or "burnout" to the sensitive input stages of receivers or internal electronic circuits. The effectiveness of any RF ASAT weapon would be dependent on the radiated power of the weapon, the damage threshold level of the target, and detailed technical knowledge of the target. It is expected that if the Soviets were to deploy an RF ASAT weapon it would be ground-based and in times of conflict would be directed against high-priority targets such as those in geosynchronous orbit. Such a weapon would require a high effective radiated power, and the damage it caused would be more permanent than conventional electronic warfare techniques. By 1990, there is a moderate likelihood the USSR will test a ground-based RF ASAT weapon capable of physically damaging satellites. We believe it is highly unlikely that a space-based RF-damage ASAT weapon will be tested before the year 2000.

53. [ ] we believe the basic technology for an RF weapon already is available [ ] It is noteworthy that Soviet scientists pioneered the development of power-tube technology, and there is continued interest in high-power electronics that could be applied to RF weapons. One project was begun in 1973 at a Moscow institute responsible for developing long-range radars. This project included investigation of the feasibility of destroying targets in space by ground-based microwave transmitters.

Lasers

54. Extensive resources have been committed to develop high-energy laser weapons. More than 100 academic and industrial organizations, including several central design bureaus, are involved, and at least a dozen laser test facilities and ranges have been located.

55. *Ground-Based Lasers.* There are two test facilities at Saryshagan that are assessed to have high-energy lasers and associated optical equipment with the potential to function as ground-based ASAT weapons. We estimate that one of these facilities, Complex D, could demonstrate the capability to damage or degrade an unprotected satellite overhead, in clear weather, to a range of about 500 kilometers. The other

facility, termed the R&D Complex, probably houses a high-energy pulsed laser that may be able to damage unprotected satellites at ranges up to 3,000 kilometers and electro-optical sensors at geosynchronous altitudes.

56. The configuration of the R&D Complex and its location at Saryshagan suggest a ballistic missile defense (BMD) or ASAT mission. An exclusive ASAT mission makes it difficult to account for all the features of the R&D Complex. Testing at one facility of the complex appears to involve either explosively driven high-energy lasers or possibly development of explosively driven power generators for laser weapons, or both.

57. We believe that the primary purpose of the explosively driven ground-based laser development program at the R&D Complex is BMD. In addition, Project "Terra," reportedly the development of a laser for ABM purposes using an explosively driven iodine laser, has been associated with the R&D Complex. Significant work related to Terra-type lasers has been conducted since the middle-to-late 1960s. The Soviet goal of 1-megajoule energy for a single pulse would probably be sufficient for initial feasibility tests against reentry vehicles (RVs). As of 1978, power levels of 100 kilojoules had reportedly been achieved.

59. *Airborne Lasers*. Soviet research on an airborne laser weapon was well under way in the mid-1970s. Such weapons could be used to damage satellites; however, they would more likely be used for other purposes, including protecting their own airborne command and control systems and defending against cruise missiles. Airborne laser weapons are not as adversely affected by clouds and the atmosphere as are ground-based systems. However, airborne lasers suffer from aircraft vibrations and atmospheric turbulence, which affect the propagation of a precisely pointed laser beam. These factors, even if successfully overcome, and other problems would probably limit the capability of early airborne lasers to damage satellites to those in orbits below about 1,000 km.

60. *Spaceborne Lasers*. In addition to the ground-based and airborne laser programs, Soviet research includes a project to develop laser weapons intended for use in space, probably for an ASAT application initially. If successfully developed, these laser weapons could involve either satellites launched on demand or space-based weapons maintained in orbit. This work is probably in the first of three distinct stages that the Soviets use in the development of a weapon system. During this stage, new concepts are investigated, experimental devices for testing the technology are built, and preliminary system designs may be developed. Whether the Soviets make a commitment to an operational system will depend on the outcome of their research, possibly on their reaction to US efforts in space-based laser weapons, and on any arms control agreements that they may enter into on the limitations of weapons in space. Figure IV-4 depicts one of many concepts for a space-based laser that US contractors have developed.

61. To date, the most detailed information on space-based lasers concerns a joint project in 1975-77 involving a Soviet physics institute and a space research institute. Open-source publications by individuals reported to be in the project are consistent with the project's existence and provide a guide to the project's organization. We know of a Soviet electric-discharge laser that matches the description of the laser reportedly being investigated in the joint project. However, the Soviets also have been researching chemical lasers, and we believe that such a laser device is now being developed for space-based applications.

62. A space-based, high-energy laser weapon offers options not available with ground- or air-based systems. Space-based laser weapons might be employed for a variety of missions including ASAT, BMD, antiaircraft, and ground target engagements. Such an

facility, termed the R&D Complex, probably houses a high-energy pulsed laser that may be able to damage unprotected satellites at ranges up to 3,000 kilometers and electro-optical sensors at geosynchronous altitudes.

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58. In addition to these test lasers described, existing Soviet low-powered, ground-based lasers are potentially capable of causing in-band interference with or damage to satellite components. IR and optical surveillance systems are particularly vulnerable because they have large optical aperture systems that collect and focus energy. Because of this, low-power lasers could be suitable against satellites having electro-optical sensors or could degrade film quality on imaging satellites. Such lasers could also be used against high-altitude satellites.

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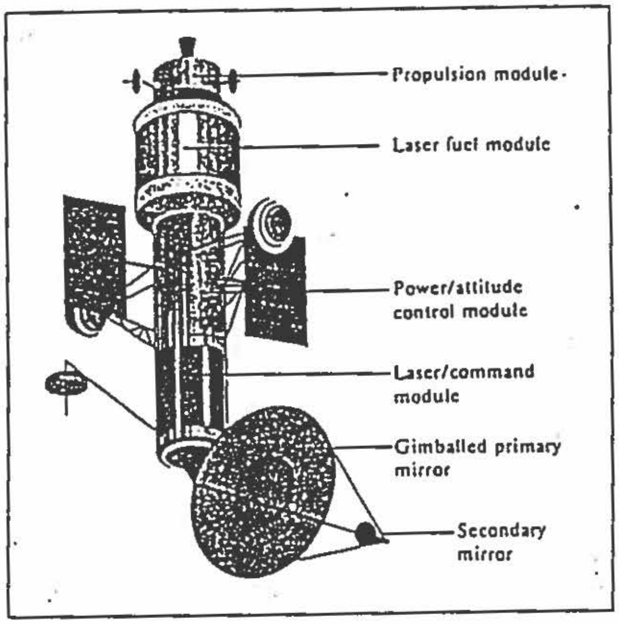
Figure IV-4
Concept of Space-Based Laser Weapon System



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ASAT system would have significant advantages over the conventional orbital ASAT interceptor in that it would have multishot and long-range capabilities (for example, 1,000 to 2,000 kilometers between weapon and target). It would also be likely to have a greater capacity to overcome a satellite's defensive measures, such as maneuvering and decoy deployment. We expect to see laser weapon components tested on manned spacecraft; however, unmanned satellites seem better suited as platforms for operational directed-energy weapons.

63. We believe there is a high probability that a prototype high-energy laser ASAT weapon will be tested in low orbit by the early 1990s. The psychological effect of the first test of a space-based laser in a weapon-related mode would be greater than the actual military significance of such a weapon in its initial application. Development of a space-based laser for antisatellite application is technologically difficult, and we are uncertain as to the approach the Soviets would take:

— One candidate for a prototype [redacted] would be a megawatt-class laser. Such a prototype probably could begin testing in the late 1980s at the earliest, but more likely in the early 1990s. If testing were successful, an initial operational system in low orbit—a few satellites, each having a megawatt-class laser weapon with an ASAT range of hundreds of kilometers—could be available by the early 1990s (if tested in the late 1980s), but such an operational system would be more likely to appear in the mid-1990s. The Soviets could elect to pursue a higher power 5-megawatt-class system (with an engagement range out to 1,000 kilometers) employing more precise pointing and tracking. Test launch and operational dates, however, would come several years later than for a system of the 1-megawatt class.

— A candidate for a space-based prototype, [redacted] is a lower power laser (hundreds of kilowatts) in an unmanned, low-orbit satellite, with an ASAT range of tens of kilometers. This concept represents an easier technological path for testing a prototype laser weapon in space. We believe, if the Soviets are pursuing such a program, a prototype could be tested somewhat earlier than a megawatt-class prototype, and, if early tests proved successful, possibly reach an operational capability by the early 1990s. An operational system with such a short-range capability, however, would have severe operational limitations.

64. There is a moderate-to-high likelihood that the development of low-orbit, space-based lasers coupled with a heavy-lift launch capability will result in testing of such weapons in geosynchronous orbit by the late 1990s, although we ascribe a low probability to operational deployment by the year 2000. There is an alternative view that holds that while deployment of a geosynchronous space-based laser would probably take place after deployment of a low-altitude system, there is a moderate chance of deployment of a geosynchro-

nous space-based laser by the mid-1990s.[11] Although space-based lasers will probably be restricted to the ASAT mission for the remainder of this century, technological breakthroughs conceivably could lead to capabilities to destroy ballistic missiles, aircraft, cruise missiles, and ground targets from space in the late 1990s or beyond.

65. Although space-based weapons for ballistic missile defense are probably feasible from a technical standpoint, such weapons require significant technological advances in large-aperture mirrors and in pointing and tracking accuracies. They would also require very large space boosters having perhaps 10 times the capacity of those now in use. We expect the Soviets to have such boosters in the late 1980s. In view of the technological requirements, we do not expect them to have a prototype space-based laser BMD system until at least the mid-1990s or an operational system until after the year 2000.

66. A Soviet space-based laser BMD weapon system based on these technologies would require many laser weapon satellites to be a significant threat to US ballistic missiles. The number of satellites required would depend on numerous factors. On the basis of our estimates of expected Soviet technology levels, with one laser per satellite almost 400 satellites operating at about a 400-km altitude would be required for continuous coverage of all possible US ICBM and SLBM missiles in the boost phase, before their RVs are dispersed. Once the RVs have been dispersed, the space-based laser defense task becomes much more difficult. If major Soviet technological advances in power and pointing/tracking accuracy were achieved—not expected until after the year 2000—the number of satellite weapons needed would decrease to about 100 because the system could operate at higher altitudes, increasing the coverage of a single weapon. Given the short period during which ballistic missiles are vulnerable to laser radiation, each laser would be able to negate only a few missiles. Moreover, these estimates do not include the effects of potential countermeasures that the United States could employ against low-orbiting weapon systems. Finally, each satellite would have to be an autonomous, extremely sophisticated system posing tremendous logistic, reliability, command and control communications, and cost problems for the Soviets.

Space-Based Particle Beam Weapons

67. The Soviets are expending significant resources on technologies of critical importance to the development of particle beam weapons (PBWs). We have little evidence, however, of Soviet achievement in this area. Soviet efforts in PBW-related technology may have reached a level suitable for conducting experimental research on the feasibility of weapon applications.

68. Space-based PBWs would not be subject to atmospheric propagation effects, which represent a fundamental feasibility issue for ground-based PBWs. It is more difficult to harden satellites against the effects of a particle beam than those of a high-energy laser. On the other hand, PBW beams, unlike laser beams, will not propagate into the atmosphere and thus cannot reach some lower altitude ballistic missiles. The power supplies and size of experimental PBW systems suggest that it will be difficult to develop an operationally practical space-based PBW. A PBW will be more difficult to achieve than a laser weapon.

69. Since the early 1970s the Soviets have had a research program to explore the technical feasibility of a neutral particle beam weapon in space, an approach currently under investigation in the United States. In this effort, the Soviets have developed technically advanced components but have not assembled them into a complete test system. These weapons would be quite different from the ground-based PBWs; the particle energy and current requirements would be much lower and the systems requirements would be far less stressing. However, the technical requirements for such a system, including precise pointing and tracking, are severe, and it is unlikely that the Soviets could test a prototype space-based particle beam weapon to destroy hard targets like missile RVs before the end of the century and no earlier than 1995 for an ASAT weapon. An alternative view holds that a space-based PBW system, intended to disrupt electronics systems and requiring significantly less power than a destructive PBW, could be developed and deployed several years earlier.[12]

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[11] *The holders of this view are the Director, Defense Intelligence Agency, and the Assistant Chief of Staff, Intelligence, Department of the Air Force.*

[12] *The holder of this view is the Director, Defense Intelligence Agency.*

Ground Site Attack

70. In addition to attacking or interfering directly with satellites, the ground stations supporting the satellites could be attacked, thereby disabling or disrupting the operation of our space systems. This could be done covertly by agents—possibly without attribution. In addition, direct attacks by Soviet military forces are a possibility, although there is no evidence of such missions. The approaches taken could range from covert jamming of signals and cutting of electrical power to physical destruction of the facility. Such activities would be more likely to occur at US sites in foreign countries.

Other Space-Based Weapons

71. In addition to the space warfare systems already discussed, there are several other potential weapons systems that deserve continued close attention by the Intelligence Community. These systems are space mines, space-delivered ground-impact weapons, and space-to-space offensive missiles. The use of space mines has caused concern for years because they could be applied in time of war with little or no warning. However, the likelihood of the Soviets being able to covertly deploy and operationally maintain a space mine in orbit is low at this time, and we believe the likelihood of the Soviets' testing such a capability by the year 2000 is very low. Satellites could also be used for the delivery of ground-impact weapons from altitudes of tens of thousands of kilometers. Prior to reentry, the descending vehicles would deploy clusters of small inert reentry vehicles to kill fixed targets by hitting them at velocities up to 8,000 meters per second. We believe the likelihood of such a development is low. The use of space-launched offensive missiles against other space vehicles would be similar to an orbital interceptor stored in space. Such a system would be difficult to maintain at operational readiness for long periods of time and would have a very limited number of targets it could attack at any time. We thus believe the likelihood of such a development is low.

Likelihood of Interference With US Space Systems

72. There is no direct evidence to indicate the circumstances under which the Soviets would initiate interference with US space systems during crisis and conflict situations. However, the Soviets appear to be integrating ASAT operations with military operations.

73. The Soviets presumably would base a decision to employ destructive or nondestructive interference against US space systems on a variety of factors including their perception of the military value of the various US systems, US ASAT and EW capabilities, their own perceived antisatellite capabilities, and ultimately their view of the potential net military advantages. Especially in the context of a war in Europe, Soviet leaders may perceive that US military capabilities depend on space systems to a greater degree than those of the USSR. In addition, the chances of conflict escalation, the impact of such a decision on other countries, and likely US responses also would be considered. We do not believe that any ASAT activities would be undertaken merely for warning or demonstration purposes.

74. Given these considerations, we believe that there is a very low likelihood that the Soviets would initiate destructive or nondestructive interference against US space systems in times of tension of an exclusively political nature, as well as in cases of limited, local conflict not involving the two powers directly.

75. During a major crisis involving the two superpowers, in which the tension was high, the likelihood of attempted destructive interference would remain very low, but the likelihood of attempted nondestructive interference would be low to moderate, as the Soviets could perceive nondestructive interference as a somewhat less risky option.

76. Should either superpower introduce combat forces into a local conflict in which the other was not involved, we believe that the likelihood of attempted destructive interference by the Soviets would continue to be very low. Should both US and Soviet forces intervene in a local conflict, with both sides playing

limited or specialized roles, such as air defense, and having limited objectives, the likelihood of attempted destructive interference would rise marginally, but still remain low.

77. In the event of imminent or actual large-scale, direct engagement of US and Soviet forces in a local conflict located outside Europe, we believe there would be a high likelihood of attempted Soviet interference with US space systems. The Soviets would have strong, immediate incentives to enhance the operational effectiveness of their forces by degrading US reconnaissance and command and control capabilities in the theater of conflict. Should the Soviets decide to interfere with such US space systems, we believe that in most cases active EW and low-energy lasers would be used initially because their effects are not necessarily permanent and their use is not as easy to detect. Active EW and low-energy lasers would probably be the only means used at lower levels of conflict. Interference with US space systems at this point would probably not be viewed as adding appreciably to the risk of widening the conflict (to Europe, for example), whereas interference and potential degradation of some US space system capabilities at this point could markedly enhance the Soviet ability to succeed as well as to seize operational initiatives in the event of a wider war. Although initially the Soviets would be concerned not to provoke unwanted US escalation or add to the strength of US counteractions in the longer run, these concerns would tend to lessen if they interfered with the pursuit of their political-military objectives.

78. We believe there is a high likelihood that, during a NATO–Warsaw Pact conventional conflict, the Soviets would attempt to interfere with selected US space systems that provide important wartime support, using both destructive and nondestructive means. In such a conflict Soviet leaders may perceive an operational advantage if both sides experience significant satellite losses because of greater US dependence on space systems. In addition, Soviet satellites can be more quickly replaced if space launch facilities remain intact. The decision to launch ASAT interceptors against such systems during the early part of a conventional phase of such a conflict would be affected by Soviet uncertainties with regard to US responses, including the likelihood of attacks against existing Soviet space launch sites.

79. During a period of conventional combat, the Soviets would probably avoid interfering with space systems that provide warning of ballistic missile launch or specifically support US strategic nuclear forces, unless the use of strategic nuclear weapons appeared imminent. The Soviets might attempt subtle, nondestructive interference with such satellites during a conventional conflict, in an attempt to erode US confidence in these systems, although in doing so the Soviets would run some risk of provoking a disadvantageous US reaction. This type of interference, if detected, might be difficult to attribute initially to deliberate Soviet actions. We cannot judge the likelihood of this occurrence because we cannot evaluate how the Soviets would perceive the risk that this would trigger undesirable US responses.

80. If a general war were under way in which the massive use of nuclear weapons appeared imminent, the likelihood of attempted interference with all US space systems is very high, using all available means. The fact that Soviet ASAT control and launch facilities are not hardened against nuclear attack probably indicates the Soviets plan to launch orbital ASATs prior to and at the onset of their initial nuclear strikes.

CHAPTER V

SOVIET MANNED SPACE ACTIVITIES

Current and Developmental Projects

1. The size, scope, and integrated nature of Soviet manned space activities is impressive. We believe that within 10 years the Soviets will have established a permanent manned presence in space with substantial political, technological, and possibly economic benefits. The comprehensive Soviet program will probably consist of several interrelated components including:

— A modular space station for a crew of six to 12 persons.

— A reusable space transport similar to the US space shuttle.

— A heavy-lift launch vehicle (HLLV) in the Saturn-V class.

— A reusable space tug.

— A military space plane.

— A medium-lift launch vehicle in the Titan-III class.

Inherent in these projects is a design philosophy that emphasizes flexibility. For example, the HLLV will serve as the launch system for the Soviet reusable space transport, and parts of the medium-lift launch vehicle may serve as components of the HLLV.

2. To a large extent, the Soviet manned space program reflects US concepts and designs, strongly suggesting the illegal transfer of US technology. For example, prototypes of the Soviet space plane closely resemble US lifting-body research vehicles flown in the late 1960s. Even more apparent is the Soviet reusable space transport that appears nearly identical to the US space shuttle. Furthermore, the engines that will propel the Soviet HLLV are probably copies of the liquid hydrogen rocket engines on the US shuttle. By capitalizing on US designs and technology, the USSR has developed a comprehensive, well-coordinated, and flexible space program that emphasizes the utilization of man in space.

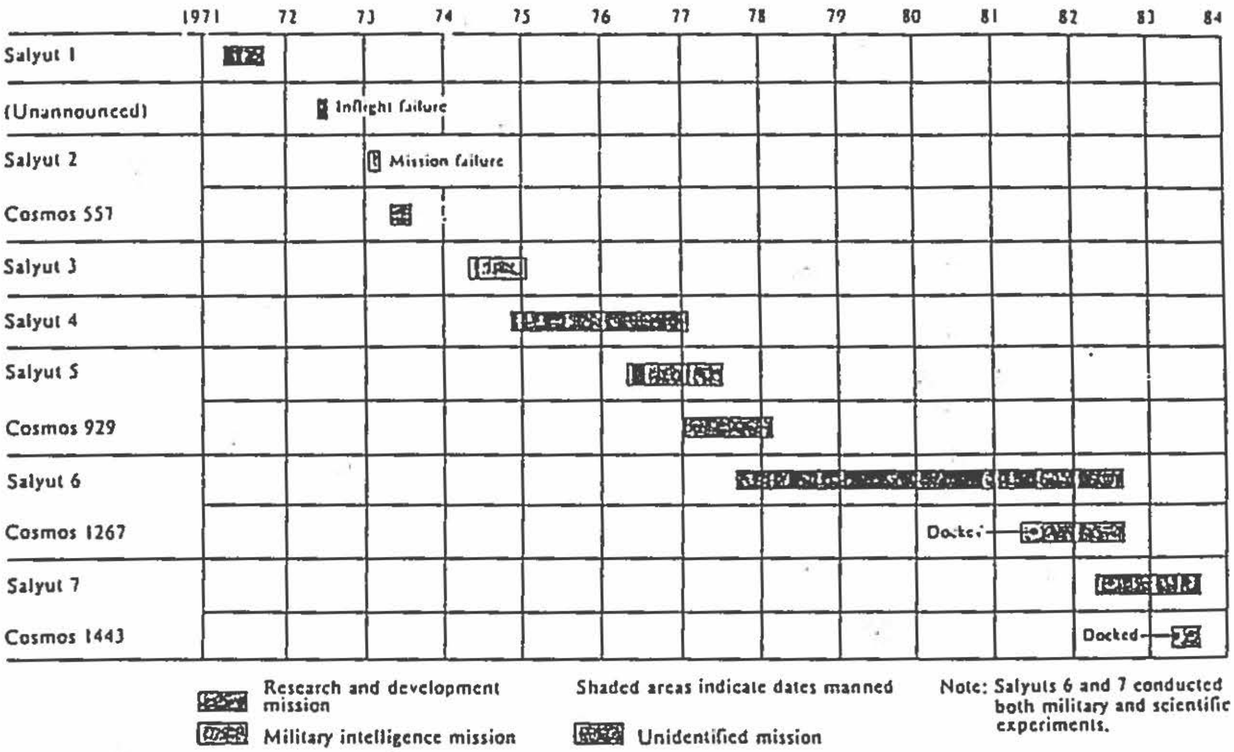
3. Soviet cosmonauts were the first to perform an extra vehicular activity (EVA) using a rudimentary space suit in March 1965. Subsequently, Soviet space suits were based on the US Apollo space suit, with modifications to reduce the preparation time required for the cosmonauts (prebreathing) before working in space. Current Soviet space suits require only about 25 minutes of prebreathing, as compared with about three and a half hours for current US space suits. We believe the Soviets also may adopt the manned maneuvering unit (MMU) first demonstrated on the US Skylab space station in 1973. A Soviet cosmonaut could use an MMU to retrieve small satellites, inspect and repair satellites, and conduct construction operations.

Salyut Space Stations

4. Senior Soviet officials and scientists have repeatedly stated a national goal of having permanently functioning, continuously manned, orbiting space stations. Since 1971, there has been a near-continuous presence of Soviet space stations in orbit, periodically occupied by Soviet cosmonauts. (See figure V-1.) Salyuts 2, 3, and 5 were primarily military in nature and functioned as intelligence collection platforms, although the Soviets stated their purpose as "scientific research." Salyuts 1 and 4 served primarily scientific purposes, and Salyuts 6 and 7 conducted both military and scientific experiments.

5. The Salyut systems have brought the USSR worldwide recognition as the leader in manned space flight. Crews aboard Salyut 6 logged more man-days—1,534—than have been logged in the entire US space program. One cosmonaut established a new endurance record in 1979 of 175 days in space and then broke his own record in 1980 with a 184-day flight. In 1982, the

Figure V-1
Soviet Space Station Systems



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first crew to visit Salyut 7 stayed for 211 days, breaking both previous records.

6. Salyut 6 remained in orbit for almost five years and was manned for approximately 38 percent of the time. Unlike previous space stations, Salyut 6 was equipped with a second docking port to accommodate a new vehicle, Progress, a nonrecoverable resupply spacecraft. This spacecraft was used to replenish all consumables (oxygen, food, and fuel) and to deliver replacement parts and scientific equipment. The capability to resupply consumables was necessary for the long-term missions. In addition, the cosmonauts' ability to do extensive repair work was essential to achieving such long-duration missions.

7. [redacted] military-related experiments have been an important part of Soviet manned space flights. These experiments have been more numerous and

complex on Salyut 7, the most recent Soviet space station. [redacted]

[redacted]

Cosmos 929–Type Manned Spacecraft

8. In 1977 the Soviets conducted the first flight test of a new type of spacecraft, the Cosmos 929. The missions of this spacecraft are uncertain. However, we believe they may include resupply of space stations, temporary space station modules, and independent military missions such as reconnaissance, weapons development, and satellite inspection. The Cosmos 929 spacecraft was never manned

Cosmos 929

was approximately 30 percent smaller than the Salyut vehicles and had a unique two-segment configuration consisting of a large maneuverable segment (12,500 kilograms) and a smaller but very heavy recoverable, highly dense segment (6,500 kg). The latter segment was separated from the main body after 30 days in orbit and was successfully recovered in the Soviet Union. The main body continued in orbit another 170 days performing numerous orbital maneuvers. We believe the purpose for the dense, recoverable segment is to serve as an emergency recovery system for cosmonauts and to protect them from solar radiation. In addition, we believe cosmonauts could be launched in a spacecraft similar to the Cosmos 929 with the recoverable segment serving as a launch-abort system.

9. In April 1981 the Soviets conducted the second test of a Cosmos 929-type vehicle. This vehicle—Cosmos 1267—also deorbited its recoverable segment after 30 days in orbit. In June 1981 Cosmos 1267 was maneuvered and docked with Salyut 6. Both vehicles remained unmanned, and in July 1982 they were intentionally deorbited over the Pacific Ocean. Soviet comments regarding Cosmos 1267 indicate that the purpose of the joint flight with Salyut 6 was to conduct engineering tests of two large vehicles docked together—a clear step toward building a modular station. In March 1983 another Cosmos 929-type vehicle (Cosmos 1443), was launched and docked with Salyut 7.

10. Soviet statements suggest that versions of the Cosmos 929-type vehicle under development will have different missions, including serving as replaceable units for a modular space station and as a new class of cargo/resupply vehicle. The Soviets have often discussed the necessity of having a cargo/resupply vehicle that could return space-processed or space-manufactured materials to Earth. This procedure is unlike that of Progress, which is destroyed after it resupplies Salyut. There are many factors that lead us to conclude that there may be other purposes for the Cosmos 929-type vehicle. These factors include the following:

- Secrecy. Prior to the flight of Cosmos 1443, knowledge of the Cosmos 929-type vehicle was apparently restricted among Soviet space officials. Further, at international conferences most Soviets refuse to discuss the purpose of this type of vehicle, but some have referred to it as a "modular spacecraft" and a "multipurpose spacecraft."

- Military Association. [redacted]

- Spacecraft Capabilities. The Cosmos 929-type vehicles have demonstrated some unusual capabilities:

[redacted]

  - A large solar-powered electrical system capable of supplying about 3.5 kilowatts (kw) from two fixed panels.
  - A propulsion system capable of performing a large number of orbital maneuvers.

11. Considering the above characteristics and other factors, we postulate several other military uses for Cosmos 929-type spacecraft in addition to resupply:

- Ocean Surveillance Platform. The station could be used as a platform for conducting visual and photographic reconnaissance of ports and naval units at sea. The crew could relay information to the General Staff or directly to naval commanders. [redacted]

- Near-Real-Time Electro-Optical Imaging System. [redacted]

[redacted] In such a case, cosmonauts may not continuously man the vehicle, but visit periodically to conduct setup, maintenance, and repair operations. The heavy recoverable segment could be used to recover a considerable number of the electronic subsystems for reuse on another mission.

- Space Weapons Component Research and Development. A space-based laser is under development [redacted] Weapons components and prototype subsystems could undergo testing on a Cosmos 929-type vehicle either in a manned or unmanned configuration.
- Satellite Inspection/Imaging System. A Soviet capability to image or inspect another satellite has not yet been demonstrated. But the growing technological capability to conceal satellites or disguise their true mission may encourage the development of such a capability.

12. Although these missions seem reasonable in view of current information, there may well be other possibilities. At this point, we can only conclude that the Cosmos 929 program is an important military system and its development must be monitored closely.

Future Projects

13. Soviet leaders perceive that their future manned space program will satisfy a number of political, military, economic, and scientific goals. The Soviet space program generates enthusiasm in the socialist countries and projects the Soviet image of world leadership in space. The program is based on reusable and common components that offer substantial flexibility and cost savings. This is consistent with Soviet design practices that stress innovation through modification, avoiding completely novel concepts whenever possible.

Modular Space Station

14. The next major objective in the Soviet manned space program is a modular space station, which will be a transitional element in the development of a larger space station. A Salyut-type space station and modules similar to the Cosmos 929-type spacecraft are expected to be assembled into components of a modular space complex by about 1986. Statements by Soviet scientists and cosmonauts suggest:

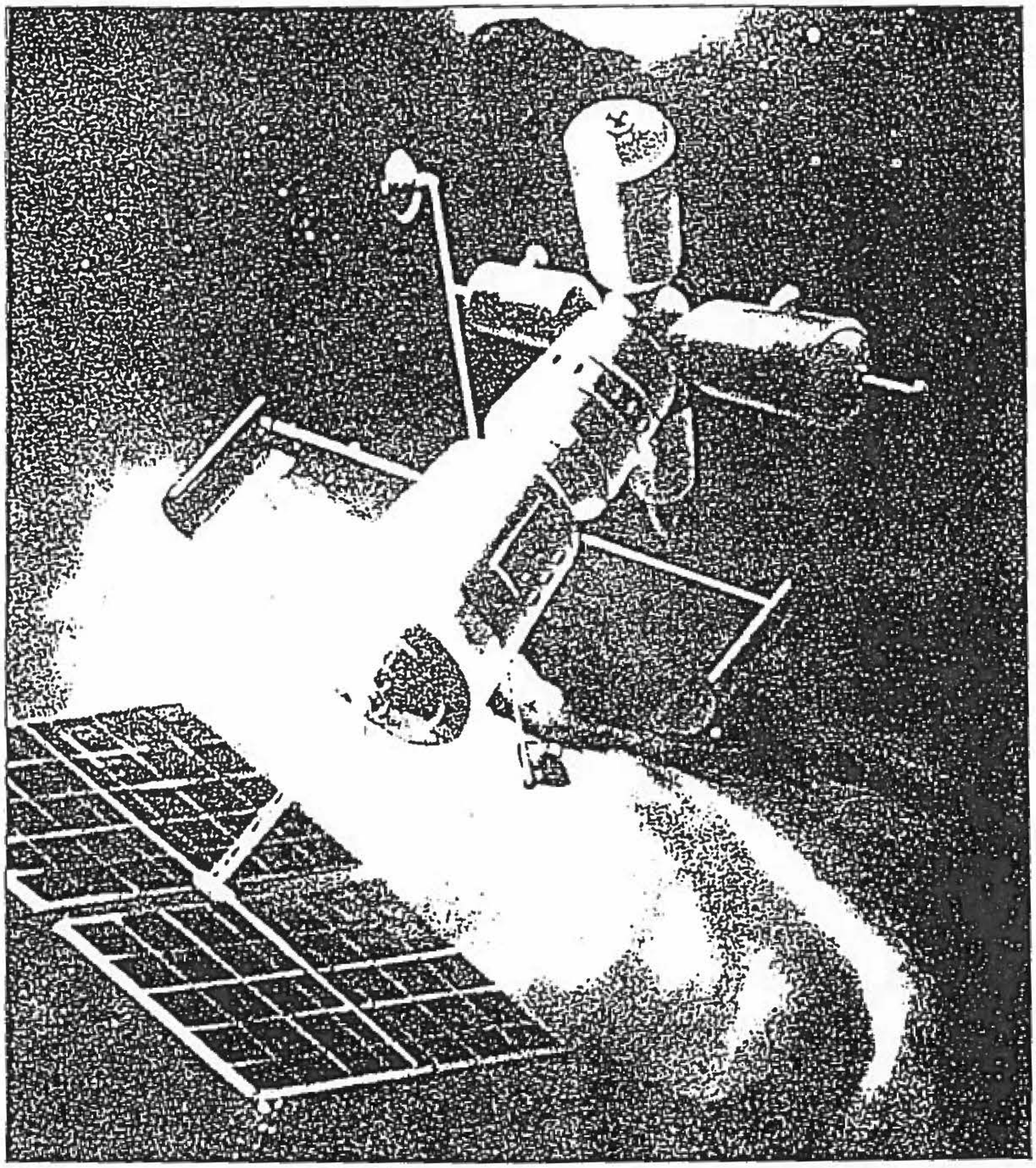
- Construction will start in 1984, with Salyut 8 as a primary component.
- No more than two Salyuts will be attached end to end.
- A "cactus"-type arrangement may be used—this could imply Cosmos 929 modules attached to midsection multiple docking adapters to form limbs. (See figure V-2.)
- A crew of six to 12 persons will occupy the completed station.

15. A modular space complex could be used for a variety of missions. For example, one module could provide the living area (eating, sleeping, and recreation), another module could contain support systems (electrical power, attitude control, and propulsion), while still other modules could be dedicated to Earth resources and reconnaissance, to materials processing, or to experimental development of new sensors and other hardware for unmanned military satellites. These last-mentioned modules could include provisions for testing of components for space-based laser weapons such as pointing and tracking subsystems.

New Resupply Vehicle

16. The Progress resupply vehicle began service in January 1978 and is the current spacecraft dedicated to resupply of Soviet space stations. The payload capability of Progress is approximately 2,300 kg, of which approximately 1,000 kg are fuel and approximately 1,300 kg are for life support, supplies, and spare parts, including about 120 man-days of expendables. With the advent of modular space stations, we expect a second-generation supply vehicle will be developed with a much greater payload capability. A

Figure V-2
Soviet Concept for Modular Space Station



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vehicle of the Cosmos 929 type is a likely candidate in that it has been described as a multipurpose vehicle. Soviet space academician Sagdeev described Cosmos 929 as a "prototype of a second-generation cargo ship." As such, we believe it would carry a payload of about 9,000 kg, almost four times that of the current Progress. In addition, the vehicle would have a recoverable front end for the return of cosmonauts or experimental and operational data. When the spacecraft has been emptied of its cargo, it could serve as a living/lounge area for cosmonauts on the modular space station. Spacecraft designer Feoktistov has also mentioned the need for something beyond Progress in his description of a Cosmos 929–type spacecraft that was docked with Salyut 6 for more than a year. Feoktistov stated that one of the functions of the multipurpose spacecraft would be that of a cargo carrier. We believe a version of the Cosmos 929–type spacecraft will become the primary Soviet space station resupply vehicle within the next five years.

Large Space Station

17. In the early-to-middle 1990s the Soviets' experience with their modular space station probably will be ;ufficient to begin the construction of a large space ;tation. The components of such a station would be nodules, each in the Skylab class, that would be aunched by the heavy-lift launch vehicle. We expect he assembly of such a station to take place over everal years with initial crew sizes ranging from 12 to .0 persons. (Some Soviet scientists have discussed the evelopment of a very large space base in the 1990s /ith provisions for crews of 20 to 100 persons.) The eusable space transport would resupply and transfer rews to the space station. The uses of such a large pace station would include the maintenance, repair, id control of satellites in orbit; military R&D, includg directed-energy weapon development; scientific id industrial work in a zero-g environment; the ocking of fuel and supplies for lunar or planetary peditions; and the reception of international visiting rties, including Third World cosmonauts. In the iger term, a large manned space station would rmit the assembly of interplanetary and other spaceift that would be free of the design constraints posed by the requirements of aerodynamic flow.

Space Solar Power Station

18. A large space station could serve as a base from which to organize the construction of a large solar power station in geosynchronous orbit. Modules for such a station also could be assembled over many months or years in low orbit and gradually moved to geosynchronous orbit using low-thrust electric propulsion units.

19. A Soviet concept to provide solar power to Earth involves a large solar power station, about 1 kilometer in diameter. This idea may have been based on a US concept discussed in the 1970s. Such a station would require 10 to 20 payloads using the heavy-lift launch vehicle now under development. A demonstration of the power-station technology could be conducted in space by the mid-1990s, but the chances are very low that a full-scale system could be operating before the next century.

Geosynchronous Space Station

20. Although the Soviets have never discussed the concept of a space station in geosynchronous orbit, we believe there is a low-to-moderate possibility that they might develop such a station by the mid-1990s. A station in geosynchronous orbit offers continuous access to a large area of the Earth's surface. Thus, a manned station in geosynchronous orbit could be used for surveillance purposes such as early warning or reconnaissance or for command and control. At geosynchronous orbit, a station serving such purposes would be considerably less vulnerable to attack than a low-altitude station. A geosynchronous station could also be used for space observations, including inspection and negation of other geosynchronous satellites. A geosynchronous station could be used as a service center where communications, data relay, weather, and other geosynchronous satellites could be transferred for servicing and repair. Finally, a geosynchronous station could serve as a platform from which to organize and prepare the hardware and personnel for a lunar or planetary expedition.

21. The new heavy-lift launch vehicle probably will have a capability to put into geosynchronous orbit a space station of the Salyut class. Similarly, an upgraded Proton (SL-12) space launch vehicle could place a

transport vehicle of the Soyuz T class in geosynchronous orbit. Manned flights to and from geosynchronous orbit require an upgraded SL-13 Proton vehicle, which we believe the Soviets may be developing. Soyuz-type capsules have been returned from the Moon which is technically equivalent to return from geosynchronous orbit. Operations at geosynchronous orbit would also require increased protection of cosmonauts from the hazards of solar radiation. We believe sufficient research into shielding has been done to provide such protection.

Space Transportation System

22. A major national space project called Buran (Snowstorm) is under way with the goal of developing a family of reusable space systems, including a heavy-lift launch vehicle, a space shuttle orbiter, and a space tug. [redacted]

23. The Soviet Space Transportation System (STS) is a near copy of the US orbiter. Major design features of the US orbiter probably were adopted in order to minimize risk, cost, and development time. The major difference between the Soviet and US space shuttle orbiters—the aft fuselage section—is the result of a difference in their respective launch configurations. The US system consists of an orbiter with three main rocket engines, an external fuel tank, and two solid-propellant, strap-on booster rockets. In contrast, the Soviet shuttle system will consist of an orbiter with only small maneuvering engines, a core booster with main rocket engines mounted on its base, and two strap-on booster rockets that will use liquid propellants.

24. Development of the Soviet STS probably began in the mid-1970s shortly after the cancellation of their SL-X-15 [redacted] HLLV program. The SL-X-15 was a Saturn-V–class booster designed to place a space station and lander in lunar orbit. By 1978, the STS program was in the final design phase. Facilities for the manufacture, test, transport, and launch and recovery of the system were all under way by the end of that year. By early 1983, at least one prototype shuttle had been produced, and captive flight-testing of the vehicle was conducted atop a Bison aircraft. Also, the central core of the new HLLV was delivered to the launching facility. The new HLLV is expected to begin flight-testing in 1985 or 1986 and the space shuttle in 1986 or 1987.

25. Components of the core vehicle for the HLLV were first observed in imagery of the Ramenskoye Airfield in late 1980, where they were undergoing compatibility tests with the modified Bison air transport system. [redacted]

26. In early 1983 these components were shipped via air to Tyuratam and assembled to form a 59-meter core vehicle. (See figure V-3.) In March they were observed outside the large booster and assembly checkout building that will support launch complexes J and W. The configuration of this assembled section indicates that the LOX tank is positioned above the LH_2 tank and that at least two and probably three engines are positioned across the bottom of the core vehicle. Pod-like objects positioned at the bottom of the vehicle may be part of a recovery system for the reusable LH_2/LOX engines. Most parts of the STS will be recoverable and reusable, according to Soviet sources. It is not clear at this time, however, how the recovery of the engines will be accomplished.

27. A prototype of the Soviet space shuttle orbiter was first seen in February 1983 at the Ramenskoye Flight Test Center atop a modified Bison aircraft. The

Soviet space shuttle orbiter prototype is nearly identical to the US shuttle orbiter in size, configuration, and layout details. (See figure V-4.) Subsequent imagery indicates that captive flight-testing of the mated vehicles has taken place. After a landing accident in late March 1983, the orbiter was removed from the Bison, and it was returned to the shuttle assembly facility in Moscow in April 1983. This prototype or another early production orbiter will probably be outfitted for aerodynamic drop tests similar to those conducted with the US shuttle Enterprise from a Boeing 747 in 1977. The capabilities of the US and Soviet Space Transportation Systems are compared in figure V-5.

28. The design for the Soviet reusable space system presented in figure V-5 has some unique features. The main engines are on the launch vehicle, which allows testing of the launch vehicle separately from the orbiter vehicles. This enables the launch vehicle to be used for a variety of purposes in addition to launching the shuttle orbiter. Also, the launch system can be developed into a family of heavy-lift space launchers by adding an upper stage (or stages) and additional (or different size) strap-ons. We believe that another version, with three or four strap-ons and a liquid hydrogen upper stage, could place up to 150,000 kg in low Earth orbit. This type of vehicle could be used to launch large components of a permanent space base as well as exploratory missions to the Moon and planets.

Space Tug

29. A space tug would provide access to higher orbits, such as geostationary or planetary escape, and would complement the Soviet space shuttle. One mission identified for a space tug is the gathering of separately launched space station elements and assembling them. According to Soviet articles, the use of an interorbital space tug with a shuttle vehicle would greatly expand the shuttle's utility. The shuttle would boost space vehicles into a base orbit, and the tug would place them in their final orbit. The combination would extend satellite service life; practically eliminate unsuccessful launches; make it possible to build refueling, repair, and a space base with orbital launch complexes. The shipment of goods between the Earth and the Moon also would be more practical with this combination of launch and transport vehicles.

30. The most basic configuration for a space tug would be a propulsion package with a manipulator arm for catching or placing satellites. Simple missions such as launch to a higher orbit or shuttling between two space stations or between a Moon base and a space station could be done with a completely automated space tug. Repair missions probably would be manned because a man might be able to repair a satellite on orbit. This would be less expensive because unmanned retrievals would require the tug to make two round trips for each repair job.

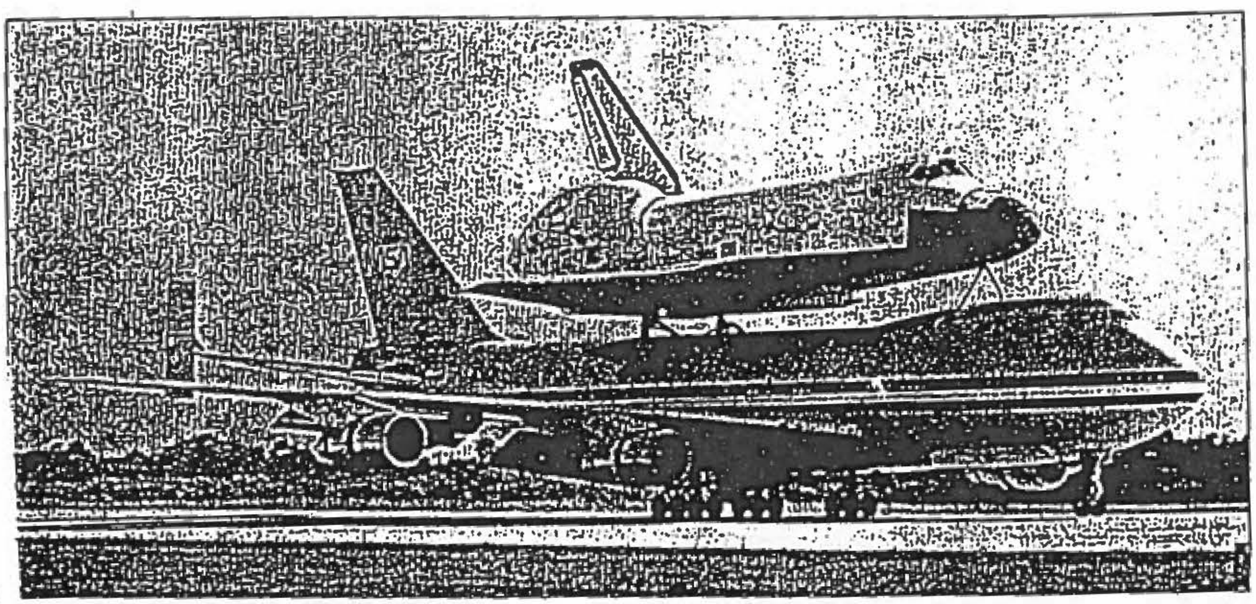
31. It is not clear if the Soviet tug will be launched in the shuttle payload bay or by a booster like the new HLLV or the SL-X-16. The tug, however, will be a reusable system and could be maintained in orbit for reuse, in which case, on-orbit propellant operations would be called for or the tug may be returned to Earth in the shuttle bay. We do not expect the space tug will be operational until the late 1980s or early 1990s when the entire space shuttle system is expected to be operational.

Military Space Plane

32. In 1962, about the same time scientists in the United States were considering a space bomber, noted Soviet aircraft designer Artem Mikoyan publicly proclaimed the need for a *kosmolyot* (space plane) so that the Soviet Air Force could have an operational capability in space. Classified Soviet military articles also have expressed the need for an "orbital aircraft" capable of inspecting hostile spacecraft and conducting antisatellite operations. These classified writings also address other missions, such as targeting of strategic weapons, poststrike assessment, retargeting, and even orbital bombardment.

33. A program to develop a military orbital aircraft began in 1969. The vehicle was to be produced by the Mikoyan Design Bureau with assistance from the Berezniyak Design Bureau. The operational vehicle reportedly would weigh about 12,000 to 18,000 kg, carry a one-man crew, be launched by an expendable launch vehicle, and be used for reconnaissance and inspection missions. Large orbital plane changes would be accomplished through a combination of aerodynamic and propulsive forces (synergetic). The program apparently was motivated in part by the US X-20

Figure V-4
Comparison of US and Soviet Shuttle Orbiters



IS shuttle mounted on modified Boeing 747

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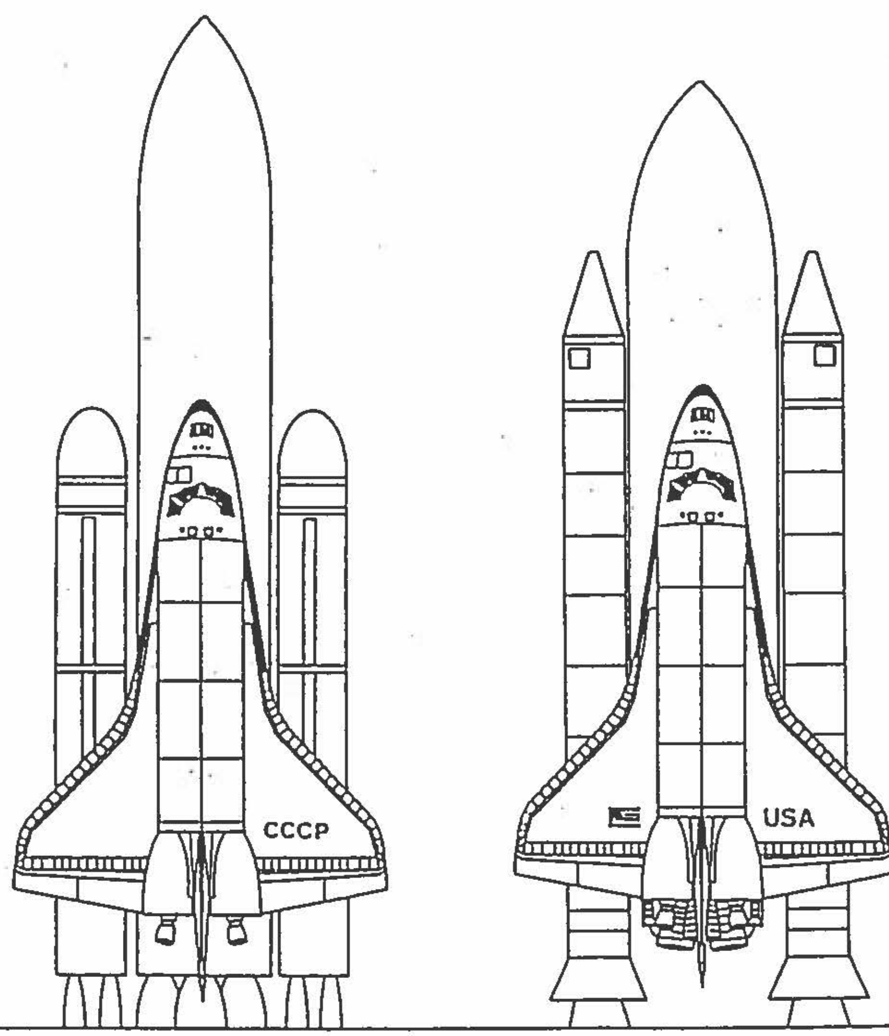
Figure V-5
US and Soviet Space Transportation Systems



	Soviet Reusable Space System	US Space Transportation System
Height (m)	59	56
Lift-off weight (kg)	1,700,000	2,026,000
Lift-off thrust (kN)	26,450	30,500
In-orbit weight (kg)	75,400	97,700

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Dyna Soar program and may actually have employed classified Dyna Soar documents in the development process.

34. In the 1976-78 period we observed a delta-wing vehicle incorporating a lifting-body design at a flight test center in the southwestern USSR. On several occasions the vehicle was observed under the wing of a TU-95 bomber and was probably dropped in tests reportedly conducted in 1977. We believe this vehicle was a research version of a military orbital aircraft designed to test subsonic flight characteristics.

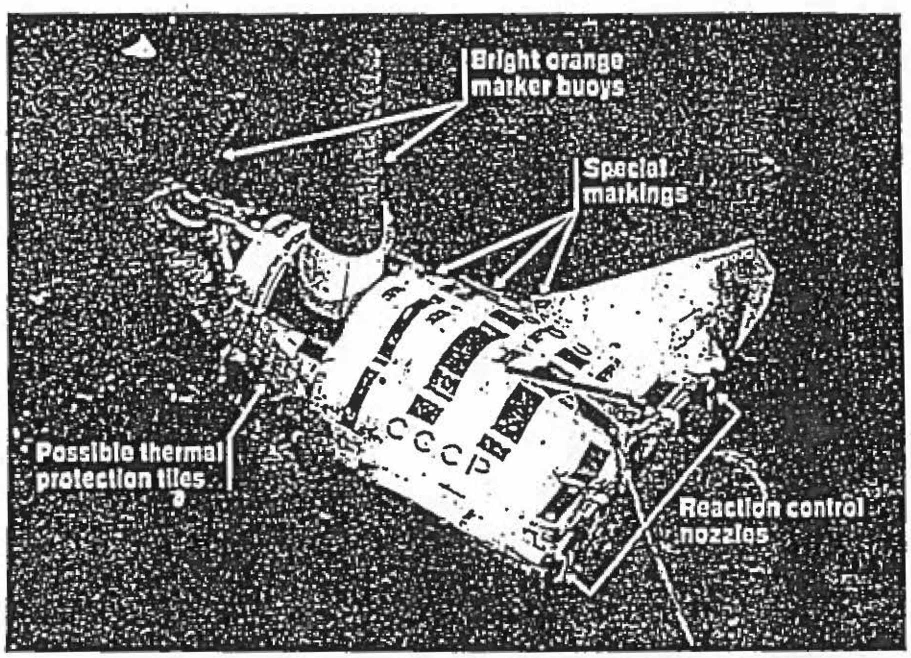
35. [redacted] In June 1982 [redacted] the unmanned spacecraft (Cosmos 1374) was placed into low Earth orbit, [redacted] and was recovered in the Indian Ocean. In March 1983 the one orbit test was repeated with Cosmos 1445. (See figure V-6.) We believe this vehicle could be a scale model, perhaps one-third or one-fourth scale, of the space plane.

36. The configuration of the Soviet space plane bears a strong similarity to the US Air Force X-23A. (See figure V-6.) The X-23A project followed the X-20 Dyna Soar program and was designed to assess the performance of a lifting body during hypersonic reentry, including aerodynamic maneuverability, and the integrity of structure and heat protection systems.

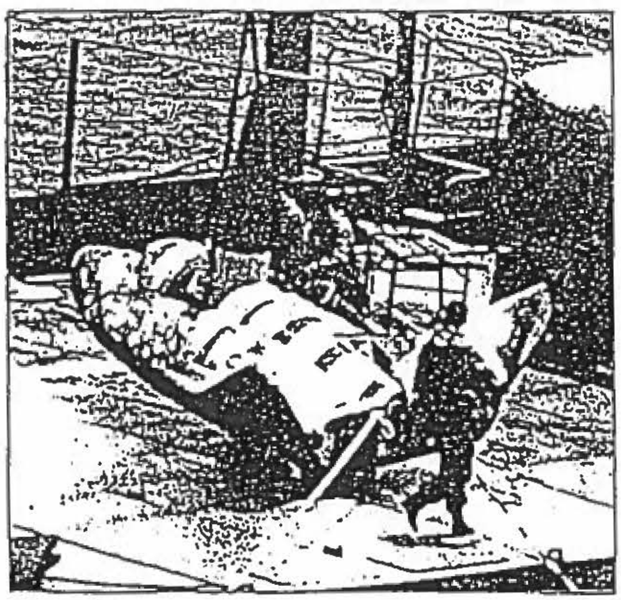
37. We believe a full-scale space plane will be flight-tested in 1984-85. Candidate launch vehicles are the SL-13 Proton and the new SL-X-16 launch vehicle. The first of two new launchpads at Tyuratam Complex Y is considered ready for use. On the basis of the design features of this pad, we estimate the SL-X-16 will have the characteristics shown in figure V-7 and will be capable of placing about 15,000 kg into low Earth orbit. On the basis of program timing and estimated payload, we believe the SL-X-16 is the best candidate for the space plane launch vehicle.

38. A small manned space plane has several advantages over the shuttle orbiter. It would have a shorter turnaround time, would be much lower in cost, would be more maneuverable, and could be launched quickly. We do not know what the final configuration of the space plane will be because at least two versions have been developed to date. Its mission is likely to include reconnaissance and satellite inspection roles. The research program could be designed to determine the utility of a space plane to perform a variety of other functions, including: ASAT weapons platform, orbital bombardment, poststrike assessment and targeting, and crew transfer. We postulate the space plane might be launched from the ground or be docked to a permanently orbiting space station, using the station as home port between reconnaissance missions. If launched from the ground, careful choice of orbital parameters would permit such a vehicle to overfly a given target twice within about two hours. This would be particularly valuable in crisis or wartime situations. In whatever role, the flights would be relatively short in duration, probably no longer than 24 hours.

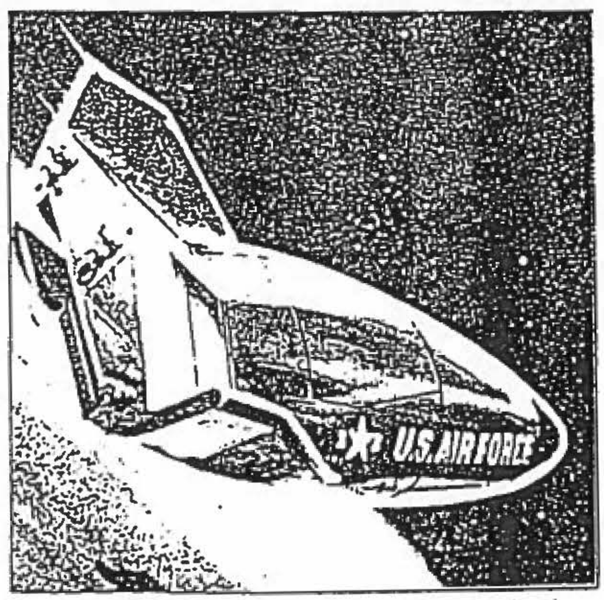
Figure V-6
Comparison of Possible Soviet Space Plane Prototype and US Reentry Test Vehicle



Cosmos 1445 after parachute landing in Indian Ocean, March 1983



Cosmos 1445 on deck of recovery ship Yamal



US X-23A reentry test vehicle (1966-67)

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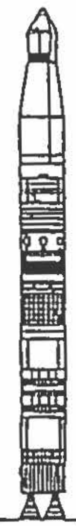
Figure V-7
SL-X-16 Launch Vehicle, Postulated for the Soviet Space Plane



Height (m)	55
Diameter (kg)	3.8
Weight (kg)	390,000
Lift-off thrust (lbs)	1,000,000
Payload to 185-km orbit (kg)	15,000

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CHAPTER VI

LUNAR AND PLANETARY EXPLORATION

1. There are two types of Soviet lunar and interplanetary programs: the manned exploration program that is under the direction of the Soviet Air Force and Strategic Rocket Forces; and the unmanned programs that are directed by the Academy of Sciences. Overall, Soviet lunar and planetary activity dropped rather sharply in the mid-1970s. During the past seven years, there have been only four Soviet scientific missions, all exploring Venus. But this trend of reduced activity may be changing. More than a dozen new missions are being contemplated and additional space launch vehicles will be available as SL-12 production increases. In addition, many new planetary missions will be possible because of international cooperation, greater launch capability by the late 1980s, and the availability of new technologies. (See tables VI-1 and VI-2.)

2. Soviet exploration of deep space provides a scientific return but also enhances the Soviets' desired image as a peaceful and technologically advanced nation. Hence, one factor in planning Soviet exploration programs has been to achieve prominent "space firsts." For example, they took the first far-side lunar pictures in 1959, the first pictures from the lunar surface in 1966, and used the first lunar surface roving vehicle (Lunakhod 1) in 1970. But the successes of the United States in manned lunar expeditions probably caused Soviet interest in lunar exploration to decline. Both Soviet manned and unmanned lunar exploration activities ceased after 1976. Similarly, Soviet Mars missions were discontinued after 1973. Recently, however, there has been renewed Soviet interest in lunar exploration, possibly for the purpose of establishing a manned lunar base. The hiatus since 1976 also may reflect a redirection and redesign in Soviet lunar programs. A new series of lunar missions is being planned beginning in about 1990 with an unmanned launch of a lunar polar orbiter. New planetary missions will take place within the next year or two.

3. Most of the identified lunar and planetary missions are already technologically feasible or soon will be. Figure VI-1 summarizes Soviet plans for lunar and

Table VI-1
Soviet Deep Space Exploration

Mission	Earliest Expected Launch	Likelihood
Lunar		
Lunar polar orbiter	1990	High
Lunar far-side lander, soil sample return	1991	High
Lunar near-side lander	1992	Moderate
Manned lunar base	Late 1990s	Low
Planetary		
Venus radar mapping	1983	High
VEGA (Venus and Halley's Comet flyby)	1984	High
Mars orbiter/lander/rover/ soil sample return	1986	High
Venus balloon mission	1988	Moderate
Titan mission	1988	Moderate
Long-duration Venus lander	Late 1980s	Moderate
Jupiter mission	1989	Moderate
Additional Mars orbiters/ landers	Early 1990s	Moderate
Manned orbital Mars mission	Late 1990s	Moderate

~~This table is Secret~~

Table VI-2
History of Lunar and Planetary Exploration [a]

	United States	Soviet Union
Total	89	89
Lunar	59 (1973)	42 (1976)
Venus	8 (1978)	31 (1983)
Mercury	1 (1973)	0
Mars	9 (1975)	16 (1973)
Outer planets (beyond Mars)	12 (1977)	0

[a] Total launches between 1958 and 1983; year of last launch in parentheses.

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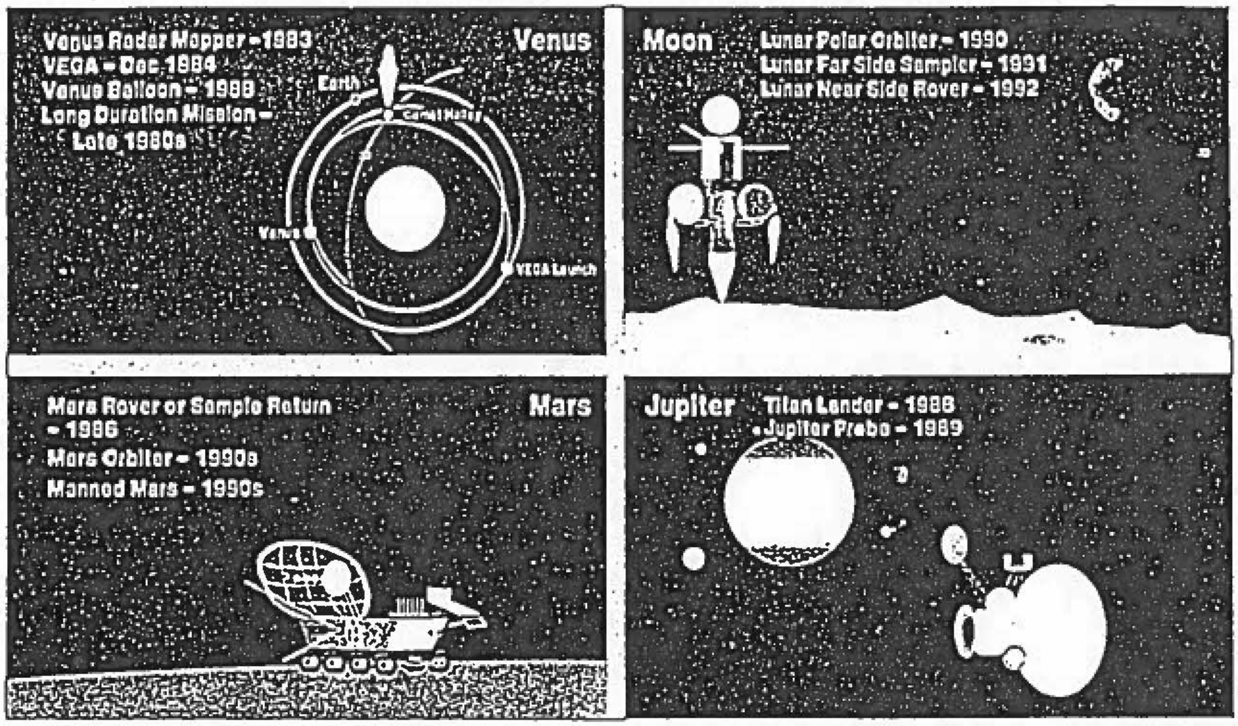
Figure VI-1
Soviet Lunar and Planetary Research Program[a]



[a] Dates indicated are for earliest expected launch.

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planetary missions in the 1990s. For planetary missions, the estimated earliest launch dates, on the basis of planetary proximity, also reflect windows of opportunity. Should these windows be missed, the missions would be delayed a few years until the next launch opportunity. In any event, we do not expect the frequency of launches to increase dramatically and approach the level of effort noted in the 1960s when up to 10 lunar and planetary launches were conducted per year. That period of high launch rates also was characterized by a high rate of failure. About two-thirds of the Soviet lunar and planetary missions up to 1976 ended in failure; about half of these were launch vehicle failures, while the other half had spacecraft malfunctions. It was not until the SL-12 space launch vehicle was introduced in 1969 that the success rate began to improve significantly. Since that time, about 60 percent of the Soviet lunar and planetary missions have achieved at least partial success.

4. We believe an unmanned Soviet lunar polar orbiter will be the first mission in the new series, in about 1990. The main purpose of the mission would be to search for subsurface ice and other volatiles near the lunar poles, possibly to support the eventual establishment of a manned lunar base. The orbiter also could provide mapping and communications support for a

subsequent unmanned far-side lunar landing. In any event, a polar orbiter would add to the list of Soviet space firsts.

5. Another mission in the lunar series is an unmanned landing on the far side of the Moon that would include returning a soil sample. This would be another space first. Such a mission would also require another satellite in lunar orbit at the same time to relay communications to and from the far side of the Moon. This lunar landing most likely would follow the polar orbiter mission in the early 1990s. A near-side lunar landing also has been discussed by senior Soviet space officials. If the lunar series is aimed at the eventual establishment of a manned lunar base, then we would expect to see additional lunar missions involving site surveys and exploration by lunar rover vehicles.

6. In the 1975-78 time frame, Soviet institutes were conducting research on lunar transports and engineering equipment for the construction of shelters, roads, and tunnels on the Moon. This work was canceled in 1978. However, if this work has been continued elsewhere, a lunar base could be established in the late 1990s. However, we believe this is unlikely.

7. Two Venus radar mapping missions were launched in June 1983. These missions involve one spacecraft in a polar orbit and one in an equatorial orbit, which will probably map the Venusian surface. We judge that one spacecraft is carrying a synthetic aperture radar with about a 2- to 5-km resolution.

8. An unmanned landing on Mars is likely as early as 1986. This mission may be an orbiter/lander combination, and it may include a rover vehicle or the return of a soil sample. If either of these two events were included, the mission would require the new heavy-lift space launch vehicle and could not be conducted until the late 1980s. A Mars soil sample return mission is likely by 1990. We also have information of an optical mass spectrometer using a laser for analysis of the Martian soil being planned jointly with the Bulgarians, implying perhaps a less ambitious lander mission.

9. We believe there is a moderate chance a Soviet manned orbital Mars mission will be conducted before the end of the century. Such a mission would require fewer resources than a lunar base and would bring greater prestige. Evidence of intentions for a manned Mars mission is almost entirely from open sources. Most of the statements indicate that such a mission is being considered and could be accomplished in the mid-to-late 1990s. Such a mission would be limited to orbital reconnaissance of Mars and return. Soviet research in long-term manned spaceflight is the only clear indication of such a mission. First, we would expect to see Soviet simulation of such a mission in Earth orbit, verifying that both people and equipment could sustain such long flights. Prior to a manned Mars mission we would also expect additional unmanned missions.

10. Another project is part of an international effort involving the USSR, Hungary, and France, with minor participation by Bulgaria, Poland, Czechoslovakia, Austria, and West Germany. The project, VEGA, involves launching two spacecraft in December 1984 to encounter Venus in June 1985 and Halley's Comet in March 1986. This would be another first and would further enhance Soviet prestige, particularly after the United States declined to undertake such a mission. When the spacecraft encounters Venus, it will separate into descent and fly-by sections, with the descent section deploying small balloons that will carry meteorological experiments sampling the atmosphere at an altitude of about 55 km. The descent stage will continue on to a landing. In the meantime, the fly-by stage will continue on with a gravity assist from Venus and will encounter Halley's Comet in March 1986. The payload in this section will include a video-imaging system with French optics and two Hungarian cameras with Soviet charged-couple device (CCD) sensors. Each vidicon will have a 512 x 576 element CCD array. At the intended miss distance of 10,000 km, each picture element of the narrow field camera will cover a 180-meter resolution of the Comet's nucleus. Other scientific experiments will measure the Comet's ultraviolet, visible, and infrared radiation; the makeup of dust particles; and gases, using particle detectors, magnetometers, and other devices.

11. Other possible Soviet planetary missions include exploration of Venus with large balloons. The idea of using 9-meter-diameter balloons with gondolas carrying various meteorological sensors was originally part

of the Vega project, but was dropped and is being considered as part of a separate joint Soviet-French Venus mission in the late 1980s. In addition, we have noted Soviet interest in conducting a long-duration mission involving a landing on Venus. Such a mission would require electronics capable of withstanding high temperatures for the two-week period envisioned, possibly in the late 1980s.

12. Exploration of Jupiter is another possibility. Soviet exploration of Jupiter prior to the planned US "Galileo" mission would require several sophisticated maneuvers such as "Earth gravity assist" and "aerobraking" to offset current lift and payload shortcomings. However, such maneuvers would double the flight time, requiring about four years to reach Jupiter. Such a long flight would increase the chances of spacecraft failure. Therefore, a more likely scenario would involve waiting until the heavy-lift launch vehicle is available to provide the necessary lift capacity without the Earth-gravity-assist maneuver, which adds about two years to the flight. In any event, it will be difficult for the USSR to achieve a Jupiter mission space "first" if the US Galileo mission is launched as scheduled in 1986. One additional outer solar system mission being considered is exploration of Titan, a satellite of Saturn and the largest satellite in the solar system. This mission could be a fly by, an orbiter, a lander, or some combination. This mission could be launched as early as 1988 and would require the heavy-lift launch vehicle.

CHAPTER VII

INTERNATIONAL COMPETITION AND COOPERATION

1. The USSR may become a serious competitor in international telecommunications and commercial space launch services. Eventually the competition may broaden to include Earth resources data, navigation and meteorological support, and materials processing and manufacturing in space. This type of competition will not only bring increased prestige and respect, but, over the longer term, will offer an opportunity for the Soviet Union to gain badly needed hard currency earnings. In addition, opportunities for technology transfer will be improved by increasing Soviet involvement in cooperative and commercial space ventures.

2. In the late 1960s and early 1970s the Soviet Union established two international space organizations—Intercosmos and Intersputnik. The initial objectives were to involve the Communist Bloc nations in space research, take advantage of advanced technology in the Bloc, foster national pride within the Bloc, and build better relationships with lesser developed countries. Most of these early objectives have been achieved and more ambitious goals may be pursued in the mid-to-late 1980s.

Intercosmos

3. The Council for International Cooperation in Space Exploration (Intercosmos), under the USSR Academy of Sciences, was established in 1967. Intercosmos represents the USSR in international space matters without revealing the military control of the Soviet space program. The Council coordinates the activities of the member countries, which initially included the USSR, Bulgaria, Hungary, Poland, East Germany, Romania, and Czechoslovakia. Each country forms national committees for space physics, communications, meteorology, biology, and medicine. In recent years Intercosmos has expanded to include Cuba, Mongolia, and Vietnam. Bilateral cooperative agreements also have been negotiated with France, Sweden, and India. There have been [redacted] cooperative projects with France, including at least three French-built satellites (Orcol 1 through Orcol 3), manned missions in Salyut 7, and the upcoming VEGA mission. Sweden also has provided some experimental payloads for Intercosmos satellites.

4. Soviet leadership dominates the Intercosmos program. A Soviet official always chairs the Council and coordinates the activities of the member countries and Soviet launch facilities, spacecraft, and ground control sites. Proposals for space experiments are accepted from all Intercosmos member countries, but the Soviet Union decides which proposals are to be implemented and the extent of non-Soviet participation.

5. To date, 30 satellites have been launched in the Intercosmos program. Between 1969 and 1975, Intercosmos launched an average of two satellites per year. Most of these missions consisted of relatively unsophisticated experiments in solar physics, ionospheric/magnetospheric research, cosmic rays, and space radiation. In 1976 Intercosmos introduced a new spacecraft called the automatic modular orbital station (AUOS) with a new universal radio telemetry system. Also, a new ground station entirely dedicated to receiving data from Intercosmos satellites was built in the USSR and was activated in 1980. In 1981 Intercosmos launched another new spacecraft based on the Meteor weather satellite. This spacecraft was considerably heavier than the SL-8–launched AUOS vehicle and required the SL-3 launch vehicle. We expect this trend toward more diversified missions and spacecraft to continue. In addition, emphasis is shifting more toward applied rather than pure scientific research. For example, oceanography and Earth-resources research have been emphasized in Intercosmos programs since 1979.

6. Intercosmos participation in the Soviet manned space program also is likely to continue, including more flights by cosmonauts from member and non-

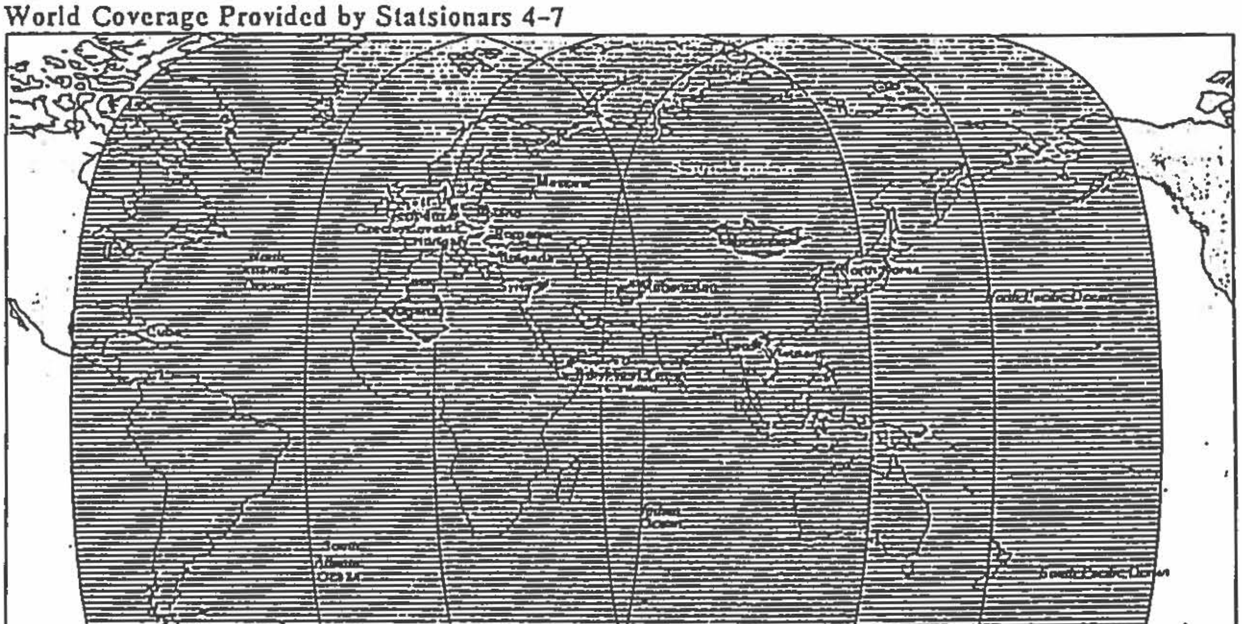
member countries as well as additional experiments. These flights have offered participating countries an opportunity to be involved in space programs that they could not undertake individually. This participation is widely publicized, and the nine national cosmonauts have been received as heroes in their own countries. As a result, national pride, gove.nment prestige, and Soviet good will all benefit.

Intersputnik

7. On 15 November 1971 representatives of the Intercosmos organization countries signed an agreement to establish Intersputnik. The original members were Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, and the USSR. Intersputnik is an open international organization designed to help member countries meet their needs in telephone, telegraph, TV, and radio communications. Each member sits on a governing board and has one vote. This is in contrast to Intelsat where voting is weighted and reflects the relative use of the system. Like Intelsat, Intersputnik requires contributions to a statutory fund in proportion to usage. The space segment satellites are owned by Intersputnik or they are leased from members (USSR in practice). The ground stations are owned by the individual states.

8. At this point, the Intersputnik system is much smaller and more limited in services than Intelsat, which now includes 107 members, 310 ground stations with 397 antennas, and a space network of 15 satellites. In contrast, Intersputnik currently is limited to coverage provided by Gorizont 4/Statsionar 4 over the Atlantic and Gorizont 5/Statsionar 5 over the Indian Ocean. This coverage, however, includes all of South America, Central America, Africa, and Asia. (See figure VII-1.) Intersputnik services are considerably

Figure VII-1
World Coverage Provided by Statsionars 4-7



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Area of coverage

Statsionar 4 and 5 — Statsionar 6 and 7

Country in Intersputnik communications system less expensive than those of Intelsat. The satellite voice circuit may be leased for about $12,000 annually, compared to about $20,000 for similar services from Intelsat.

9. In the 1980s the USSR began marketing Intersputnik circuits to developing countries. This effort has been successful because of Intersputnik's lower prices and easier membership requirements. Technological progress has enabled Intersputnik to become an even stronger competitor. Since the original nine Soviet Bloc countries formed Intersputnik, five additional states have become signatory members: Vietnam, South Yemen, Afghanistan, Syria, and Laos. Other countries such as Algeria and Iraq have become users but are not signatory members. By the end of this year, 16 Intersputnik ground stations will be connected via the Gorizont satellites. In 1984 North Korea will open its Intersputnik station. In addition, Soviet officials are negotiating with Libya, Angola, Mozambique, Madagascar, and Sri Lanka to join Intersputnik. Nicaragua and other Latin American countries also are interested in becoming members. Thus, Intersputnik is becoming Intelsat's foremost competition in the international telecommunications market.

Intelsat and Inmarsat

10. The Soviets, although users of Intelsat services, have never become members. It is doubtful they will ever join because membership requires that states not offer competitive services. Soviet use of Intelsat has been limited, ranking in the bottom 10 percent of the 130 users of Intelsat services.

11. In contrast to Intelsat participation, the Soviet Union is a charter member of the International Maritime Satellite Organization (Inmarsat). The USSR currently holds 14-percent ownership but accounts for less than 1-percent usage. Soviet ownership will soon shrink to about 7 percent as other countries join and relative Soviet use declines even further. Despite these developments, Soviet officials have publicly stated they do not intend to create another maritime satellite service to compete with Inmarsat. They have indicated that the Volna communications satellite system will remain limited to use by Soviet shipping only.

Commercial Space Launch Services

12. The USSR is planning to enter international commercial competition in providing space launch services. Soviet launch vehicles have placed three Indian satellites in orbit and agreements have been readied to launch a Swedish-built satellite. To be successful in this arena, the Soviets will have to offer prices competitive with those of the United States, the European Space Agency (ESA),[13] and Japan. They may also release some technical and reliability information on their boosters, provide insurance, and allow Western access to satellite and launch support facilities. This would be a sharp break with past practices, but the prospect of acquiring hard currency, increasing trade in high-technology products, and offsetting some space costs may outweigh security concerns.

13. The USSR may offer space launch services at prices well below both ESA's Ariane and the US shuttle. We believe, on the basis of the expected launch rate, that the demand for commercial space launchers may exceed the projected capacity of the shuttle and Ariane launch vehicles. The SL-12/13 Proton booster would be the most likely launch vehicle for Soviet-offered commercial services. The Proton is the world's largest expendable space booster, and the only one that could compete with Western vehicles in launching payloads to geosynchronous orbit. The Proton has achieved about a 90-percent reliability rate during the past 10 years. Extensive new Proton production facilities suggest that the launch rate may double in the next few years. By the late 1980s, about five Protons could be available each year for commercial purposes. Inmarsat has been the target of recent Soviet efforts to provide Proton launch services for the next generation of Marisats (maritime satellites) in the 1988-89 period.

14. The new Soviet heavy-lift launch vehicle and space shuttle will further enhance Soviet commercial potential. The Soviet shuttle appears to be virtually

[13] ESA was founded in 1972 by a 10-member consortium of West European countries led by France and West Germany. The purpose was to challenge NASA's monopoly on commercial space-launch services. Arianespace is the French-based marketing corporation for ESA's space-launch services. The French Space Agency is the principal shareholder (59 percent) in Arianespace and soon will take over the entire Ariane program, including the launch facilities in South America at Kourou, French Guiana.

identical to the US orbiter in size and configuration, including the same dimensions of the payload bay. Thus, payloads designed for the US shuttle may be compatible with the Soviet orbiter. The new heavy-lift launch vehicle and shuttle launch facilities are being constructed with two separate launch control facilities, which would provide for easy separation of military and commercial launch activities.

Remote Sensing

15. Current US commitments to provide Earth resources data to domestic and foreign users with Landsat do not extend beyond the mid-1980s. Furthermore, there is no indication that the private sector is willing to become involved. At this point France has expressed an interest in providing this service with SPOT, a high-resolution, multispectral Earth resources satellite. Also, the Japanese may provide data from their future Earth resources satellites. The USSR may also see an opportunity and move to offer similar services. If so, there are two approaches the USSR could take in entering the Earth resources data market. First, they could offer data from the MKF-6 multispectral camera system. This system, built by Zeiss-Jena, has been flown on Salyuts 6 and 7 and possibly on unmanned photoreconnaissance-type spacecraft. The MKF-6 camera takes pictures in six spectral bands with a resolution of 10 to 20 meters. Although this is much better than the resolution of either the thematic mapper or multispectral scanner on the US Landsat, the data are more limited in quantity and generally not as timely. A second and more likely choice involves new sensors currently being developed and tested on board the Meteor-Priroda spacecraft. These sensors are high-resolution, electro-optical, multispectral scanning devices with resolutions similiar to Landsat D (30- and 80-meter picture element sizes).

16. The first operational Meteor-Priroda is expected to be launched in 1985. We believe an operational land remote-sensing system will be available by the late 1980s. Such a system would provide the opportunity to improve Soviet access to Third World countries by providing Earth resources data for national development. Soviet engineers would be required to process the data.

Processing and Manufacturing of Materials in Space

17. There is considerable interest in the manufacture of high-value, low-volume products in space. Extensive research in this field is under way in the United States, the USSR, Europe, and Japan. Activities on board the Salyut 6 space station between 1976 and 1981 indicate that Soviet interest has progressed beyond the initial research phase. These activities included experiments to produce unique semiconductors, superconductors, special alloys, glass, and crystals. Much of this work continued on Salyut 7. These experiments were more extensive than those planned for the US Spacelab mission in 1984.

18. At this point, we believe the Soviets are ready to move beyond the research and development phase of materials processing in space. The most likely next step would be to create a special materials processing module as part of a modular space station. Such a space station can be assembled in orbit by the mid-1980s. Most of the materials developed in the Salyut experiments have a military or scientific application. However, a Soviet modular space station also could manufacture materials for commercial markets.

Other Areas of Competition

19. There are other activities in space where the Soviets may choose to compete. This competition may not provide direct economic benefits, but could enhance the image of the Soviet Union as a technological power and a friend to developing countries. Such competition could include the provision of data from GLONASS, the Soviet global navigation system. This system may be available to any user without charge, provided the user has the appropriate receiver and data processor. The Soviets might make receivers available at low cost, making the system more attractive to some users. The Soviet GLONASS system is expected to be operational at about the same time as the US Global Positioning System (GPS).

20. The launching of GOMS, a geostationary meteorological satellite delayed since 1978, could fill a void in weather coverage that exists over the Indian Ocean. The USSR could then offer ground terminals for receiving GOMS data, which several African and Asian nations may find useful, especially if used in conjunction with Earth resources data.

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