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Interagency Intelligence Memorandum

The Soviet Statsionar Satellite Communications System: Implications for INTELSAT

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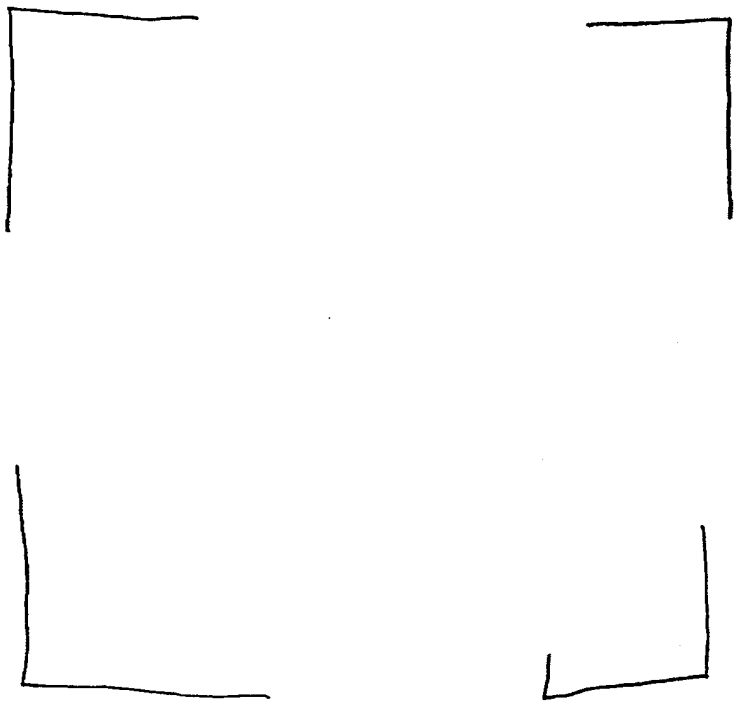


THE SOVIET STATSIONAR SATELLITE COMMUNICATIONS SYSTEM: IMPLICATIONS FOR INTELSAT[1]

KEY FINDINGS

- The Soviet Statsionar program, consisting of 11 geostationary communications satellites, is planned for deployment in stages between now and 1980. The USSR is committed to carrying out the Statsionar program mainly to satisfy domestic communications requirements, commercial and military. We believe Statsionar will have a negligible impact on the International Telecommunications Satellite Organization (INTELSAT) and is not being developed as a competitor to INTELSAT for global international commercial use.

- We foresee important Soviet military usage for Statsionar: internally for strategic command-and-control communications and tactical use; externally for linking Moscow with military and quasi-military units deployed worldwide. Statsionar may also be used by Soviet diplomatic and commercial representatives in foreign countries.

- The Soviets lag far behind INTELSAT in communications satellite technology and will not achieve technological parity with INTEL-

[1] This memorandum was prepared under the auspices of the National Intelligence Officer for Economics and drafted by CIA's Office of Economic Research with contributions and participation by CIA's Offices of Scientific Intelligence, Weapons Intelligence, and Strategic Research, and the State Department's Bureau of Intelligence and Research. Both CIA and State/INR concur in this assessment. The memorandum was also submitted for review to the following agencies: the National Security Agency, the Defense Intelligence Agency, Air Force Intelligence, the Naval Intelligence Support Center, and the Air Force Systems Command's Foreign Technology Division. Formal concurrences, however, were not sought from these agencies.

SAT in the currently announced program. Indeed Statsionar satellites will have difficulty reaching even planned communications capacities. This technological gap, however, need not impair Soviet ability to meet internal requirements.

- The Statsionar program got off the ground in December 1975 with the launch of Statsionar-1, about five years behind the original time schedule. Recent technical difficulties in orbit with Statsionar-1 probably will delay planned launches of follow-on Statsionars. Deployment of the last three satellites in the series—Statsionars 8, 9, and 10—which will give the Soviets, for the first time, a global communications satellite capability, probably will be delayed beyond the scheduled 1980 launch date.

- Intersputnik, the Communist counterpart to INTELSAT, probably will use some Statsionar satellites for commercial communications among its members. Although the Intersputnik organization will eventually have its own dedicated satellites, it could begin operating by leasing channels on Stationars 4 and 5, currently scheduled for 1978-79.

- Only a few non-Communist countries have shown interest in using Soviet communications satellites: Nigeria, Somalia, Syria, and possibly India, all countries in which the Soviets are politically influential. Eventually one or more of these countries, and possibly other developing countries, may wish to use spare capacity on Statsionars to set up domestic or regional communications satellite systems.

- Soviet launching, tracking, control, and ground station technology appear adequate to carry out the Statsionar program. Facilities currently in use with the Molniya program can be used to service the Statsionar program as well.

- Despite its efforts to develop Intersputnik, the Soviet Union is increasing its use of the INTELSAT system. With complete access to INTELSAT services for international communications and partial access to INTELSAT technology as a nonmember user, incentives for formal membership are not great. However, Soviet attitudes toward INTELSAT appear sufficiently benevolent to make formal membership a possibility in the next three to five years.

- INTELSAT officials are concerned that planned orbital locations for some Statsionars may cause interference with INTELSAT satellites in the Indian and Atlantic regions. The interference problem may require modifications in the orbital locations or technical characteristics of Statsionar or INTELSAT satellites.

DISCUSSION

Introduction

1. The USSR recently filed technical data on a new series of geostationary communications satellites (comsats), called Statsionars, with the International Frequency Registration Board (IFRB) of the International Telecommunications Union (ITU). This study of the filings was undertaken at the request of the Office of Telecommunications Policy, Executive Office of the President, to determine the scope of the program, to evaluate Soviet capabilities to carry it out, and to assess the implications of the program for INTELSAT in the area of international commercial communications.

2. Judgments expressed in this study are based on the limited information so far available. As new analytically useful information is acquired, follow-on studies will seek to reduce major current uncertainties. In particular, such studies will seek to clarify the level of priority the Soviet leadership has assigned to the program, the technical capabilities of the Statsionar system, and Soviet intentions for using the system.

Background

3. The Soviet comsat program, like that of the US, is only a little more than ten years old. The Soviets began construction on a basic network of experimental ground stations in the early 1960s, and orbited the first Molniya comsat in 1965 shortly after the launch of the first INTELSAT satellite (Early Bird) when the "space race" was near its peak. Since that time, however, Soviet and US comsat programs have diverged, owing to basic differences in technical capabilities, priorities, and requirements. The US pushed the development of geostationary systems for transoceanic communications. Although the US already had one of the best developed internal communications systems in the world, communications with allies and trading partners was limited to unreliable, low capacity, high frequency (HF) radio, and to reliable, but expensive, submarine cable of limited capacity.

4. The Soviet Union was faced with an entirely different problem. Its terrestrial domestic telecommunications system was poorly developed and comsats for internal use had special appeal as an economic alternative to expensive cable and microwave systems. The Soviets favored the use of elliptically orbiting satellites because they are better suited to reach high northern latitudes in the USSR and because the Soviet Union in the mid-1960s had no capability to launch geostationary satellites. Launching geostationary satellites from within the USSR would have required use of the largest operational Soviet booster—the SL-12—which was still extremely unreliable in the late 1960s.

5. Satisfied that Molniya technology was adequate for a workable system, Moscow engaged in

a crash construction program during 1965-67 to provide satellite television (TV) coverage of the fiftieth anniversary of the Bolshevik Revolution in November 1967. The Soviets built a network of about 20 TV receive-only earth stations called Orbitas, some in the most remote corners of the USSR. The program was highly successful and enabled the Soviet Union to claim the world's first operating domestic comsat system.

6. Since 1965 more than 50 Molniyas have been launched, representing three generations of Soviet communications satellite development.[2] Following the original Molniya-1 series, a second generation (Molniya-2) began to appear in November 1971 with double the relay capacity of the Molniya-1. Since October 1974, Molniya-2 satellites have been used primarily for internal civil telephone communications and for relay of Moscow TV programs to the Orbita network. We believe the Molniya-1 satellites are now dedicated to full-time military and governmental use. A third generation (Molniya-3) satellite system, initiated in late 1974, has not yet reached its full operating potential.[3] The supporting ground station network also has expanded rapidly and now includes more than 60 Orbita stations and numerous military stations as well. All told, more than 200 fixed-comsat antennas are deployed in the USSR at nearly 150 sites.

7. The USSR announced the formation of an international satellite organization called Intersputnik in 1971. That organization, which includes the USSR, Cuba, Mongolia, and all East European countries except Albania and Yugoslavia, probably will not be able to provide services to all members

[2] See Table I for a summary of technical data on Molniyas.

[3] Molniya-3 is intended to be used, in part, for Hotline communications between Moscow and Washington.

Table I

Summary of Molniya Characteristics
(Data as of 1 April 1976)

Characteristics	Molniya-1	Molniya-2	Molniya-3	Molniya-1S
Orbit	Elliptical	Elliptical	Elliptical	Geostationary
First launch	April 1965	November 1971	November 1974	July 1974
Total launches	34	15	4	1
Number active	8	4	4	0
Number of transponders	1	2	4	1
Voice channel capacity per transponder (duplex)[a]	60	60	60 (est)	60
Television channels per transponder[a]	1	1	1	1
Communications frequencies				
Uplink (MHz)	805-830	6,040-6,155	Unknown	805-830
Downlink (MHz)	975-1,000	3,735-3,885	3,650-3,900	975-1,000
Current uses	Military communications	Public television Public communications Military communications Intersputnik	Operational testing	None[b]
Projected uses, 1976-80	Military communications	Phase out	Public television Public communications Military communications DCL[c] Intersputnik	

[a] A transponder can be used for either voice or TV, but not both simultaneously.

[b] [redacted]

[c] DCL is direct communications link (satellite hotline).

before 1978-79. Membership has not grown beyond the Communist countries.

Advent of Geostationary Satellites

8. While expanding and improving the comsat program for elliptically orbiting Molniyas, the Soviets have been making an intensive concurrent effort to develop and deploy geostationary communications satellites. The first prototype geostationary comsat, Molniya-1S, was orbited in mid-1974, a few months before the launch of Molniya-3, the most advanced vehicle in the Molniya program. The first operational geostationary comsat, Statsionar-1, was launched about a year and a half later.

9. Even though the Molniya program is capable of meeting Soviet satellite communications needs for many years, broad usage of geostationary satellites would make good sense for several technical, economic, military, and political reasons:

a. A geostationary orbit is easier to maintain than a semisynchronous (elliptical) orbit, ground tracking mechanisms can be simpler, and only one dish rather than two is required to maintain continuous satellite contact.

b. Geostationary satellites do not pass through the Van Allen radiation belts, as do elliptically orbiting satellites. Since extraordinary protection of the solar cells and communications electronics against Van Allen radiation is not required, geostationary satellites can operate more efficiently. They should also last longer in orbit.

c. Geostationary comsats may offer significant economic advantages for the Soviets. Since they provide broader coverage of the earth (below 70° N latitude) than do elliptical satellites, only two Statsionars would be required to cover the entire USSR, compared with four Molniyas; fewer launches per year are needed; and ground stations, being simpler, are cheaper to build.

d. Geostationary comsats have important advantages for military communications. Since there is no hand-over problem, reliability is likely to be enhanced. In coverage, Statsionars can service important regions such as Africa, South America, and the Indian Ocean not now covered by Molniyas.

e. Because of the vastness of the USSR, which encompasses 11 time zones, the geostationary satellites offer advantages for television broadcasting. Geostationary satellites using multiple TV trunks are especially well suited to achieving quickly and economically a major Soviet goal—specialized programing from Moscow to each major geographical and ethnic region of the USSR.

f. The Soviets need to develop geostationary technology as a matter of national prestige, both political and technical. Lacking a geostationary comsat capability, Moscow's claims of parity with the US in space technology ring hollow. Moreover, the USSR is committed to geostationary comsats for Intersputnik use. Failure to deliver could result in a loss of face within the Communist world.

The Statsionar Program

10. The Soviet Statsionar program, according to ITU filings, is to consist of 11 satellites—Statsionars 1 through 10 and Statsionar-T.[4] Statsionar-T will be equipped for television broadcasting only and will have no communications capability. All other Statsionars will be equipped for TV and communications (voice, data, facsimile, and telegraphy).

11. On paper, Statsionar is a formidable program representing a major advance in Soviet communications capabilities. The program is to be implemented in stages, each successive stage building on the experience of the preceding one, while increasing coverage of the earth's surface. Worldwide coverage will not be achieved until the final stage is reached—Statsionars 8, 9, and 10—currently planned for 1980.

12. The Statsionar program may be viewed as a set of six sub-programs, based on launch dates, coverage, and similarities in technical characteristics, involving one or several satellites, as follows:

a. Statsionar-1
b. Statsionar-T
c. Statsionars 2 and 3
d. Statsionars 4 and 5
e. Statsionars 6 and 7
f. Statsionars 8, 9, and 10

[4] See Table II for a summary of Statsionar characteristics.

Table II

Summary of Statsionar Data[a]

Statsionar	Planned Date of Operation	Planned Location	Intended Service Area	Type of Service[b]	Number of Transponders	Transponder Bandwidth (MHz)	Total Bandwidth (MHz)	Satellite Transmission				Satellite Reception			Earth Stations	
								Downlink (MHz)	Antennas[c] Glo.	Reg.	Spot	Antennas[c] Glo.	Reg.	Uplink (MHz)	Antenna Size (m)[d]	Receiver Noise Temperature
T	1975-76	99°E	USSR	F-5	1	24	24	702-736	0	1	0	1	0	6,188-6,212	12 TX 6 RX	-- 800°K
1	Dec 75[e]	85°E[f]	USSR	F-9	10[g]	50[g]	500	3,400-3,900	1	0	0	1	0	5,725-6,225	12 TX 12 RX	-- 150°K
2	1975-76	35°E	USSR & Europe	F-9	10	50	500	3,400-3,900	0	1	0	0	1	5,725-6,225	12 TX, RX	100°K
3	1975-76	85°E	USSR	F-9	10	50	500	3,400-3,900	0	1	0	0	1	5,725-6,225	12 TX, RX	100°K
4	1978-79	14°W	90°W-60°E[h]	F-9	6	50	300	3,650-3,950	1	0	0	1	0	5,975-6,275	12 TX, RX	100°K
5	1978-79	58°E	USSR & Eastern Europe	F-9	6	50	300	3,650-3,950	1	0	0	1	0	5,975-6,275	12 TX, RX	100°K
6	1979-80	90°E	USSR	F-9 & F-5	6	50	300	3,650-3,950	0	1	1	1	0	5,975-6,275	12, 25 TX 2, 12 RX	-- 200°K & 100°K
7	1979-80	140°E	USSR	F-9	6	50	300	3,650-3,950	0	1	0	1	0	5,975-6,275	12 TX, RX	100°K
8	1980	25°W	110°W-50°E[h]	F-9	6	50	300	3,400-3,700	1	1	0	1	1	5,725-6,025	12 TX, RX	100°K
9	1980	45°E	30°W-120°E[h]	F-9	6	50	300	3,400-3,700	1	1	0	1	1	5,725-6,025	12 TX, RX	100°K
10	1980	170°W	115°E-95°W[h]	F-9	6	50	300	3,400-3,700	1	1	0	1	1	5,725-6,025	12 TX, RX	100°K

a/ Derived from ITU filings.
b/ F-5 = TV only; F-9 = telephony, telegraphy, facsimile, radio, and TV.
c/ Glo. = Global; Reg. = Regional
d/ TX = transmit antenna; RX = receive antenna
e/ Actual launch date.
f/ Actual location.
g/ Twelve 42-MHz transponders, according to the 1969 filing.
h/ The northern and southern latitudinal limits are both 75°.

13. *Statsionar-1.* Statsionar-1, which the Soviets call "Raduga," is the first and only satellite in the series that has as yet been put into orbit. However, the satellite has been plagued by technical difficulties, and after less than three months of intermittent operations has stopped functioning. The difficulties may be in the attitude control system (see paragraph 45). It was placed in geostationary position over the Indian Ocean at 85° East longitude on 22 December 1975, five years to the month after the Soviets had first declared it would become operational [5] (see Figure 1 following page 15). According to a TASS announcement, Statsionar-1 will be used for Soviet domestic communications and for television relay to the Orbita network. According to the 1969 ITU filings, Statsionar-1 was to carry global antennas, which would permit the satellite to be used for external communications. Recent information indicates that Statsionar-1 has been used for television transmission within the USSR.

14. *Statsionar-T.* Statsionar-T is scheduled to be placed into geostationary orbit over Indonesia at 99° East longitude during 1975-76 (see Figure 2). It will relay television from a transmitting earth station at Gus' Khrustalnyy [6] (near Moscow) to a network of small (6-meter) antennas in northern and eastern parts of the USSR. According to the Soviets the transmitted beam from Statsionar-T will be shaped to provide coverage only of the USSR. However, analysis of the beam indicates that it is likely to spill over into northern China as well.[7] Statsionar-T will be able to receive television broadcasts originating outside of the USSR, including Asia, East Africa, and the Middle East.

15. Statsionar-T is intended for use in TV broadcasting to community antennas. This could be the first step toward the development of a direct broadcasting system (DBS), that is, a system for broadcasting TV directly to individual homes and apartments. The Soviets have claimed for several years to be developing technology for DBS. Most recently, the Soviets stated that complete coverage of the entire Soviet land mass via Orbitas would be too expensive, and that a DBS capability would be provided to fill in the "holes" in TV coverage. The Soviets expect, probably unrealistically, to have a DBS system operational within five to seven years.[8]

16. *Statsionars 2 and 3.* Statsionars 2 and 3, scheduled for service during 1975-76, are to be fixed in orbit over East Africa (35° E) and the Indian Ocean (85° E), respectively (see Figure 3). The characteristics of on-board transmit and receive antennas indicate that they are designed to provide regional coverage of Eastern and Western Europe and the USSR, with overlapping coverage of western USSR. Specifically, Statsionar-2 will cover Western and Eastern Europe, and the USSR except most of eastern Siberia and the Far East. Statsionar-3 extends coverage to most of the eastern region of the USSR except Kamchatka and the extreme northeast.

17. We believe both satellites are intended mainly for domestic use. In addition, Statsionar-3, which we believe will replace Statsionar-1, possibly will service military as well as civil networks. Statsionar-3 can provide complete coverage of the Soviet military command-and-control earth station network.

18. The Soviets have stated that Statsionar-2 will serve "Europe and the USSR." This suggests that the Soviets are preparing for exchanges of television programs and perhaps telephone communications with some West European countries such as France. The USSR and France have been irregularly exchanging TV programing, via Molniya, for several years.

19. Statsionar-2 would appear to offer an excellent opportunity to East European countries to gain experience in the operation of their earth stations prior to activation of the Intersputnik system. Thus, once Statsionar-2 becomes operational, we expect an exchange of TV programs and telephone communications on an experimental basis between the USSR and East European Intersputnik members.

[redacted]

[5] A March 1969 filing with the IFRB stated that Statsionar-1 would become operational in December 1970.

[6] Gus' Khrustalnyy is a transmitting site for several Soviet comsat programs.

[7] In June 1975 the Chinese protested strongly to Moscow that radiation from Statsionar-T would cause harmful interference with China's telecommunications and broadcasting services.

20. *Statsionars 4 and 5.* These satellites are scheduled to go into service during 1978-79. Statsionar-4 is to be situated over the Atlantic at 14° W, and Statsionar-5 over the Indian Ocean at 58° E (see Figure 4). Both satellites will have global transmitting and receiving beams. Together they will provide coverage of most of the nations in the world excluding, in particular, Mexico and most of the United States and Canada. With Statsionars 4 and 5, the USSR for the first time will have a system with a near-global comsat capability.

21. We believe that Statsionar-5 is intended for use, at least in part, with Intersputnik. The Soviets had indicated earlier that Intersputnik members would lease channels on a geostationary satellite located in the vicinity of 60° E longitude for operations in the "second stage" (i.e., geostationary stage) of development of the Intersputnik system.[9] In a third and final stage, Intersputnik members are to build or procure from the USSR their own satellites, which will bear the "Intersputnik" label. Also, the timing seems to fit, since it is during the 1978-80 time period that the Intersputnik earth station network is scheduled to be completed and ready for operations.

22. Cuba is the only Intersputnik member not covered by Statsionar-5. Statsionar-4 could provide coverage of Cuba but is unlikely to be launched for that purpose alone. According to a Soviet official [10] Cuba will continue to use elliptically orbiting Molniya-type satellites, unless Intersputnik membership expands to justify economically a geostationary vehicle over the Atlantic. If Statsionar-4 is intended to establish a Cuba link only, it may not be launched as scheduled.

23. In filing for Statsionar-4, the USSR could be making provision for eventual expansion of Intersputnik membership to the Western Hemisphere. It costs the Soviets little to stake out a claim with the ITU for satellite frequencies and locations, and there is no binding obligation to implement stated plans.

24. Statsionar-4, equipped with global antennas, will provide overlapping coverage (with Statsionar-5) of Africa, and for the first time coverage of South America and the east coast of North America. Possibly the Soviets are planning to use Statsionars 4 and 5 for communications with Soviet military and intelligence personnel who are active in these areas.

25. *Statsionars 6 and 7.* These satellites are to become operational during 1979-80. Statsionar-6 will be located over the Indian Ocean at 90° E; Statsionar-7, over the Pacific at 140° E (see Figure 5). These satellites will transmit on regional beams, plus a spot beam for Statsionar-6, and receive on global beams. Statsionar-6 will provide transmission coverage of Eastern Europe and most of the USSR; Statsionar-7 will extend coverage across the entire eastern part of the USSR and into the North Pacific region. Reception will be possible from virtually all of the Eastern Hemisphere.

26. According to the filings, regional beams of both satellites will be used for general telephone and telegraph communications and TV. In addition to regional coverage, Statsionar-6 will have a spot beam centered on the Moscow area. The spot beam will be used for transmitting TV to small (about 2-meter) antennas. In general, Statsionars 6 and 7 provide complementary coverage of the entire USSR for multichannel communications and TV broadcasting.

27. We believe this sub-program is designed mainly for Soviet domestic use. The filing itself specifies that the satellites will serve "the territory of the USSR" (Statsionar-6) and "eastern regions of the USSR" (Statsionar-7). The fact that both satellites have a global receive beam could indicate that these satellites will also be used for one-way communications with Soviet organizations abroad.

28. The spot beam to be provided by Statsionar-6 is of extraordinary interest because of the unusually small size of the earth station antennas it will serve. It seems unlikely that the beam will be used to transmit TV to a civil network of small receiving stations, as claimed. That is because small stations for expanded TV coverage, according to other official Soviet statements, are to be installed primarily in sparsely populated areas, especially Siberia,

[9] A Soviet official, I. Y. Petrov, so wrote in an official publication of the ITU in 1972: *Telecommunications Journal*, Vol. 39, No. 11, 1972, pp. 679-684.

[10] Petrov, *loc. cit.*

whereas the spot beam covers mainly the more densely populated western part of the USSR which contains the best developed cable and microwave systems for TV relay. Moreover, there are no small receiving stations of the type indicated in use in the Soviet civil sector, or, so far as is known, under development for civil use.

29. We believe that, to the contrary, the Soviets will use the spot beam transmitter of Statsionar-6 for military communications. Small fixed and mobile comsat antennas already exist at headquarters echelons of Soviet missile forces. The Soviets almost certainly have chosen to use a spot beam (instead of a regional one) for technical reasons rather than for communications security. The spot beam, though focused on the USSR, could, for example, be intercepted from Scandinavia.

30. The coverage of the regional beams of Statsionars 6 and 7, also appears to have been chosen with strategic usage in mind. There is a distinct overlap of coverage in the eastern part of the USSR, a region that includes important concentrations of Soviet forces along the Chinese border.

31. Statsionars 6 and 7 are not well suited for Soviet external communications. Although global receive beams provide excellent coverage of the Indian Ocean and good coverage of the Pacific, communications would have to be one-way only, i.e., from abroad back to the USSR, since Statsionars 6 and 7 will have no global transmit antennas on board. This limitation may be acceptable for certain types of communications such as situation monitoring and intelligence reporting.

32. *Statsionars 8, 9, and 10.* The final three satellites in the Statsionar series, which are scheduled to go into operation by 1980, appear to describe a true global system. Their locations at 25° W, 45° E, and 170° West longitude will provide essentially worldwide coverage, similar to that of the current INTELSAT system (see Figure 6). All satellites will be equipped for global and regional transmission and reception.

33. A three satellite system would meet most of Moscow's needs for domestic and worldwide communications. For domestic purposes, however, we believe that Statsionar-T and elliptically orbiting Molniyas will continue to be needed for full communications and TV coverage. Molniyas will be needed to provide coverage of northern Siberia and probably also for efficient communications between far western and eastern regions of the USSR; for example, communications between Moscow and Vladivostok using only Statsionars 8, 9, and 10 would require a double-hop satellite linkup. Statsionar-T will continue to be needed to provide a community antenna TV broadcasting capability.

34. For worldwide purposes, we expect that Statsionars 8, 9, and 10 will be used for both commercial and noncommercial communications. Commercially, these satellites could be used for communications among Intersputnik members (Moscow and Eastern Europe can "see" the outermost stations in Mongolia and Cuba); noncommercial communications could include any or all of the following: diplomatic and covert; communications with military, fishing, and research vessels around the globe;[11] global airspace coverage for direct communications with military and official aircraft; and, possibly, future "Hotline" coverage (Moscow can "see" Washington, D.C.).

35. Because most countries, including even the USSR and Eastern Europe, are devoting major resources to their increased use of INTELSAT (see paragraph 54), we see little likelihood that Statsionar will be used for international commercial communications between Communist countries and the West or among non-Communist countries for many years, if ever. However, it is possible that the USSR, to further political goals, will make spare satellite capacity available to developing countries for domestic or regional use.

Communications Capability of Statsionars

36. Soviet filings do not describe the communications subsystems to be employed on Statsionars. The brief and sometimes ambiguous technical descriptions given make it difficult to determine even generally what communications capability actually will be provided. However, combining information in

[11] Statsionars could be used for communicating with Soviet maritime vessels without formally establishing a maritime satellite organization or utilizing frequencies allocated by the ITU for maritime use.

the filings with statements by Soviet officials and other information, we judge that the Statsionar program is intended to have communications capabilities as described below.

37. Statsionar satellites will operate in the conventional 4 and 6 gigahertz (GHz) bands, except for the Statsionar-T down-link which will operate at 714 megahertz (MHz). All Statsionars with the exception of Statsionar-T will carry multiple transponders, each with a 50 MHz bandwidth for relaying TV, voice, or data communications. Statsionars 1, 2, and 3, are apparently designed to have ten transponders for a total bandwidth of 500 MHz. Statsionars 4 through 10 will have only six transponders and a total signal bandwidth of 300 MHz. (It is not clear why the early satellites will carry ten transponders and later ones only 6; see paragraph 53). Statsionar-T will carry a single onboard 24-MHz transponder.

38. Although the bandwidth of Statsionar transponders is wider than those of INTELSAT IVA [12] (40 MHz), they will provide far less actual communications capacity. With wider guard bands between transponders and individual carriers and the use of relatively more bandwidth for each carrier, Statsionar transponders will make less effective use of the total satellite bandwidth. For example, the Soviets plan to use both conventional modulation (FDM/FM) and single channel per carrier (SCPC) techniques. Using conventional modulation, the Soviets have stated that Statsionars will be able to handle 60 two-way conversations per transponder.[13] On a comparable basis, an INTELSAT IVA transponder (global beam) would provide about 200 two-way conversations. Using SCPC a Statsionar transponder, according to Soviet statements, theoretically will be able to handle 200 simultaneous two-way voice conversations, compared with 400 for INTELSAT IVA.[14] Other modulation techniques, of course could be used to increase channel capacity.

39. Most Statsionar earth stations will use 12-meter antennas.[15] These are standard-size Soviet antennas, widely deployed in the Orbita earth station network and in operational use with Molniya satellites. Two satellites, however, Statsionars 6 and T, will have additional ground antenna requirements.

40. In addition to using 12-meter antennas, Statsionar-6 will use one or more 25-meter ground transmitting antennas to communicate with small 2-meter receiving antennas. The receivers at 2-meter stations probably will be of low capacity, relatively noisy (200°K compared with 100°K for 12-meter stations), probably of simple construction, and relatively inexpensive to build.

41. The reasons for the use of a 25-meter ground transmitting antenna instead of the usual 12-meter antenna are not well understood. The larger antenna might be required to compensate for the low gain of the small receiving stations, or to permit an increase in the capacity per station or in the number of stations, to a level above that possible with a 12-meter antenna.

42. Statsionar-T will use a large diameter, high gain antenna on the satellite to retransmit signals from a single 12-meter station to small receiving earth stations. The small (6-meter) receiving stations planned for use with Statsionar-T will be simple, cheap, and extremely noisy, with a noise temperature of 800°K.

Launching, Tracking, and Control

43. The Soviets have demonstrated a capability to put satellites into geostationary orbit. During 1974-75, the USSR successfully positioned four such vehicles in space, most recently Statsionar-1.[16] Because Soviet satellites are launched from relatively high northern latitudes, the USSR must use transfer orbit techniques to place satellites into geostationary orbits. These techniques, which are

[12] The most recent vehicle in the INTELSAT series.

[13] The Soviets have indicated that FDM/FM transponders will be operated using ten carriers with 12 one-way channels per carrier.

[14] However, INTELSAT uses digital modulation; the Soviets use FDM/AM.

[15] The size of earth station antennas to be used with Statsionar is not explicitly stated in ITU filings, and has been calculated from data given on antenna gain and frequency.

[16] Other satellites in geostationary orbit include Molniya-1S and two non-communications satellites, Cosmos 637 and Cosmos 775.

somewhat more complex than direct injection normally used for their other satellite launches, have required the use of the most powerful Soviet booster—the SL-12.

44. Booster technology no longer represents a major technical barrier for the Statsionar program. Although the early SL-12 launch history shows many failures, 24 consecutive successful launches have occurred since August 1970. Launch support is provided both from sites within the USSR and from ships at sea.

45. The USSR has also demonstrated a capability to track and command satellites in geostationary orbit. In the case of Statsionar-1, orbital drift was reduced to an insignificant rate.[17] However, Statsionar-1 recently appears to have developed attitude control problems—it may have been tumbling in orbit—but since has been stabilized.

46. The Soviets have adequate facilities within their borders to carry out tracking and control functions for all currently programed Statsionars. Statsionars can employ stations now in use for tracking Molniyas 2 and 3, and possibly deep-space tracking facilities as well. Molniya tracking facilities are believed to be located in the western USSR at Gus' Khrustalnyy and Leningrad, in the central USSR at Yeniseysk, and in the eastern USSR at Galenki and Khurmuli. A deep-space facility is located at Yevpatoria in the Crimea. In addition, a number of relatively new satellite support facilities of undetermined functions could be intended for use with Statsionar.

Potential Program Delays and Problems

47. Clearly, the Soviets could launch and orbit all Statsionars on time; however, they are unlikely to do so. We believe the USSR will not meet the announced schedule or reach intended levels of performance and reliability for the individual Statsionars.

48. We expect that the launch of Statsionars 2 and 3 will be delayed by one to two years. That is because the Soviets, following a practice of extremely thorough testing of prototypes of first generation vehicles, will not want to launch expensive follow-on satellites until current problems with Statsionar-1 are fully resolved. Delays in the launch of Statsionars 2 and 3 of more than two years are also possible if the current problems with Statsionar-1 stem from fundamental deficiencies in vehicle design.

49. The Statsionar-T satellite also could be delayed one to two years beyond its 1976 launch date. Delays seem likely because the Soviets have not yet deployed the receiving stations for use with Statsionar-T, and they probably will run into difficulties developing and deploying the 9-meter parabolic antenna on board the satellite for space-to-earth TV transmission. The Soviets are not known to have any previous operational experience with large aperture antenna systems. Recent US experience with a similar NASA satellite, ATS-6, demonstrated that unfurling such an antenna requires extraordinarily complex mechanical techniques. Although some design data on the ATS-6 has been published in open literature that is available to the Soviets, the data cannot substitute for the very precise engineering expertise and machining capability needed to build a workable system. Antennas planned for all other Statsionar models should not present any design or operational difficulties; they are 4- and 6-GHz types with which the Soviets have extensive flight experience.

50. Because of the high cost of building and launching Statsionar satellites, the USSR will want to improve the useful life of vehicles in orbit before initiating an operational system. The operational lifetimes of Soviet satellites, from the beginning, has been a particularly intractable problem, and it has been getting worse. Molniya-2s, on the average, have lasted only ten months in orbit compared with 15 months for the earlier Molniyas.

51. Van Allen radiation is believed to be a cause of the short lifetimes of Molniya satellites. Transit of the satellites through Van Allen radiation belts probably decreases the life of the solar cells, thereby reducing the amount of electrical power available to sustain spacecraft systems. This factor will not be a problem for Statsionars, however, since they will not transit the Van Allen belts.

[17] 0.015° of longitude per day.

52. Additionally, the relatively shorter average lifetime of Molniya-2 may be related to its operating frequencies. Molniya-2 operating frequencies (4 and 6 GHz) are considerably higher than Molniya-1 frequencies (800 and 1,000 MHz). Generally, the higher the frequency, the greater the complexity of design and fabrication of electronic components and circuitry. We believe that deficiencies in design or fabrication of microwave components (e.g., traveling wave tubes),[18] have led to the premature failure of Molniya-2 communications subsystems. This factor could affect the lifetimes of Statsionars also, since they will operate in the same frequency range as Molniya-2.

53. We expect that the Soviets will have difficulty achieving planned communications capacities on Statsionars for two reasons.

— We do not believe that Statsionars 1, 2, and 3 will have ten operational transponders and a total signal bandwidth of 500 MHz, as implied by the filings. Indeed, judging from the amount of power estimated to be available we suspect that the Soviets are shooting for only six active transponders and a total bandwidth of 300 MHz; the four additional transponders on these early vehicles probably will be test transponders added to experiment with new systems. Even six transponders and a 300-MHz bandwidth could present a problem since this represents a capacity beyond what has been achieved to date; Molniya-3, according to a Soviet filing, is designed to carry only four transponders.

[redacted]

[18] In some cases the Soviets have imported traveling wave tubes from the West.

Soviet Use of INTELSAT

54. For the next few years at least, the USSR and Eastern Europe apparently will provide for their relatively small international satellite communications requirements through INTELSAT. The USSR recently completed construction of a standard INTELSAT ground station (which was purchased following the Nixon-Brezhnev Summit in 1972) at L'vov in the Ukraine (near the Polish border). Almost ready for commercial use, the station will handle Soviet traffic to and from the Americas through an INTELSAT Atlantic satellite. In addition, the Soviets are planning to funnel the North American traffic of some East European countries through the L'vov facility. The Soviets have stated that by 1980 they plan to have 22 satellite voice circuits with the United States.

55. In Eastern Europe, Romania reportedly has awarded a contract to a Japanese firm for its own INTELSAT station to become operational by the end of 1976. Hungary, which is planning for 20 satellite voice circuits to North America by 1982, also would like to build an INTELSAT station but may be under pressure to use the Soviet facility at L'vov. In 1969 political pressure from Moscow prevented Hungary from buying an INTELSAT station. Currently, Czechoslovakia, Hungary, and Romania are directing their North American traffic through an INTELSAT station in Yugoslavia [19] that became operational in 1974.

56. The USSR will access the INTELSAT system on a nonmember basis as of May 1976, according to recent information. The USSR will be charged nonmember rates for use of the system.[20]

57. User status gives the USSR technological benefits—information about the advanced telecommunications hardware embodied in the system—that could be of some help in the development of its own satellite systems. Soviet technicians can gain knowledge of US design technology and also familiarity with the entire operational concept. However, technological gains are less than could be

[19] Yugoslavia is a member of INTELSAT.

[20] The 1971 INTELSAT Definitive Agreements provide for use of the system by nonmembers.

realized by full membership, which would give the Soviets direct access to work being done in Western development labs and manufacturing facilities.

. . . And the Question of Formal Membership

58. User status allows the USSR to enjoy the benefits of membership without compromising its long-standing political objections to membership. When INTELSAT was chartered in 1964, the USSR opposed the voting and membership provisions of the "Interim Agreements." Under the voting formula, a member country's vote is weighted by its investment in INTELSAT and its investment is proportional to its share in international telecommunications traffic. In effect, this requirement would have given the USSR negligible leverage in the organization, perhaps a 1-percent interest. Moreover, membership in the ITU was a prerequisite for INTELSAT membership. The ITU membership requirement effectively excluded mainland China, North Korea, North Vietnam, and East Germany and was politically unacceptable to the USSR.

59. Although formal Soviet membership in INTELSAT seems remote, we cannot rule it out entirely. Indeed, Soviet efforts to funnel East European satellite traffic through its L'vov facility could be a scheme to increase the volume of Soviet international communications (by counting East European traffic as Soviet) in order to qualify for a larger share of voting power on the INTELSAT Board of Governors. In addition, the ITU membership barrier has since been diminished by the fact that North Korea, East Germany, and China have all joined the ITU in recent years.

60. Certainly, current Soviet attitudes toward INTELSAT would not stand in the way of membership. The hostile anti-INTELSAT rhetoric of the mid-1960s is gone now, and has been replaced by press appeals for international cooperation in comsat activity. There is even some reason to believe that the question of formal membership has been under active study in the USSR

61. We believe that the USSR probably will not join INTELSAT as long as it is managed by a US company, even if the USSR could muster a respectable vote. Selection of an international group to run INTELSAT probably would make formal membership more palatable. Thus, we would not expect the USSR to make any formal move toward membership before 1979 at the earliest, when the technical management role of Comsat Corporation comes up for review.

International Prospects for Statsionar

62. In its current unproven state, Statsionar is not likely to attract many non-Communist countries for international communications. Statsionars cannot offer potential subscribers any advantages in coverage or quality of communications over that already available through INTELSAT. Even communications with the USSR and Eastern Europe will soon be possible through INTELSAT. Moreover, aside from a continuing dialogue and test program with France, the USSR has had very little prior success generating foreign interest in the use of its comsat system. Cuba and Mongolia are the only countries outside Eastern Europe to acquire Soviet comsat earth stations.

63. Indeed, it does not appear that the USSR is pushing use of Statsionar—or of Intersputnik when it is developed—for international commercial communications. For example, the Soviets show every intention of adhering to INTELSAT tariffs. They have stated that "communication channels shall be made available at fixed tariffs on a par with average world tariffs for international telephone channels, expressed in gold francs." [21] No doubt any attempt to undercut, or even match, INTELSAT rates would result in heavy financial losses. That is, with more limited satellite capacity, shorter satellite lifetimes, and relatively higher launch costs, the capital cost per circuit year of a Soviet comsat channel is likely to be much higher than that of INTELSAT.

64. Possibly some developing countries will be interested in using Statsionars to set up domestic or regional communications systems. This option might prove attractive if Soviet earth stations and

[21] Petrov, *loc. cit.*

leasing rates are priced cheaply enough. Also, for political reasons, some countries may wish to use Statsionars even though formally members of INTELSAT. For example, Syria, which is now building an INTELSAT station, recently queried INTELSAT about the possible consequences to Syria of Intersputnik membership.

65. For the future, three countries bear watching: Somalia, Nigeria, and India. Somalia expressed interest in Soviet assistance in the construction of a satellite earth station in late 1972. Soviet activity in Somalia was (and still is) widespread, and the Soviets had already constructed HF radio facilities there. Moscow thus far has declined to provide assistance.

66. Nigeria contacted Soviet experts in April 1975 to discuss comsat collaboration, possibly concerning Nigeria's plans to build a domestic comsat system. The Soviets suspended discussions suddenly in September 1975, citing major developments in Soviet satellite communications. Probably the Soviets were referring to the impending launch of Statsionar-1 in December 1975.

67. Nigeria has one operational INTELSAT station, and is building a second one, for international traffic. In addition, Nigeria is now leasing one transponder from INTELSAT for domestic use until 1980, and plans to lease a second one. Possibly Nigeria is considering substituting Statsionar for INTELSAT for its domestic communications after 1980. Statsionars 4 and 5 will provide overlapping coverage of Africa.

68. India, which has received assistance from the USSR in scientific space projects, apparently discussed the possibility of experiments using Molniya satellites in 1974. Early the following year the Director of the Soviet Main Administration for Space Communications expressed a willingness to conduct further talks. In February 1976 India discussed with Soviet officials possible Soviet help in satellite TV broadcasting. No additional details are available.

69. To induce developing countries to use Statsionar for domestic or regional systems the USSR could offer to sell Soviet-made earth stations. Although Soviet earth stations suffer limitations in electronics, cryogenics, and automation, they are adequate for use with Statsionar. A good export candidate would be a relatively new, low capacity, highly compact, air-transportable Soviet earth station called MARS. It uses a 23-foot dish for duplex TV and telephony, comes in three containers, can be set up in two or three days, and is ruggedized. It has been used in Cuba, Bulgaria, India, and the USSR to provide Brezhnev with communications back to Moscow via Molniya. It can also work with geostationary comsats according to Soviet statements. There is some evidence that the Soviets would like to sell MARS stations abroad, although they have not made this goal explicit. Neither are there any known orders for MARS stations by non-Communist or Communist countries. No information is currently available on Soviet capacity to produce MARS stations or on their cost or price.

Potential Military Uses of Statsionars

70. On the surface, Statsionar satellites appear to be configured primarily for commercial use and for operation by the Ministry of Communications. However, we believe, based on the experience of the Molniya program, that whatever the configuration and subordination, the Soviet military establishment will be an important user of Statsionar communications. For example, the Molniya-1 comsat system, which has been reported in the open press and to the ITU as a civil system, is now believed to be used almost exclusively by the military for command-and-control communications. The Molniya-2 system, on file with the IFRB since December 1969, is believed to be routinely used for military communications. The Soviet military undoubtedly also uses some of the Molniya-3 channels of communications between Moscow and Havana. Moreover, the Soviet military is known to be interested in geostationary comsats, and has experimented with Molniya-1S.

71. Initially we would expect that some of the communications capacity of Statsionar will be given over to the military. Eventually, as the reliability of geostationary comsats improve, the Soviets will probably deploy a *dedicated* military geostationary comsat system. Even if a dedicated system were developed, it is likely that the Soviets would continue using some of the Statsionars' capacity for military communications. Certainly, under crisis conditions, the Soviet military would preempt Statsionars for their communications.

72. We believe that the Soviets will want to use at least part of the Statsionar system for the following military and quasi-military applications:

— *Command-and-Control Communications.* We project that by the mid-1980s small mobile communications satellite terminals will be deployed with Soviet ground force units at Front and Army levels. Additional users may include Soviet naval surface ships, airborne command posts and strategic bombers, and submarines deployed throughout the world. Geostationary comsats would be of major importance to surface vessels since in many areas where the Soviets maintain a naval presence, as in the Indian Ocean; elliptically orbiting Molniyas do not provide effective coverage.

— *Leadership Support.* The Soviets probably will use Statsionar communications [redacted] to provide support for Soviet political leaders during their travels abroad. [redacted]

— *Intelligence Collection and Support.* The Statsionar satellites can also be used for relaying information that has been collected by Soviet intelligence services, diplomatic missions, and intelligence collection ships. Similarly, Soviet and East European trawlers which perform quasi-military functions, including intelligence collection, could be expected to gain in reliability and coverage from the use of geostationary satellites.

The Technical Interference Problem

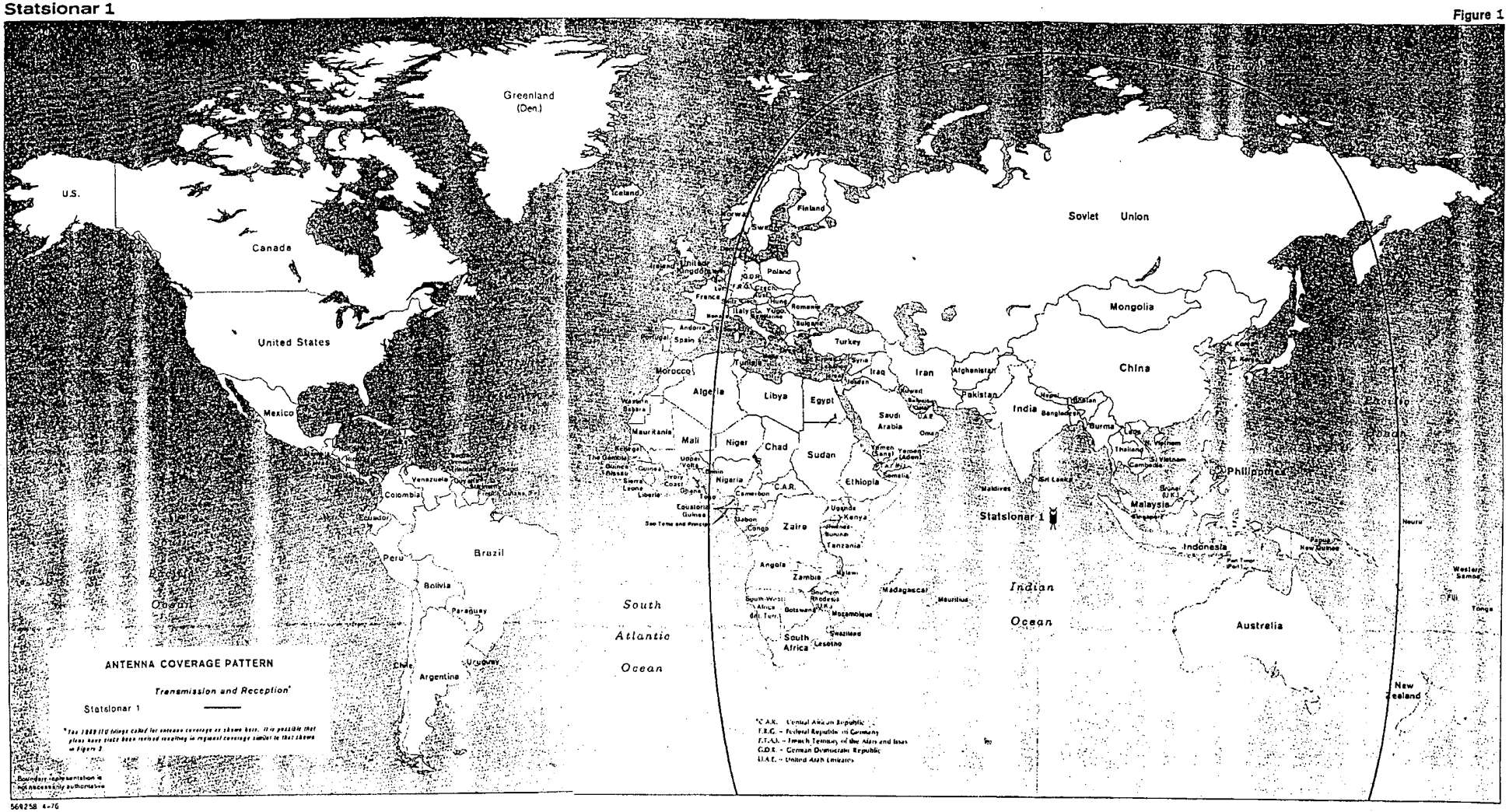
73. INTELSAT officials are very concerned about the possibility that some Statsionars, whose planned orbital locations will be very close to existing and planned INTELSAT vehicles, could interfere with INTELSAT communications. INTELSAT experts recently complained to Soviet counterparts at Geneva, apparently without avail, that the potential for interference by Statsionars 1, 2, and 3 is excessive. Further, the Secretary General of INTELSAT intends to notify the ITU that some of the other Statsionars—4 through 10—also could produce an unacceptable level of interference with INTELSAT operations.

74. The problem of interference will have to be worked out in negotiations between INTELSAT and the USSR, as the ITU has no real power to arbitrate the issue. The ITU does not allocate or assign orbital slots, nor can it shut down a "harmful" satellite. The ITU Space Telecommunications Conference in Geneva in 1971 specifically held that the use of orbital positions should be subject to mutual consultation between all states affected and that registration of a frequency for space telecommunications does not provide any measure of priority or proprietary right. Moreover, self-appropriation of orbital positions by one country should not create an obstacle to the establishment of space systems by others. In short, since there is no international mechanism for resolving signal interference problems, disputes can be settled only by mutual agreement between the concerned parties.

[p. 16 blank]

Statsionar 1

Figure 1



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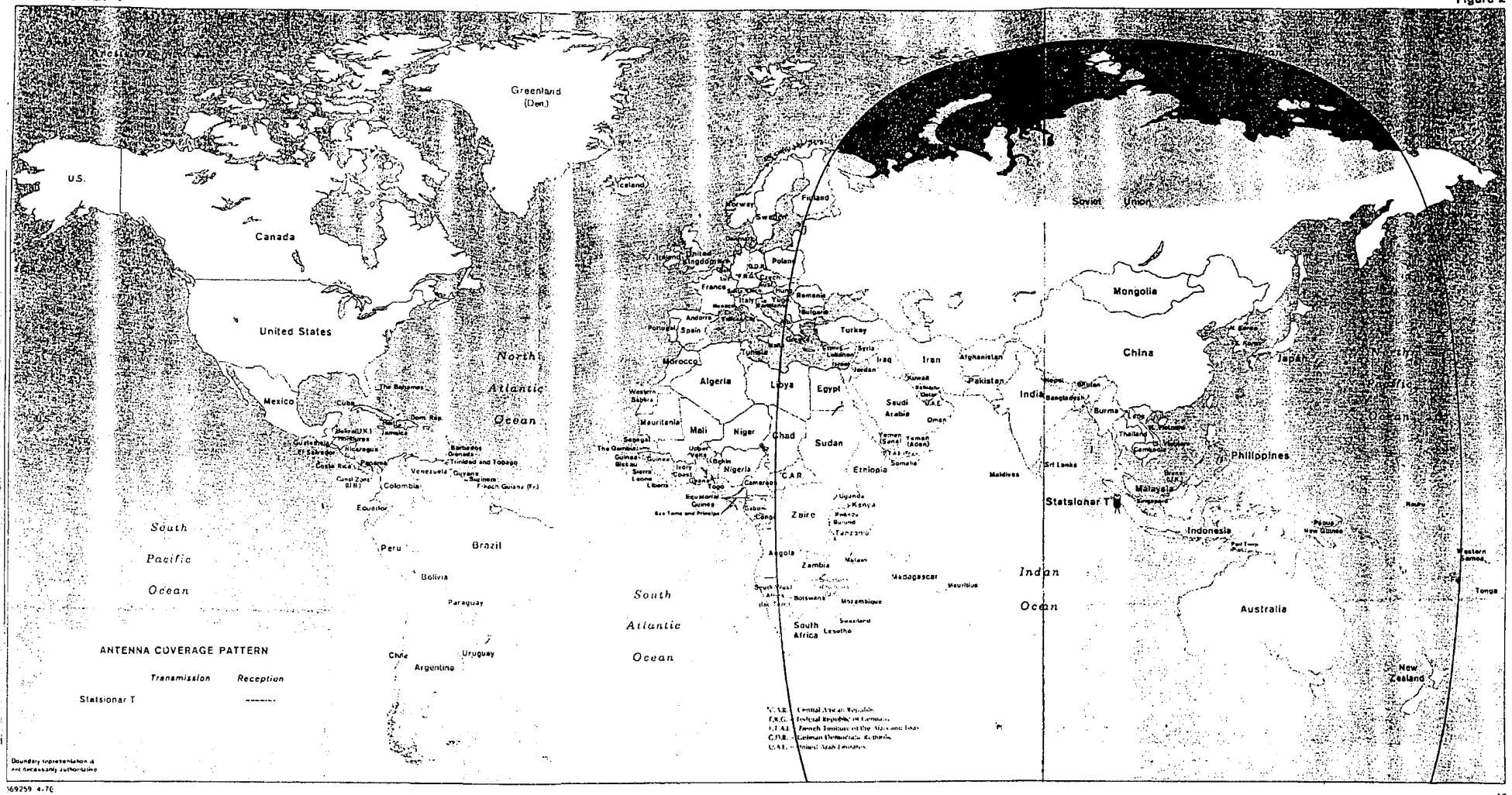
Statsionar T

Figure 2



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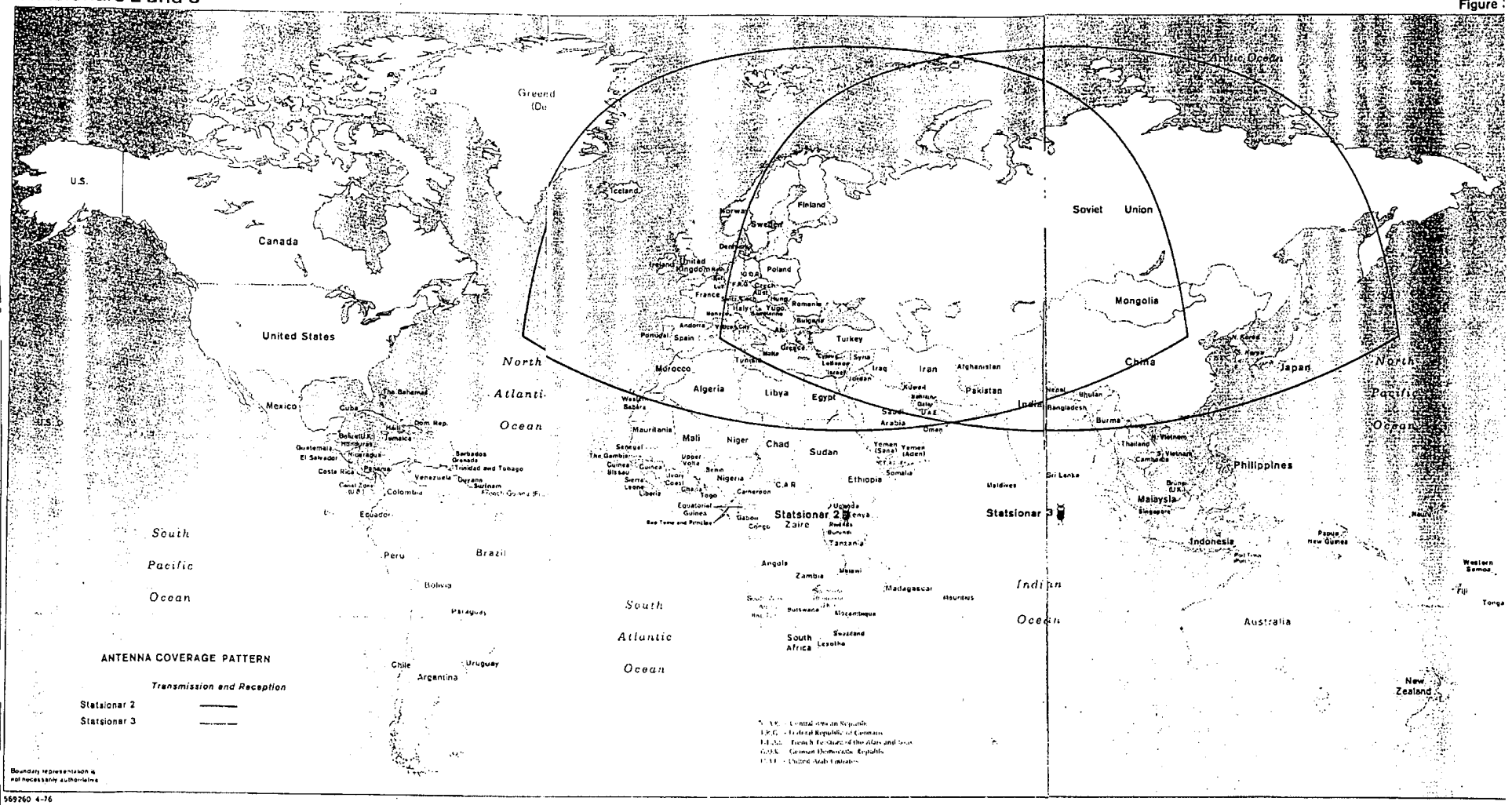
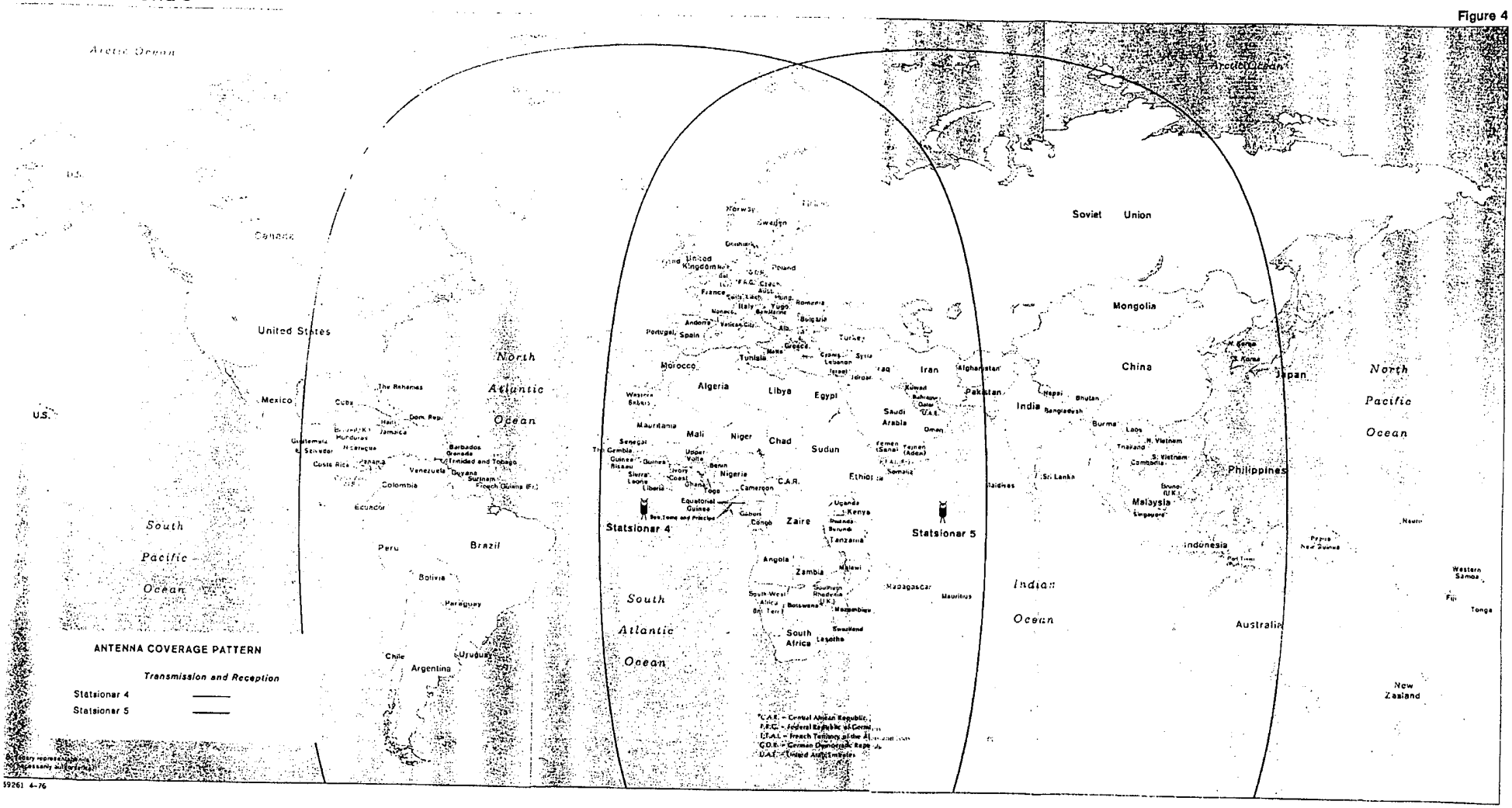
Statsionars 2 and 3

Figure :



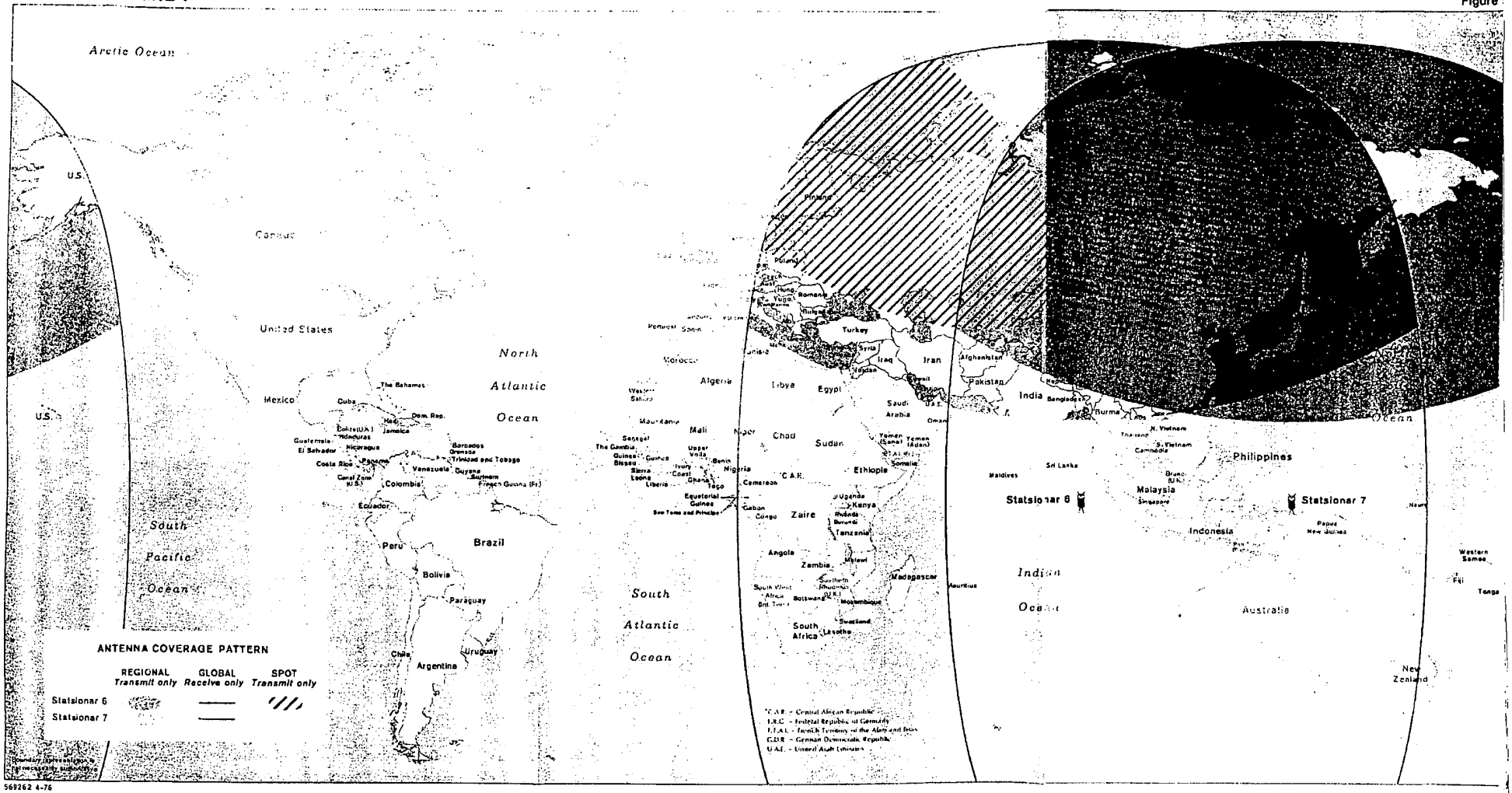
Statsionars 4 and 5

Figure 4



Statsionars 6 and 7

Figure



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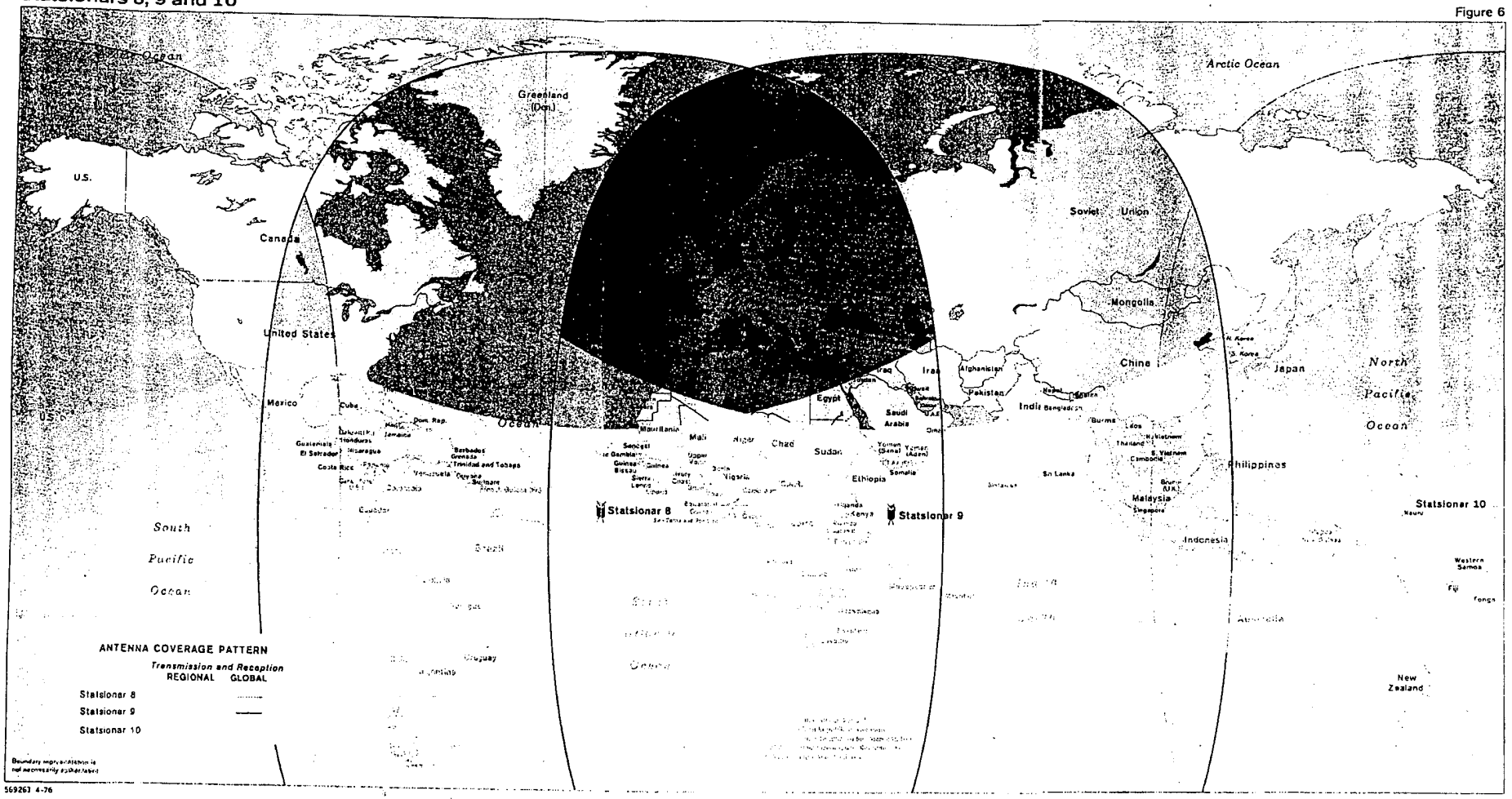
Statsionars 8, 9 and 10

Figure 6



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